2 Sheets--Sheet 1.

I. W. FORBES.

Improvement in Oscillating Valves for Steam or Air Engines

No. 115,297. Patented May 30, 1871.

Fig. 1.

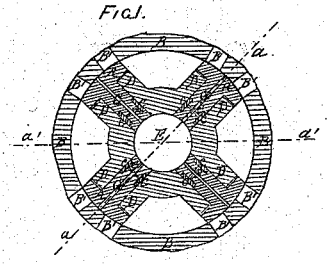


Fig. 3.

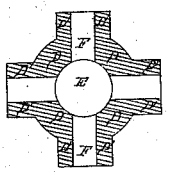


Fig. 7.

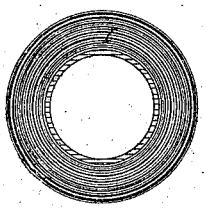


Fig. 11.

Fig. 8.

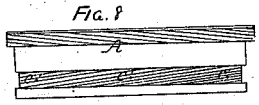


Fig. 2.

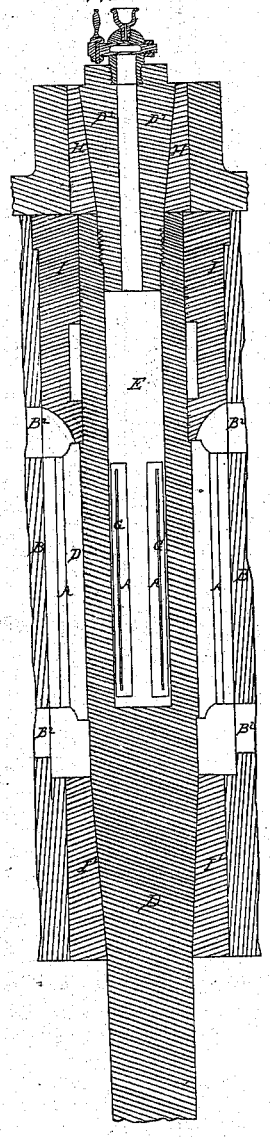


Fig. 4.

Fig. 9.

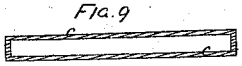


Fig. 9A.

Fig. 12.

Fig. 5.

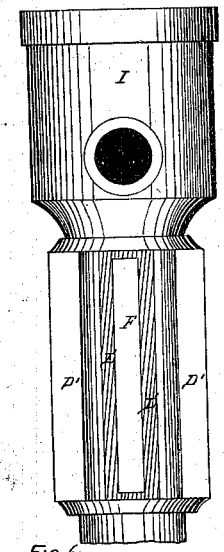


Fig. 10.

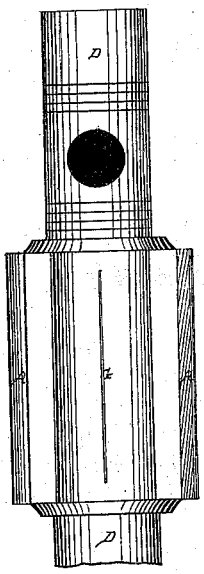
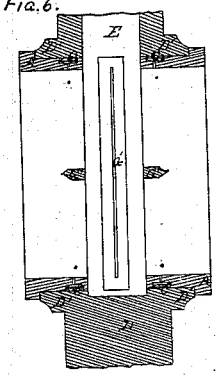


Fig. 13.

Fig. 6.



INVENTOR.

Isaac W. Forbes

Witnesses.

W. A. Fruckel

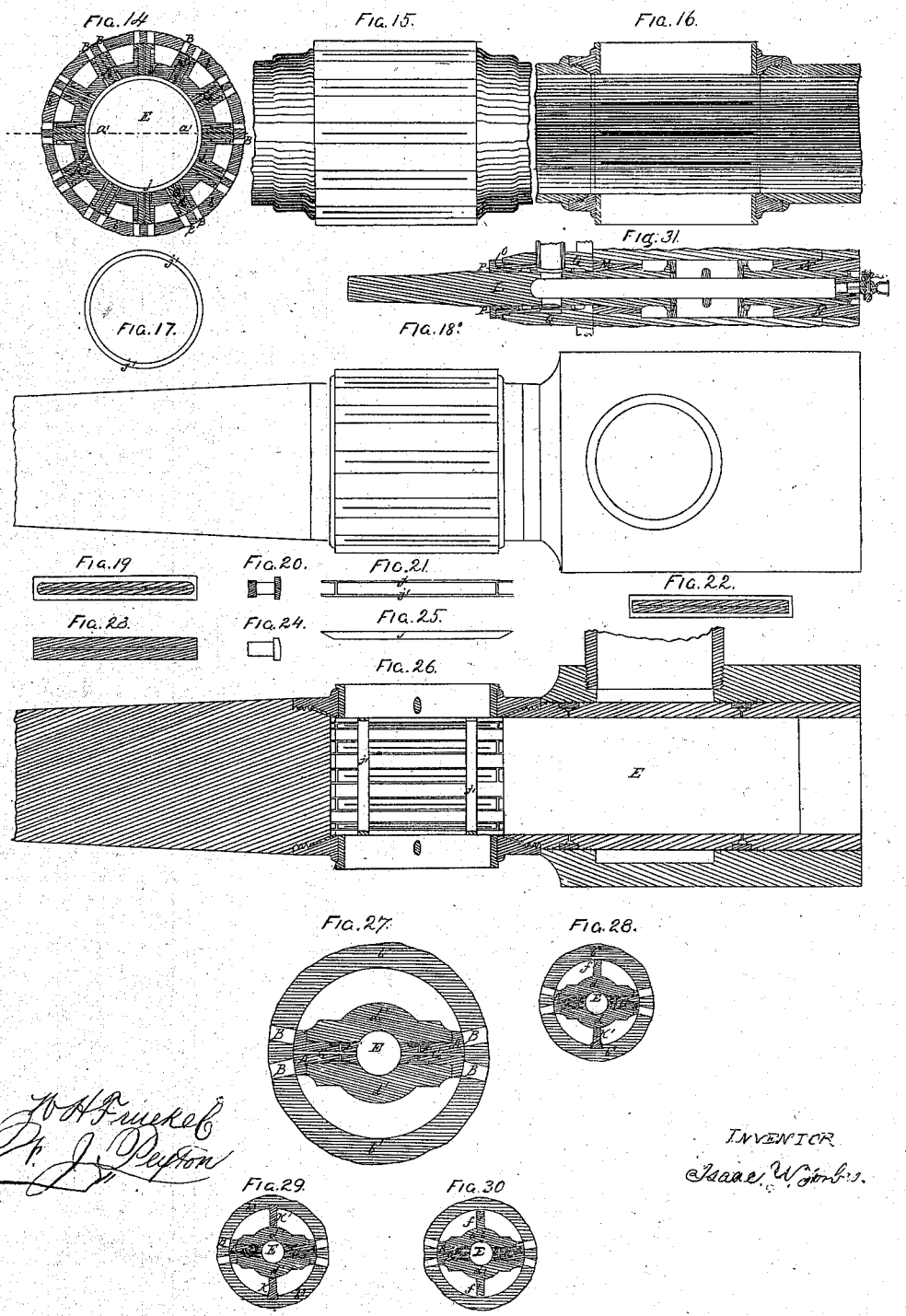
N. J. Dayton

2 Sheets--Sheet 2.

I. W. FORBES.

Improvement in Oscillating Valves for Steam or Air Engines

No. 115,297. Patented May 30, 1871.



Witnesses:
W. H. Fuller
H. J. Dayton

INVENTOR
Isaac W. Forbes.

UNITED STATES PATENT OFFICE.

ISAAC WILLIAM FORBES, OF LA PORTE, INDIANA.

IMPROVEMENT IN OSCILLATING VALVES FOR STEAM OR AIR ENGINES.

Specification forming part of Letters Patent No. 115,297, dated May 30, 1871.

To all whom it may concern:

Be it known that I, ISAAC WILLIAM FORBES, of La Porte, in the county of La Porte and State of Indiana, have invented certain new and useful Improvements in Oscillating Valves for Steam or Air Engines, of which the following is a specification:

Nature and Object of the Invention.

This invention consists in the construction of the valve and its arrangement in the hollow stem or frame into which it is inserted, and in its relation to the case or steam-chest and ports, substantially as herein described.

In the accompanying drawing, Figure 1 is a cross-section of a fourfold valve with seat and ports corresponding, divided midway between the top and bottom of the valve. Fig. 2 is a longitudinal central section of valve of same kind, with case, thimble, and valve-stem corresponding. Fig. 3 is a cross-section of the valve-frame across its middle with the valves removed. Fig. 4 is an end view of a single valve with steam-packing ring or band removed. Fig. 5 is a front view of the valve-frame and thimble with valves removed. Fig. 6 is a longitudinal central section on the fourfold valve, as represented by sectional lines *a' a'* in Fig. 1, with case removed. Fig. 7 is an end view of the thimble. Fig. 8 is a side view of the valve with packing-band removed. Fig. 9 is a steam-packing band, which fits in the recess of valve and prevents steam from passing between the valve and its frame. Fig. 9ª differs slightly from that of Fig. 9 in the matter of fitting the sides to the ends. Fig. 10 is a full front view of this fourfold valve complete, with the end of the stem broken off. Fig. 11 is a single valve, showing that part which fits in the frame, and also that part which is next to its frame. Fig. 12 is the reverse of the valve in Fig. 11, showing that part which fits to its seat. Fig. 13 is a side view of the same valve complete, with packing-band in and ready for being put in its frame in the mortise, as represented in Fig. 5. Fig. 14 is a cross-section of a twelvefold valve, valve-seat, and parts corresponding therewith. Fig. 15 is an outside view of the same valve complete, with the ends of the stem broken off and the case removed. Fig. 16 is a longitudinal central section of the same valve, the section shown by line *a' a'* in Fig. 14. Fig. 17 is one of the rings which slips inside of the valves, designed to hold the glands which press the stuffing in the boxes around the valves, and which holds them to their position to prevent the leakage of steam; or steam-packing bands may be used, if required, as in Figs. 1, 27, 28, 29, and 30. Fig. 18 is an outside view of a twelvefold valve complete, with thimble on the upper portion of the stem for receiving steam through the same into the valves. Fig. 19 is a view of a single valve from the inside, representing that part fitting in the case with the ends being rounded, in which case the mortises should correspond; also representing that part which comes next to the outside part of the frame. Fig. 20 is an end view of the valve-piece, shown in Fig. 19 with the gland on. Fig. 21 is the gland. Fig. 22 is a view of the valve-piece from the inside, the same as represented in Fig. 19 with the exception of the ends being square of that part which fits in the mortises of its frame, while that of Fig. 19 is round. Fig. 23 is the outside view of the same valve, or of that part which fits to the valve-seat. Fig. 24 is an end view of the valve complete, the same as that shown in Fig. 20, with the gland removed. Fig. 25 is a side view of the gland shown in Fig. 21. Fig. 26 is a longitudinal central section of a twelvefold valve complete, with the lower end of the stem broken, with receive steam-pipe screwed in the thimble for conveying steam through into the valve-stem and thence to the valve and supplying the same with steam, with steam-packing rings each side of the receive steam-pipe and chamber, passing around the thimble inside. These packing-rings are let in recesses in the upper portion of the valve-stem, with grooves turned in the center of the recesses for allowing steam to pass around and press the rings out, for the purpose of preventing the leakage of steam, with water-packing grooves also in valve and thimble. Fig. 27 is a cross-sectional view of a double valve and seat, with ports corresponding. Fig. 28 is a cross-sectional view of a double valve and seat, with ports corresponding, with provision made for the exhaust steam to move, or assist to move, the valve while exhausting from two ports; and while exhausting from the opposite two ports the exhaust will have

no effect in moving the valve. Fig. 29 is a cross-sectional view of a double valve and seat with valve-frame, which is also a part of the stem, with exhaust stops and ports corresponding with the valves. This valve is the same as that in Fig. 27, with the exception of the stops K K′, designed to assist the exhaust steam in moving the valve when the valve is moved sufficiently to allow it to exhaust. Fig. 30 is a cross-sectional view of a double valve and seat, with ports corresponding. This valve-frame has stops upon each side, which counterbalance the exhaust steam and prevent it from moving the valve while exhausting. Fig. 31 is a variation from the former figure in the manner of taking in steam, and in the shape of those portions of the valve-stem situated at the upper and lower ends of the valve-chamber. It is a longitudinal central section of a fourfold valve.

In all cases in the above figures where the valve-stems are shown they are represented as broken at one or both ends.

The term valve is applied both to the single valve-pieces and to the whole valve—that is, the frame with the pieces fitted in the mortises.

General Description.

A A are valves fitting in their frames. These valves should be made to fit the mortises in the frame, with steam-packing bands C C to prevent the passage of steam between the valve and frame, which might otherwise cause it to leak. However, if found necessary, fine creases for producing water-packing may be used, as in the case of the joints being close and the same kind of metal used for valve and frame, and having the same contraction and expansion. This valve should have one or more connections cast in the opening to connect the two sides together, as represented by G′ G′ in Fig. 6, which prevents the liability of spreading by the force of steam. B B represent the valve-case, the inside of which forms the valve-seat. B^1 B^1 are steam-induction ports through the valve-case. C′ C′ are holes for the purpose of passing steam from the steam-passage in the center of the valve under the packing-band, to press them against the mortises of the frame. B^2 B^2 are exhaust-ports. D D are the valve-stem and frame in which the valves fit. D^1 D^1 are the bosses of valve-frame, through which the mortises pass for holding the valves in their proper position relatively to each other and to the seat. D^2 D^2 is a taper plug, which fits in the top of the valve-stem above the valve, with the lower end made to fit the hole which conveys steam to the valve. It has a screw cut on to fasten it into the valve-frame. The screw is made as much larger as the size of the thread, which will admit of its being fastened in and allow the lower end of it to form a plug. The object of this is that the plug may be screwed in or out without varying it from its proper relation with the bearing of the valve-stem. This taper corresponds with the taper thimble H H, which fits in a hole in the head of the case, bored out for the same. As the valve-stem wears and might otherwise have lost motion, this plug may be screwed up a little, which will at once bring it to a true bearing. It has a hexagonal head for turning it, and an oil-cup screwed in the top for oiling the valve and its seat. E is the hole in the valve-stem for passing steam or its equivalent through the stem to the valves. F F are the mortises through the valve-frame in which the valves belong. G G are steam-passages through the center of the valves for conveying steam or its equivalent through the same to the ports of the engine. These steam-passages should be of the same length as the ports and equal to the area of the steam-passage inside the valve-stem. I I is a thimble which fits the upper portion of the valve-stem, with a chamber turned out inside, and creases for water-packing, with a projection or flange upon the upper portion, which fits in a recess of the valve-case bored out to receive it. A hole is bored through for screwing the steam-pipe for conveying steam through into the valve-stem for supplying the valve and engine with steam. The lower end of this thimble is shaped in such a way as to allow exhaust steam to pass freely out of exhaust-ports at that end of the valve. I′ I′ is a taper thimble fitting in the lower end of the valve-case, corresponding with the taper of the valve-stem. The object of this thimble is to form a bearing for the valve-stem. As it wears, the thimble is to be raised the required height to prevent lost motion. This may be done by set-screws passing through the lower head of the case, which is not shown in the drawing, to screw against the lower end of this thimble for the purpose of raising it the required height. A′ A′, Fig. 4, are valves the same as A, with the exception of there being no recesses for steam-packing band. Each valve covers two parts, the same as those in all the different figures; hence a double valve would have four induction-ports, a fourfold valve eight induction-ports, a twelvefold valve, as that in Figs. 14, 15, 16, 18, and 26, would have twenty-four induction-ports. These valves pass off the exhaust steam from the induction-ports. Between each valve, in the case outside of the valves, the exhaust-ports may be at either or both ends, or at either or both sides of the valve through the case, which may be constructed accordingly for passing off the exhaust steam with the least possible hindrance, so that the pressure in exhausting may be alike on all parts of the valve, or as nearly as possible so. The ports of these valves may be carried in any required direction for supplying one or any number of engines consistently therewith. Instead of having steam-packing bands, stuffing-boxes, with glands *j j*, may be used, and held in their position with rings *j′ j′*. These boxes, in this twelvefold valve, are planed out each side of each valve-mortise, and turned out at each end of them. This

forms a recess or stuffing-box entirely around each mortise for the gland of each separate valve, which passes in the same. J′ J′ are rings, which pass in the valve-frame near each end of the valves, and are designed to hold the glands in the stuffing-boxes; or, in place of these rings, flanges may be turned upon the glands and bolted down to the frame, which will hold the packing in position the same as packing is held by any other glands in their boxes to prevent the leakage of steam. *b b* is the valve-case, the inside of which is the valve-seat of the twelvefold valve. b^1 b^1 is the valve-case of the double valve. b^2 is the valve-case of a double valve, with one stop, K′, (see Fig. 28,) dovetailed upon one side of the valve-chamber, which extends the length of the valve and fits to the outside of the valve-frame, to assist the exhaust steam on that side of the valve to move the valve as it exhausts; otherwise it would pass around to the opposite end of the valve and counterbalance itself. b^3 b^3 is the valve-case of a double valve, with two stops, K′ K′, (see Fig. 29,) one upon each side of the valve, dovetailed to the valve-case or seat inside, extending to the frame of the valve, which prevents the exhaust steam from passing around the valve and striking the opposite ends and counteracting the force of exhaust. By this means exhaust steam may be used to move the valve to travel the latter half of the distance it is required to move as soon as the valve is opened sufficiently to allow it to commence to exhaust in going in either direction. *d d* is the frame of this double valve, with stop *f′* (see Fig. 28) extending to the valve-case, which prevents exhaust steam from passing around it, thereby preventing exhaust steam on that side of the valve from either port having any effect while exhausting, it being nearly the same length from the center as the valves are from their center. Stop K′, upon the opposite side of this valve, being attached to the valve-case and detached from the valve, exhaust steam, while exhausting on that side, must necessarily have the effect to move the valve while exhausting, if it is left free to be moved. This may be useful in many instances. The valve may be disconnected with the valve gear, or the piston fail to go a full stroke at that end, and otherwise might fail to move the valve to take in steam at the opposite end of the engine. d^1 are the valve-frame and stem of a double valve, the same as represented in Figs. 27 and 29. d^2 d^2 are the stem and frame of a double valve. This frame has exhaust-stops *f′ f′* upon each side of it, which counterbalance the effect of the exhaust from moving the valve while exhausting, without which the exhaust might move the valve a little before it could pass to the opposite end and counterbalance itself. *f′ f′*, an exhaust-stop, designed to prevent the valve from moving while exhausting. There is but one stop or valve in Fig. 28, and one on each side in Fig. 29.

The valves are put in their mortises in the frame where they belong, ready for use. When the whole valve is complete it is put in its seat, ready for use. This valve-seat should be bored out parallel with the bore of the cylinder or cylinders, and the valve then should run parallel with the piston-rods. It may be moved by incline or eccentric, as the case may be. It is applicable to any steam-engine which has ports and valve-seats consistent with the valve. When but one cylinder is used it will not be necessary to have more than a double valve, which will then admit of two ports and steam-passages extending therefrom to each of the cylinders; but when a great number of cylinders is used with but one valve—as, for example, a double cylinder—then a fourfold valve would, perhaps, be preferable, with two ports and passages therefrom extending to each end of each cylinder. In this case two ports extend down to the lower end of one cylinder, while their mates extend to the upper end of the other cylinder. The greater the number of valves in the one frame for the same number of cylinders, the less motion is required for producing the same opening—that is to say, if a fourfold valve is used instead of a twofold valve, but one-half of the motion is required to produce the same opening of ports which a twelvefold valve would require, but one-sixth of the motion that a two-fold valve would require.

The steam-passage through the valve may be at one side of it, if found necessary, as will be the case in quartz-batteries, rock-drills, &c. when more than one cylinder is used; in which case the cut should be on that side of the center of the valve which would be next to the ports leading to the upper ends of the cylinder, which would drive the piston down before it could drive its neighbor piston up when the motion of the valve is given by the upward motion of the piston only. (See my application of this date for improved steam-engine.)

In Fig. 31, L is the valve-stem, differing slightly from that in the other figures. The opening endwise of the valve-stem for receiving and conveying steam to the valve is bored out deeper, or of sufficient depth to receive steam in the side of the stem in the lower head of the cylinder, with double stuffing-box and glands, so that the stuffing may be used each side of the induction steam-pipe, with inclines upon the valve-stem on that part which fits in the steam-chest at each end. To make it more convenient these inclines are made the same length and shape, with thimbles bored out to correspond with the inclines, and turned off to fit the valve-chamber. The upper one, being longer than the lower one, screws in the head of the cylinder to fit the valve-chamber and incline upon the valve-stem. As the stem wears, thereby producing loss of motion, the thimbles may be carried together, the lower one screwed up and the upper one screwed down, which will produce perfect bearing and remedy the defect. In the upper end of the

valve-stem a plug is fitted steam-tight, with an oil-cup screwed therein for oiling the valve and engine.

M is the lower and N the upper thimble; O, the long gland, which is used in the stuffing-box past the induction-pipe; P, the short gland, which screws in the stuffing-box of the long gland and forms a steam-tight joint on the opposite side of the pipe; Q, the lower head of the engine.

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

1. The valve A, with steam-passage G, substantially as described.

2. The valve-stem and frame D D, as and for the purpose described.

3. The valves A A, in combination with valve-frame and stem D D, as set forth.

4. Ports B^1 B^1, in combination with valves A A, steam-passages G G, and valve-frame D D, as described.

5. Stops K′ K′, stops f' f', substantially as and for the purposes hereinbefore set forth.

To the above I have signed my name this 18th day of November, A. D. 1870.

I. W. FORBES.

Witnesses:

W. H. FINCKEL,

W. J. PEYTON.