

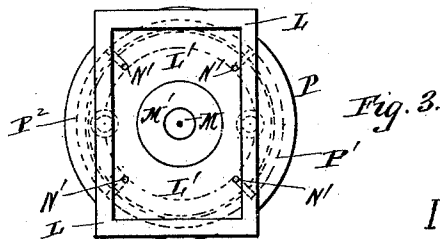
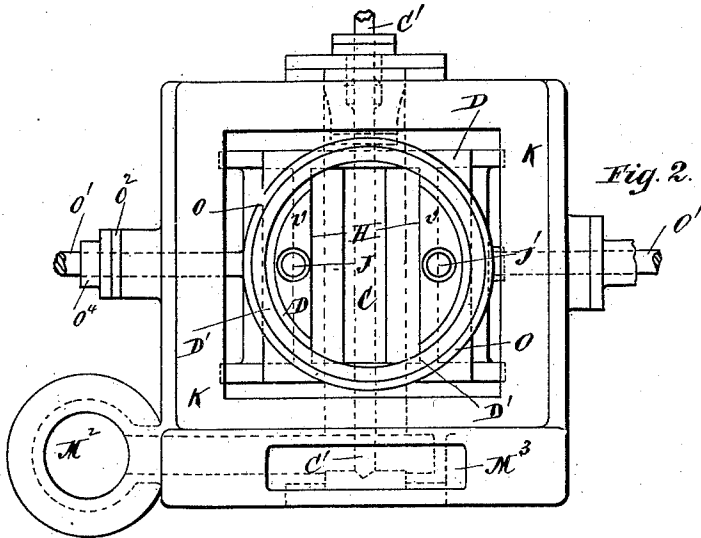
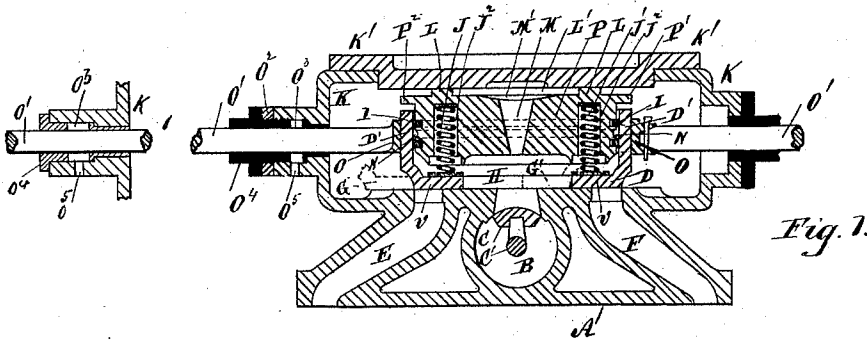
(No Model.)

11 Sheets—Sheet 1.

J. FREW.
VALVE FOR STEAM ENGINES.

No. 463,260.

Patented Nov. 17, 1891.



Witnesses:

A de vos.
J. Chebret.

Inventor:

James Frew,
By J. E. L. Bowen
Attorney.

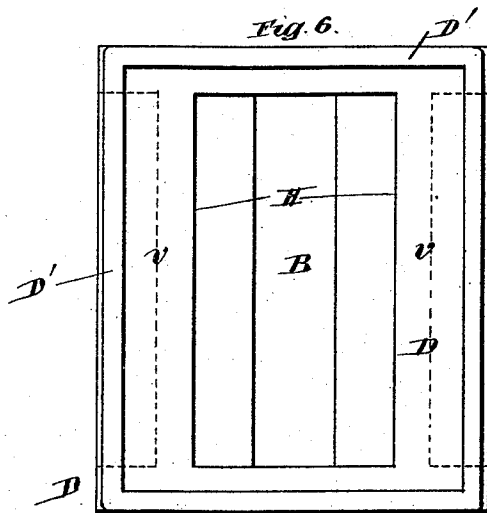
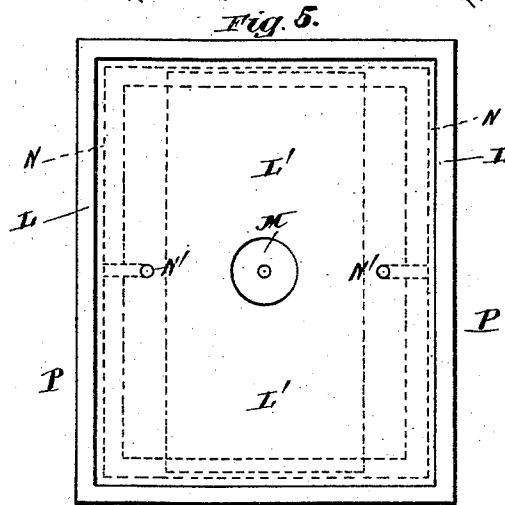
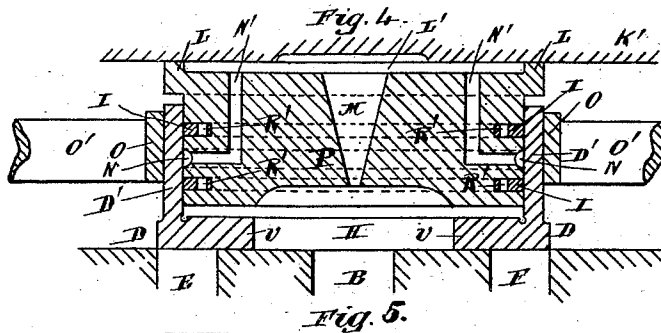
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Witnesses:

H. de Vries

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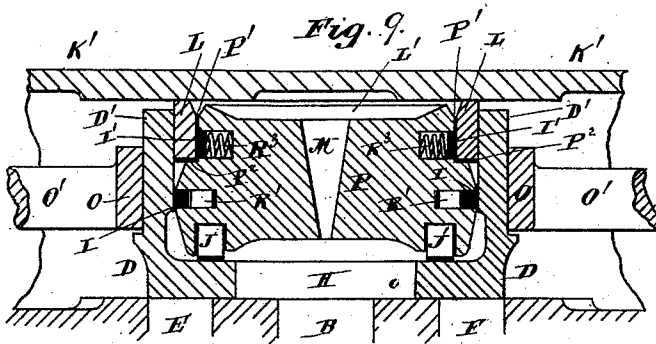
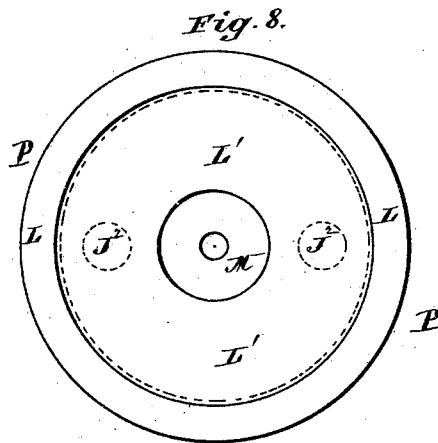
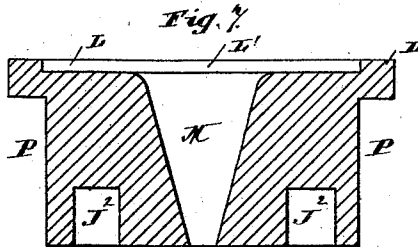
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11 Sheets—Sheet 3.

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Witnesses:

H. de Vos.
J. C. Lebel.

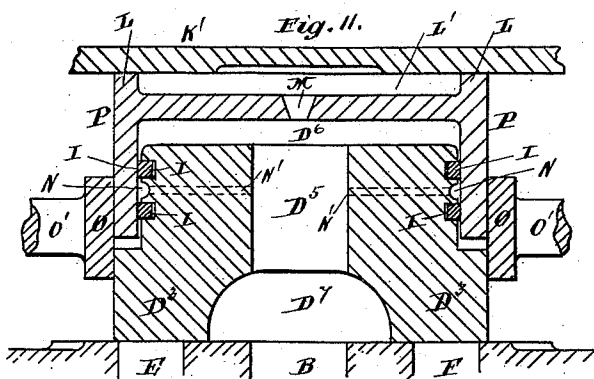
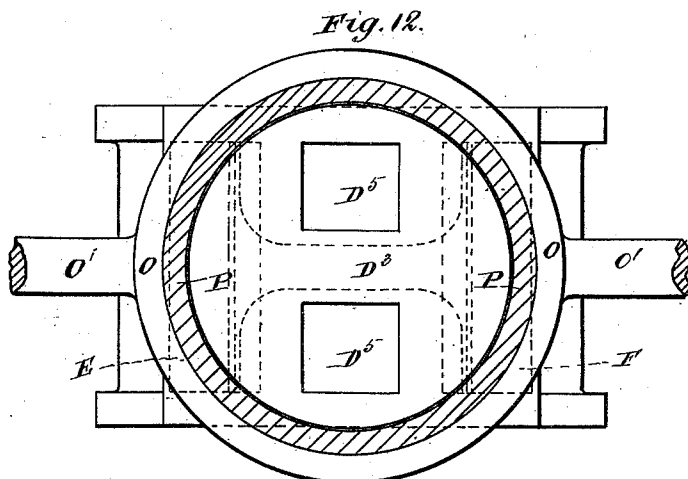
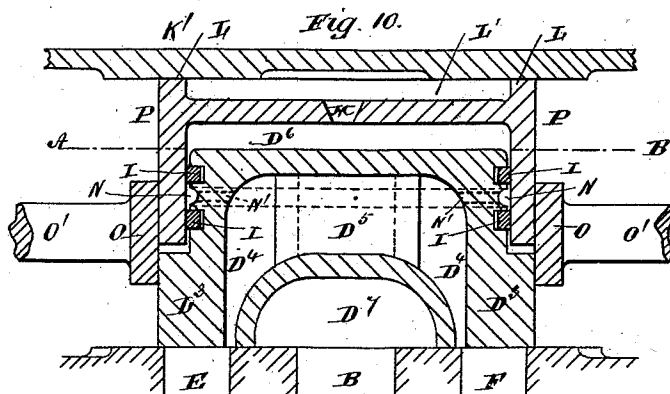
Inventor:

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Witnesses:

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J. Chebet.

Inventor:

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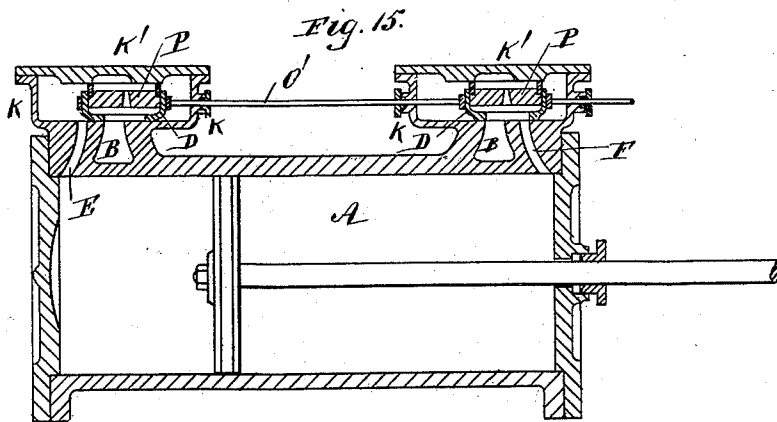
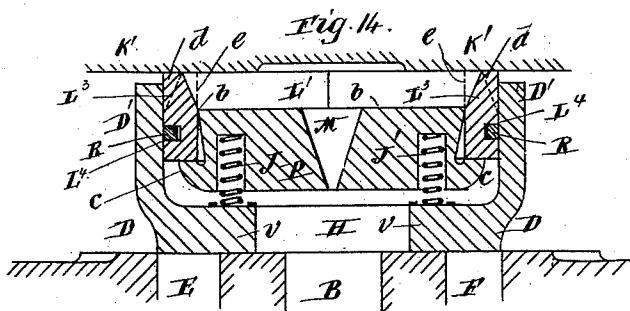
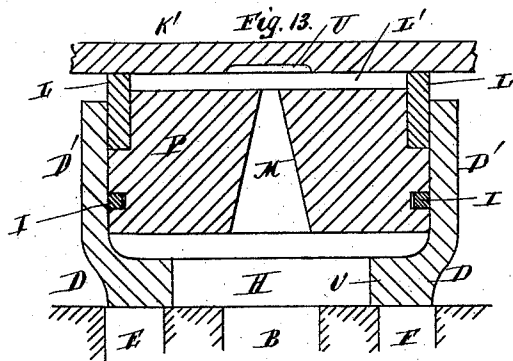
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Patented Nov. 17, 1891.



Witnesses.

H. de Vos.
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(No Model.)

11 Sheets—Sheet 6.

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Fig. 16.

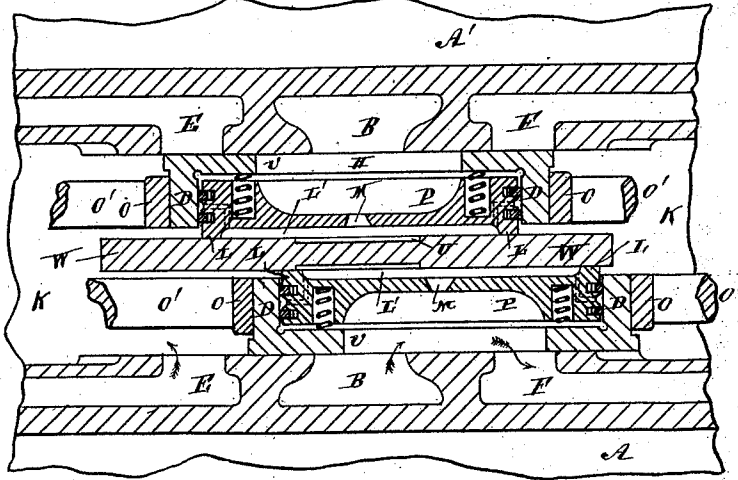
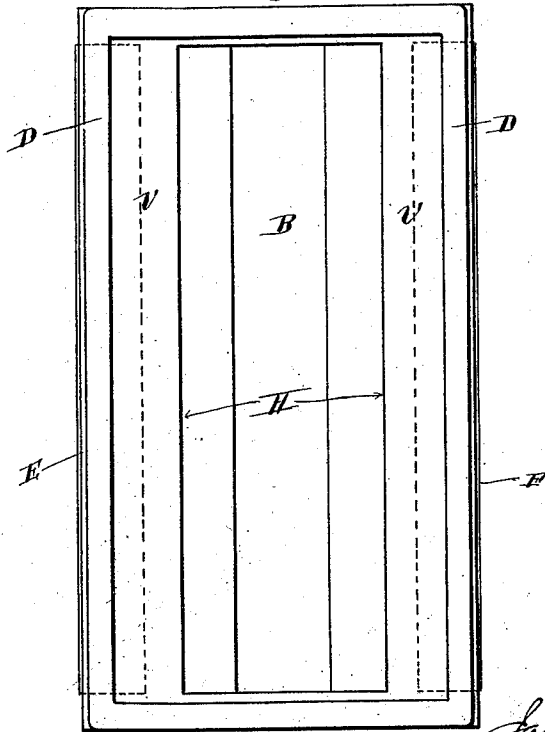


Fig. 17.



Witnesses:

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J. C. Lebet

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By J. M. Bower
Attorney

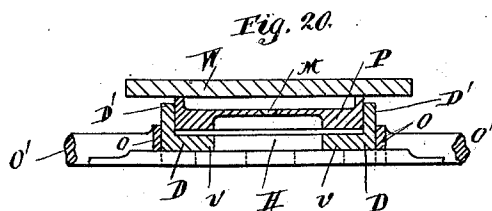
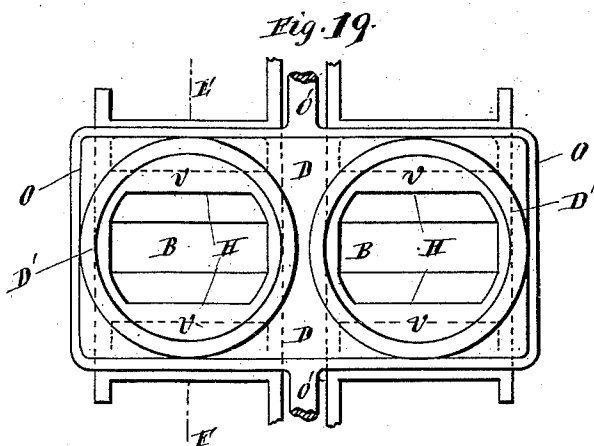
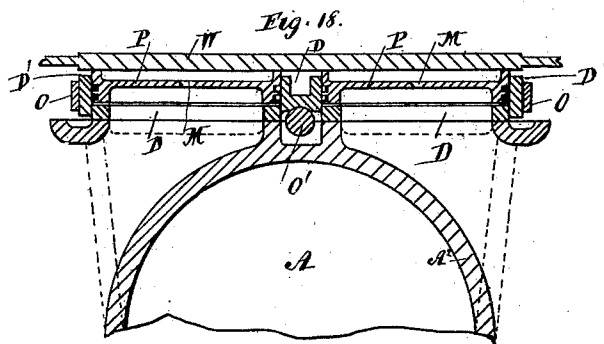
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Witnesses:

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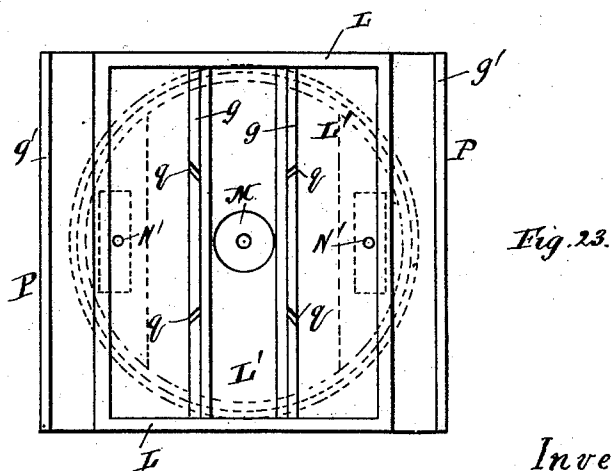
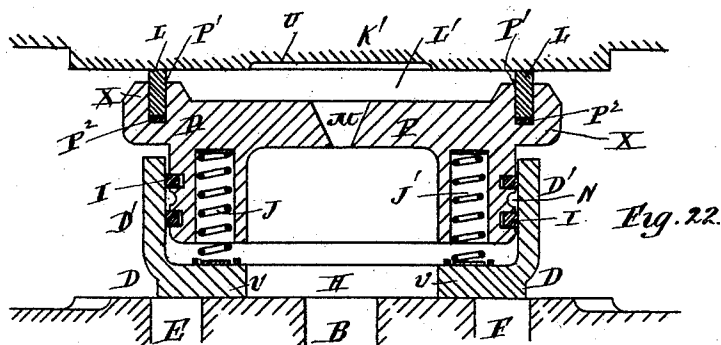
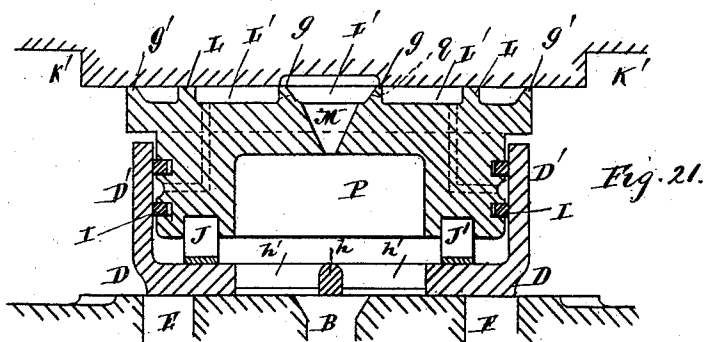
Inventor:

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Witnesses:

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Inventor:

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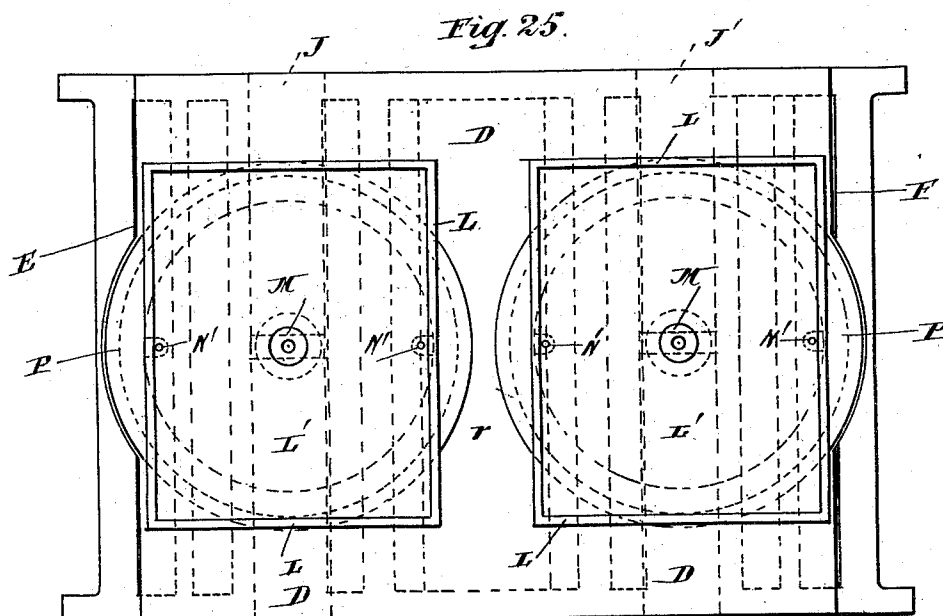
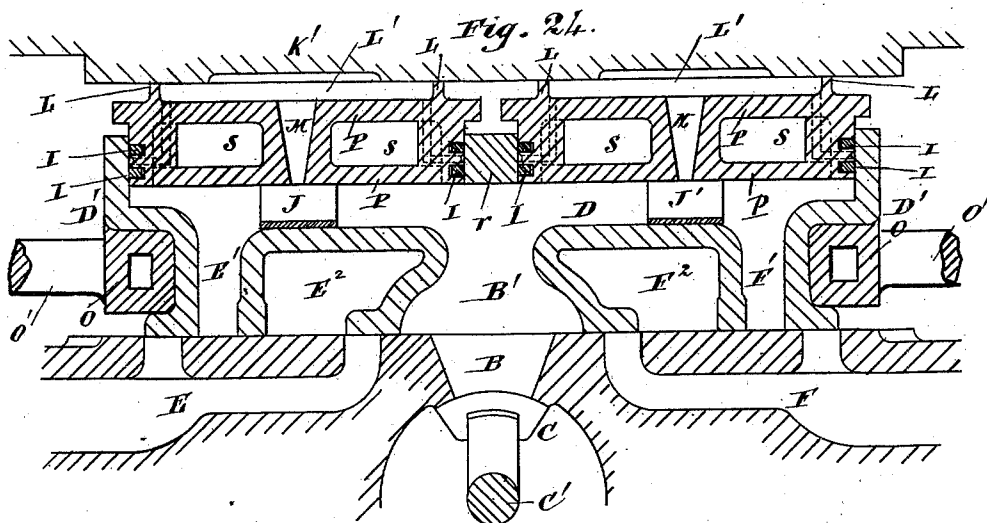
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Witnesses:

A de Vos.

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No Model.)

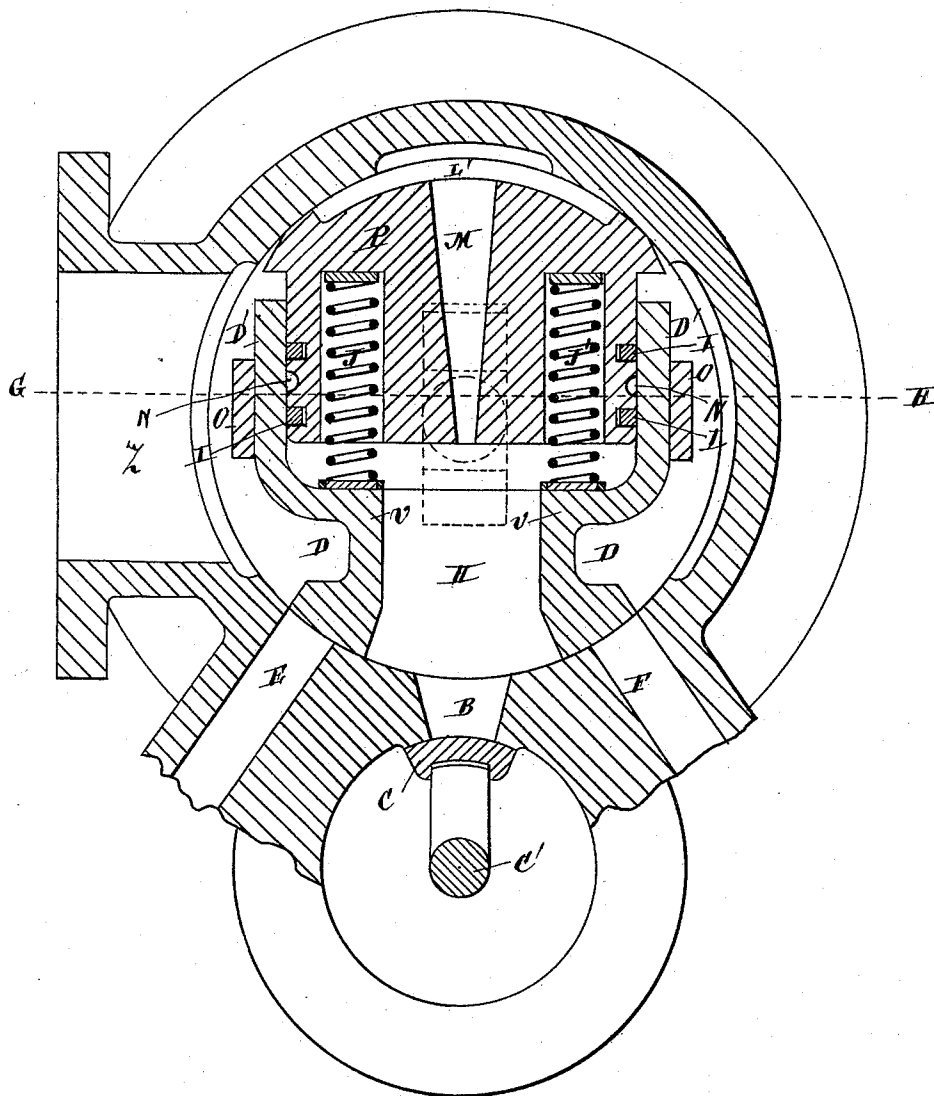
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J. FREW.
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Patented Nov. 17, 1891.

Fig. 26.



Witnesses:

Ade vos.
J. Chebet.

Inventor:

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By J. H. Bower
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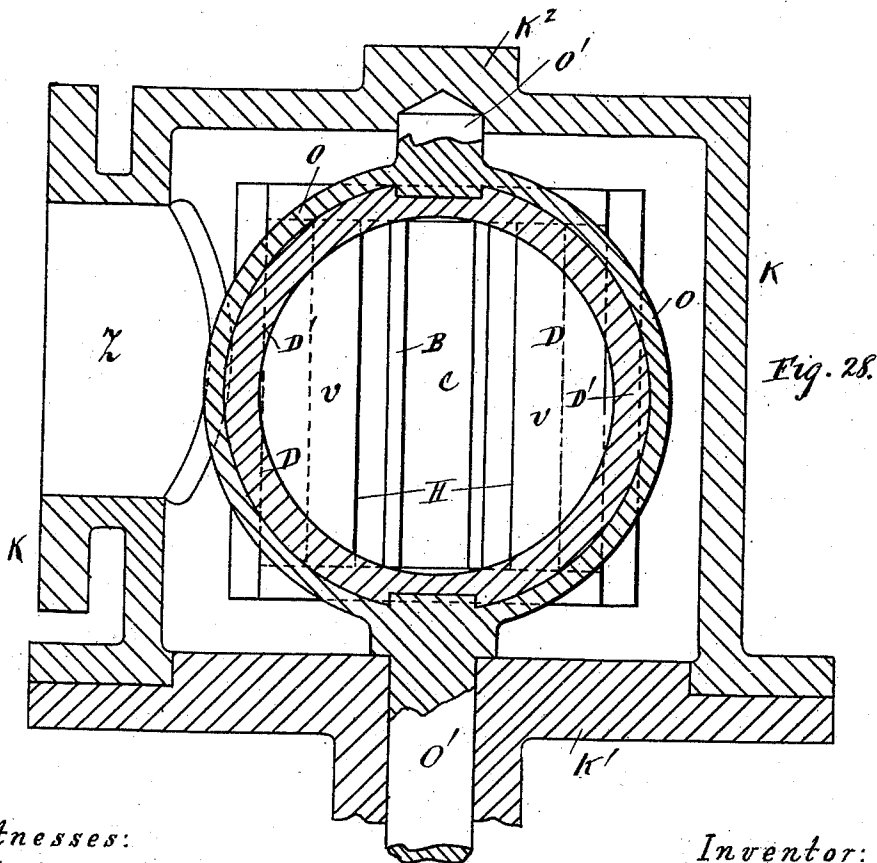
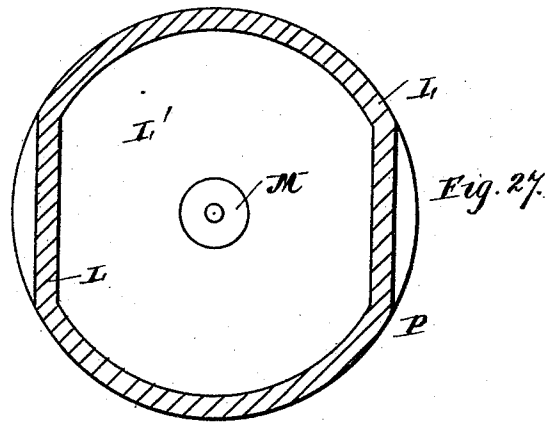
(No Model.)

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J. FREW.
VALVE FOR STEAM ENGINES.

No. 463,260.

Patented Nov. 17, 1891.



Witnesses:

H. de Vas.
J. C. Rebert.

Inventor:

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Attorney.

UNITED STATES PATENT OFFICE.

JAMES FREW, OF DUNASKIN, SCOTLAND.

VALVE FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 463,260, dated November 17, 1891.

Application filed December 15, 1890. Serial No. 374,692. (No model.)

To all whom it may concern:

Be it known that I, JAMES FREW, engineer, a subject of the Queen of Great Britain, and a resident of Dunaskin, in the county of Ayr, Scotland, have invented certain new and useful Improvements in and Connected with Equilibrated Valves for Steam and other Engines, of which the following is a specification.

My invention is a development or improvement upon that class of equilibrated valve for steam and other engines or motors wherein the live steam, air, gas, or other fluid is admitted into the cavity which in ordinary slide-valves constitutes the exhaust-port, (the usual exhaust-port thus constituting the steam or other fluid inlet and the usual inlet-port constituting the exhaust,) although it is to be understood that the inlet-steam may be admitted to the cavity of the valve in any of the usual methods, if so desired.

I will now proceed to describe my invention as applied under various modifications to steam-engine valves, reference being had to the accompanying sheets of drawings, whereon—

Figure 1 shows in section an equilibrated slide-valve with valve-chest and cylinder-ports. Fig. 2 is a plan view of valve as at Fig. 1, with the valve-piston removed. Fig. 3 is a plan of the piston of the valve removed from Fig. 2. Fig. 4 shows in section a modified form of valve with adjacent parts broken away. Fig. 5 is a plan of the piston of the valve Fig. 4. Fig. 6 is a plan of the valve, Fig. 4, with the piston removed. Fig. 7 is section of a valve-piston. Fig. 8 is a plan of the valve-piston Fig. 7. Figs. 9, 10, and 11 are sections of different constructions of valve. Fig. 12 is a sectional plan on the line A B, Fig. 10. Figs. 13 and 14 are sections of valves. Fig. 15 shows in section a cylinder with two valves fitted thereon, one at each end. Fig. 16 shows in section a double-valve arrangement for an engine with two cylinders A A', side by side. Fig. 17 is a view of the upper valve-box D, Fig. 16, looking toward the ports of the cylinder A'. Fig. 18 shows in section part of a cylinder with valve and ports and passages. Fig. 19 is a plan of the valve Fig. 18 with pistons removed. Fig. 20 is a cross-section of the valve on the line

E F, Fig. 19. Figs. 21 and 22 are sections of valves. Fig. 23 is a plan of the valve Fig. 21. Fig. 24 shows in section a double-piston valve with ports and passages. Fig. 25 is a plan of Fig. 24 with cover K' removed. Fig. 26 shows in section a rotating or partially-rotating balanced valve with accessory parts. Fig. 27 is a plan of the piston of valve Fig. 26. Fig. 28 is a sectional plan of valve and ports on the line G H, Fig. 26, with the piston of valve removed.

On the drawings the same reference-letters wherever repeated indicate similar or like parts.

Referring to Figs. 1, 2, and 3, A is the cylinder, and B the steam-inlet port, which is fitted with a cut-off valve C of the "Corliss" type.

D is the sliding box or cup of the valve for the admission and release of steam to the cylinder A through the cylinder-ports E and F. The dotted lines at G G' indicate the position of valve-box D when steam is being admitted to the cylinder through the port E and being exhausted from the back of piston through the port F.

As will be seen more particularly at Fig. 2, the valve-box D is made of a hollow cup shape with the oblong induction-port H cut in the face, the back part of valve-box D being completely cut away. If the valve-piston P were removed, as at Fig. 2, the steam filling up the interior of the valve-box D would only press down on the portions not cut out, (marked *v* on the plan, Fig. 2.) The piston P, which is fitted into the interior of the valve box or cup D, has two or other number of spring-rings I, (shown to a larger scale at Fig. 4,) which hold themselves steam-tight against the interior face of the walls D' of the valve-box D.

J J' are spiral springs, which are fitted into recesses J² in the piston P. Instead of using spiral springs, however, any other suitable form of spring may be employed, and, if desired, three or other number of springs may be fitted in the valve. The object of using the springs J J' is to press the piston P at the same time the valve-box D each against their respective working faces in the steam-chest K with sufficient force to overcome the friction caused by the piston P and spring-

rings I bearing against the inner face or wall D' of the valve-box D. The steam of its own pressure has the tendency to separate the piston P and valve-box D from one another and so cause the valve to work tight against its bearings.

The piston P, which may be flanged over at P' P², Figs. 1 and 3, has on its upper side or back bearing-strips L, which may be arranged in rectangular form, as shown at Fig. 3. These strips, which bear steam-tight against the casing-cover K', as shown, inclose a cavity or space L'. Steam passes from the induction-port H, cut out of the valve-box D, through a balance hole or opening M in the piston P to the cavity or steam-space L' at the top of said piston. The balance-hole M may be either tapered as shown or be tapered the reverse way, or be a straight channel without taper right through, or there may be two or more small channels or equivalent made in the piston in lieu of the balance-hole M. By locking steam in the cavity or space L', which is of an area equal to the area of the cylindrical part inclosed by the walls D' of the valve D, a true balance is maintained by the exposure of two equal areas or sides to the opposing action of the steam. Consequently the only upward or outward pressure on the piston P is that due to the action of the springs J J' so long as the bearing-strips L keep steam-tight against the casing-cover K'. The small opening at the bottom of the balance-hole M only admits of a small quantity of steam passing through to the cavity or space L', and therefore should the strips L wear down and leak very little steam would be lost. The top of the balance-hole M may be cup-shaped or hollowed out, as shown at M'.

N is a groove running round valve-piston P, which serves as a trap-space for any steam that might leak past the first or lower ring I.

On the plan view of the piston P, Fig. 3, four relief-holes N' communicating between the groove-trap N, and the cavity or space L', are shown. These holes N' carry off any leakage of steam which may pass into the trap N and thus replace any leakage from the cavity or space L' over the bearing-strips L, should this occur. The holes N' may or may not be used, as desired.

O is the usual hoop or ring passing round the valve.

O' is the valve spindle or stem, O² the usual collar-bush, and O³ the trap-space.

The bearing-bush O⁴ or usual packing-gland is or may be, as shown, screwed hard up against collar O².

O⁵ is a small hole leading from trap-space O³ into the smoke-box by means of a pipe (not shown) or into the trap-drain or the atmosphere. The hole O⁵ relieves the bearing-bush O⁴ from any back-pressure of steam greater than the pressure of the atmosphere.

Instead of having the bush O⁴ screwed up against collar O², a bearing-bush driven into

chest K may be used, as shown in the small view to left of Fig. 1.

M², Fig. 2, is the steam-inlet branch, and M³ the exhaust-outlet.

C' is the spindle for operating the cut-off valve C.

Figs. 4, 5, and 6 show an oblong piston P as fitted into the valve cup or box D. The valve in this case is very similar in construction to that at Figs. 1, 2, and 3, the only difference being that the valve-cup D is recessed out at right angles, so that the sectional view of the side walls D' and face v of the cup or box show like two L's. The cut-out part H of the face of the valve is rectangular, as shown in plan at Fig. 6. The piston P is in this instance made with the bearing-strips L raised all round the edge of the piston, as shown at Fig. 5. The slips I are in this case pressed against inner face of the walls D' of valve-box D by means of plate-springs R'. The springs J J' are in this case dispensed with; the upward pressure of the steam being sufficient to keep strips L close against the cover K'. The holes N' are in this view shown in full lines.

Figs. 7 and 8 show a piston P of cylindrical form, the only difference in its construction from the hereinbefore-described pistons being that it has no escape or leakage holes N' and that the bearing-face is made in the form of a raised flange-rim L on the top of the piston. The slips I in the piston may also be, as shown, dispensed with, the slips being inserted instead into grooves in the valve-box D. It is shown with cavities J² for springs, the same as in Fig. 1.

Fig. 9 shows a valve with a piston P, made with a recess P' around its upper side, into which are fitted loose bearing-strips L, inclosing the balancing steam space or cavity L'. P² is packing at the under side of the strips L. The bearing-slips I are pressed against the inner face of the wall D' of the box or cup D by the springs R', which may be plate-springs, as shown, or be spiral springs. The upper slips I' are by spiral or other springs R³ pressed tight against the inner face of the bearing-strips L. It will be seen that the strips L press in this instance both against the inner face of the wall D' of the box or cup D and against steam-chest cover K'. Plate-springs J J' are shown as being used in lieu of spiral springs, as at Fig. 1. The slips I may or may not be used, as desired.

Figs. 10 and 12 show a modified construction of valve. In this case the piston P, which is circular and very thin, is fitted on top of a solid part D³, which is hollowed out at D⁴, so as to form a trick-port, as shown. The channels N' may in this case, as indicated in dotted lines, communicate with the trick-port D⁴. Passages D⁵ for steam are made through the valve. These passages, which communicate with the steam-space D⁶ and the space D⁷, are or may be of rectangular

formation, as shown. The steam in the spaces D^0 and L' balances the piston P . This view is merely shown to illustrate a method of making my improved valve with a trick-port.

Fig. 11 shows a somewhat similar valve to Figs. 10 and 12, the only difference being that the part D^3 is made solid throughout, with a steam-passage D^5 in center, instead of having a trick-port D^4 and passages D^5 , as at Figs. 10 and 12.

Fig. 13 shows a valve somewhat similar to that at Fig. 9, with the piston P made with a recess around its upper part. Into this recess a ring L is fitted, so as to bear against the casing-cover K' . The piston in this view has the balance-hole M made with the taper toward the top instead of the bottom, as in the preceding figures. With this arrangement the ring L can be renewed at any time without total renewal of the piston or valve-box D .

Fig. 14 differs from the foregoing in having the valve box or cup D fitted with a split ring L^3 , the ring having a recessed groove L^4 around it, into which is fitted a ring, or it may be rings, R , which bear steam-tight against the walls of the box or cup D . The piston P is also in this view shown tapered like a cone and as being fitted into the inside of ring L^3 . The top edge of the piston, where it is fitted just a moving fit into the inside of ring L^3 , is shown at b . The lower flanged or bent-over edge c of the piston bears, as shown, against the lower edge of the ring L^3 . This arrangement shows the piston as without rings in itself, but with a balance-hole M and cavities for springs $J J'$. The valve in this case, although having a limited measure of escape, is only partially balanced, d showing the unbalanced area around top of ring. The ring L^3 is tapered off as much as possible consistent with leaving a sufficient working surface, as shown, to reduce the unbalanced area. By removing the piston P and leaving the ring L^3 with its bearing-surface made to the inside of ring, as shown in dotted lines at e , the valve would allow an escape or leakage limited only by the amount of steam entering at inlet-port instead of the limited escape permitted by the piston P with balance-hole M . If the piston were removed as suggested, the steam-inlet could be through the casing-cover K' or through the inlet-port B . The ring L^3 in this case would have a spring or springs fitted between its lower rim and the bottom or floor v of the valve box or cup D , so as to press the ring L^3 against casing-cover and the box D against the face of cylinder-ports.

In Fig. 15 a cylinder A , having two valves, fitted one at each end, is shown. The cylinder has its ports E and F at each end, as shown. Both valves are operated by same valve spindle or stem O' . B are the live-steam inlets. The exhaust is from the back of each valve-chest K . This arrangement is suitable for long stroke engines.

Figs. 16 and 17 show an arrangement with

a plate W inserted between two valves to meet the requirements of inside-cylinder locomotives or other engines requiring the same or similar arrangement. The plate W is inserted in the steam-chest K . The valves, which are of substantially the same structure as those hereinbefore described, are only partially balanced by the steam, the bearing-strips L being unbalanced. The pistons P may be hollowed out, as shown. The steam, as shown by the arrow to the left hand of the figure, exhausts into the steam-chest K . Fig. 17 is a view of the valve-box D with piston removed, looking up toward the ports of the cylinder A' .

Figs. 18, 19, and 20 show an arrangement of two balanced pistons P with valve spindle or stem O' between them. The steam-ports are shown as split or as two sets passing round outside of cylinder-shell A^2 . The valve-box D is made in one piece, with recesses for the reception of the pistons P . The hoop O passes right round both pistons and box D , as shown at Fig. 19. The valves are shown in this case as working against a plate W in steam-chest. Of course it will be readily understood that said double-balanced pistons are applicable whether ports are split or not. As shown in the plan view of the boxes D , Fig. 19, the openings H , cut out at bottom of boxes, may be octagon-shaped instead of circular, square, or oblong, as in prior views.

Figs. 21 and 23 show a valve slightly different in construction from the previous figures. D is the valve cup or box, and P the piston, as before; but besides the bearing-strips L , surrounding the cavity L' , there are additional bearing-strips g , fitted at right angles to the line of travel of the valve. Small grooves or equivalents g may be cut in the strips g , so as to allow the steam to pass to all parts of the cavity L' . There may also be bearing-strips g' at the ends of piston-face, as shown. The valve-cup D has or may have a bearing-strip h , strengthened by a cross tilt-bar h' in line of travel of the valve. In some cases, if so desired, the valve may have two or more strips h . The inlet-port B may be tapered outward, as shown, to compensate for the space taken up by bearing-strip h . By having the additional bearing-strips, as shown, all the bearing-surface will be rubbed over equally should the valve only travel a fixed part of its distance, which is an important item with engines that are required to run a long time with travel of valve lessened. It will be observed from Fig. 23 that the end bearing-strips g' are not joined to the cavity or balance bearing-strips L .

Fig. 22 shows a valve similar to those already described, with the addition of loose bearing-strips L (or ring or rings, if valve is circular) fitted into recesses P' in a thickened rim X on top of piston P . The recesses P' may or may not have packing P^2 in them under the strips. With loose strips or ring or rings, as aforesaid, they can be easily taken

out and renewed when necessary without necessitating a total renewal of piston.

Figs. 24 and 25 show a double-ported slide-valve with cut-off valve C. The valve box or cup D is in this case shown with ports E' F' in it and an inlet-port B', and also with exhaust-ports E² F². The pistons P work in upper part of box D and against a bridge r. s are cavity-spaces for lightening metal. The springs J J' are shown in this view as bearing up against lower side of piston just below balance-holes M. The valve is made, as shown, to economize steam-space when a cut-off valve is used. One large piston equal in area to the two small pistons P can be used, if so desired. If desired, springs might with this arrangement be fitted between upper side of back of box D and casing-cover K'.

The form of rotating or partially-rotating valve shown at Figs. 26, 27, and 28 is constructed in substantially the same manner as the other valves hereinbefore described. It consists of a valve box or cup D, into which is fitted the piston P. J J' are springs; M, balance-hole. As shown in Fig. 28, the valve is circular in plan with the valve-stem O' connected to the hoop O. The part D has an oblong port H cut in its under side. The valve is or may be rotated or partially rotated by a rocking arm or other suitable means. The exhaust from the valve-chest K is at Z. As will be seen, Fig. 28, the inner end of the valve-stem works in a recess in the solid end K² of valve-chest K, while the other end passes out through an opening or the usual gland in the valve-chest cover K'.

The piston, as shown at Fig. 27, is similar to those already described, except that it is curved at top, as shown at Fig. 26. The rim L is in this view shown sectioned for clearness, although it should not in reality be so. A cut-off valve C may be used with the valve, if so desired. Instead of the steam exhausting from the side of the chest K, it may exhaust out at the back. In this case there would be fitted on the back a loose cover with branch and a bridge across cover to receive end of spindle or stem of valve O', the steam escaping out over and under said bridge.

A valve, as hereinbefore described, having a piston or cylinder (or pistons or cylinders or equivalent) within the valve box or cup D, will travel steam-tight against the face or ports of the engine-cylinder, and also against casing-cover or plate inserted in the casing, and, as a portion of the steam or other fluid is locked in the cavity L' at the top of the piston or cylinder, which cavity is equal or nearly equal in area to the piston or cylinder, a complete or nearly complete balance is obtained by the inlet-steam or other fluid acting on said piston or cylinder or equivalent on both sides at one and the same time. The bearing-strips or ring or rings L, locking in the steam or other fluid in the cavity L', prevent any escape from the side of the piston or cylinder next the usual casing cover or plate inserted

in the casing, and should an escape occur from any cause it is limited by the balance-hole M or its equivalent, while at the same time the escape would cause such a disturbance of the balance that (the steam or other fluid acting between box D and piston P) the bearing-strips, slips, or ring or rings L would be pressed against the casing cover or plate with the difference of pressure caused by such escape, and the escape would thus be lessened or stopped.

With my improved balanced valve the following advantages result:

First. That in no case can there be more pressure put upon the cylinder face or ports with the inlet steam, air, gas, or other fluid than the area of part not cut out from face of valve box or cup will allow.

Second. That with engines exhausting into the atmosphere no packing need be used, as in this invention the engine exhausts into what is usually known as the "steam" or "inlet" chest.

Third. That no pressure more than that which is exerted by the escaping steam can affect the usual steam-chest joint or steam-chest cover or packing unless the pressure of such escaping steam fall below the pressure of the atmosphere.

Fourth. That the steam or other ports are brought nearer to the ends of the cylinder to an extent equal or nearly equal to the lap or cover of valve.

Fifth. That a cut-off valve can be used to great advantage covering inlet-port leading into valve either from what is usually known as the "steam-chest cover side" or from the central port on cylinder or steam-chest leading into valve cup or box.

Sixth. That the cut-off valve may with equal facility be used as a throttle-valve.

Seventh. That the valve box or cup D can be made with trick-ports, if desired.

The valve is equally applicable for any class of engine or motor where suitable besides those driven by steam.

It is to be understood that, although I have shown various modifications of my invention, I do not confine myself thereto, as these are given merely as illustrations, the valve being manifestly capable of being further altered without departing from the invention.

Having fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, with the valve-chest, of a box or cup having an induction-opening therein, a piston or cylinder carried by or working in said box or cup and provided with an opening through it, and bearing-strips affixed to the upper side of said piston and enclosing a cavity or space at the back or upper side of said piston, substantially as and for the purpose set forth.

2. In equilibrated valves, the combination, with a cut-out box or cup and a piston or cylinder fitted in said box or cup and provided

with an opening through it and a balancing-cavity in its upper side, of springs, as J J', and bearing strips or rings fitted to the upper side of said piston, substantially as set forth.

5 3. In equilibrated valves, the combination, with a cut-out box or cup and a piston or cylinder working in said box or cup and provided with an opening through it, of springs co-operating with the box or cup and piston
10 to press the same to their respective working surfaces, packing slips or rings fitted around said piston and bearing against the interior walls of the box, and bearing strips or rings, as L, fitted to the upper surface of said piston,
15 substantially as set forth.

4. The combination, with the cut-out cup or box D, of a piston or cylinder carried by said cup or box and provided with an opening through it and with a cavity, as L', in its back, and also with a trap space or groove, as N, and relief-holes, as N', communicating with the trap-space N and cavity L', and springs, as I, substantially as set forth.

Signed at Glasgow, Scotland, this 24th day of October, A. D. 1890.

JAMES FREW.

Witnesses:

HUGH FITZPATRICK,
WILLIAM FLEMING.