3 Sheets—Sheet 1.

W. B. DODDRIDGE.

VALVE GEAR FOR STEAM ENGINE.

No. 108,982. Patented Nov. 8, 1870.

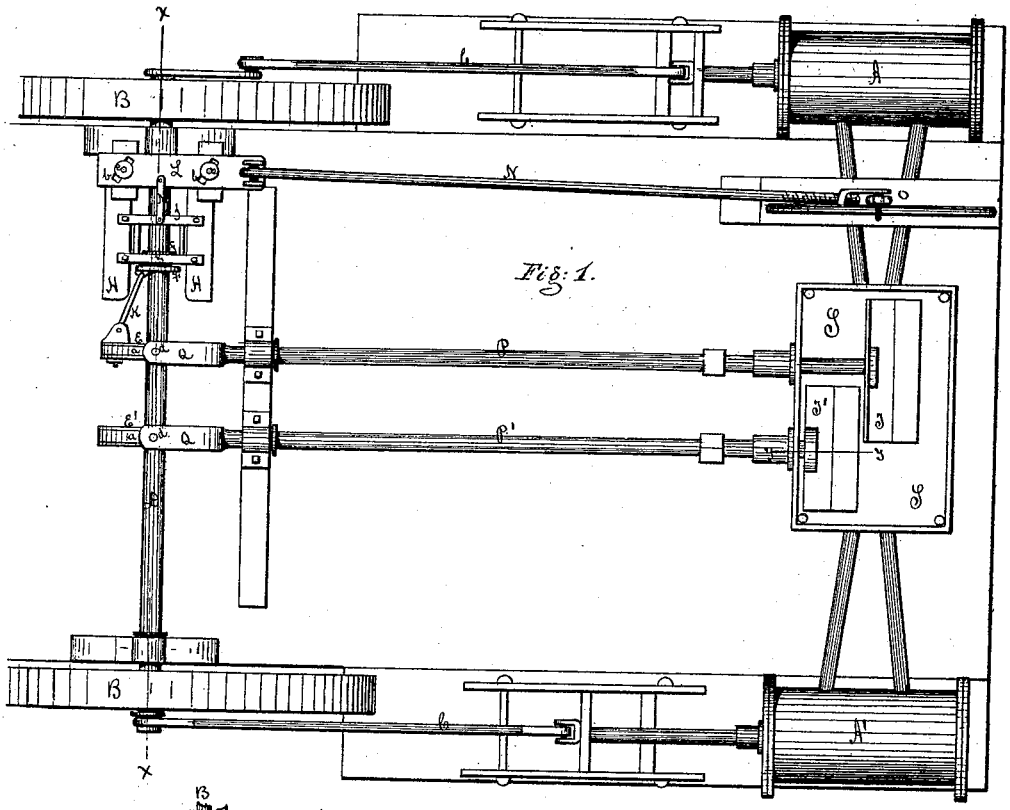

Fig: 1.

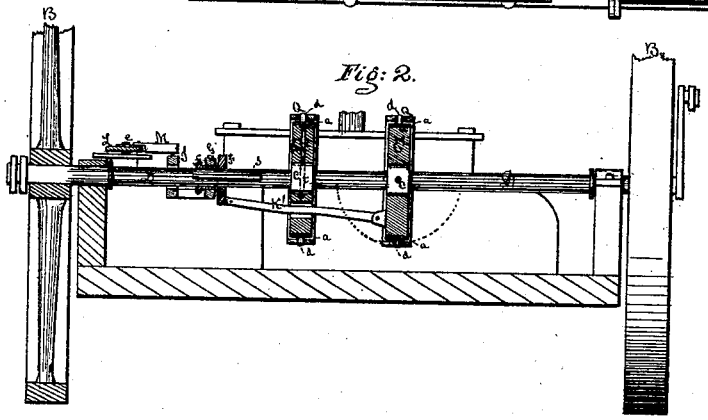

Fig: 2.

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Fig: 3

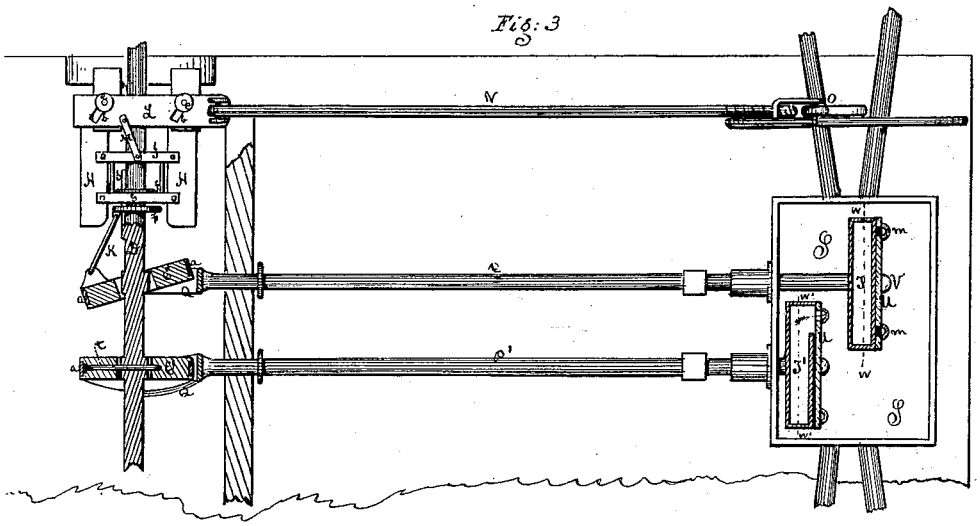

Fig: 5.

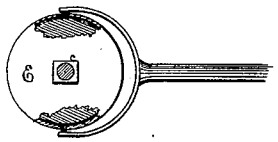

Fig: 4.

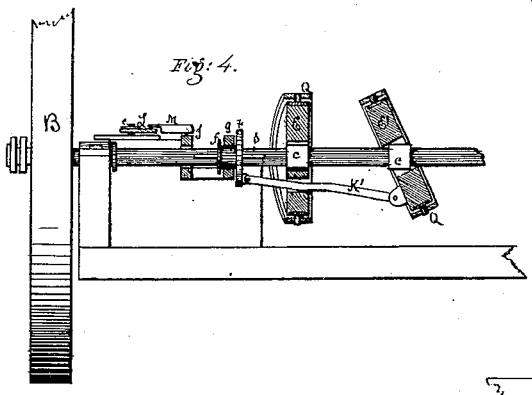

Fig: 6.

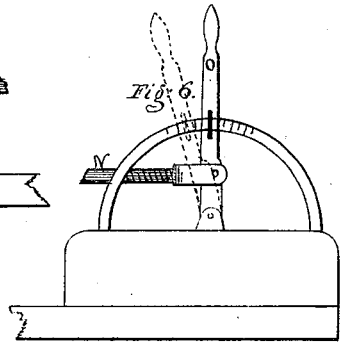

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Fig: 8.

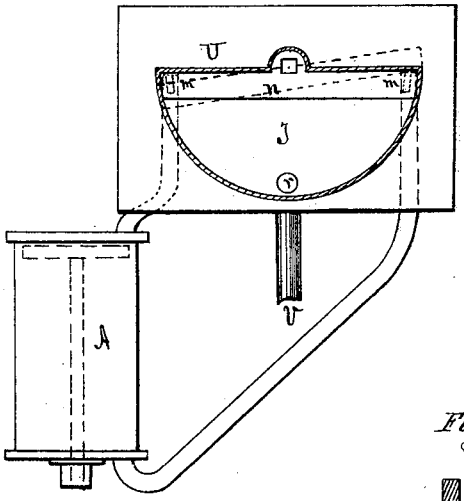


Fig: 9.

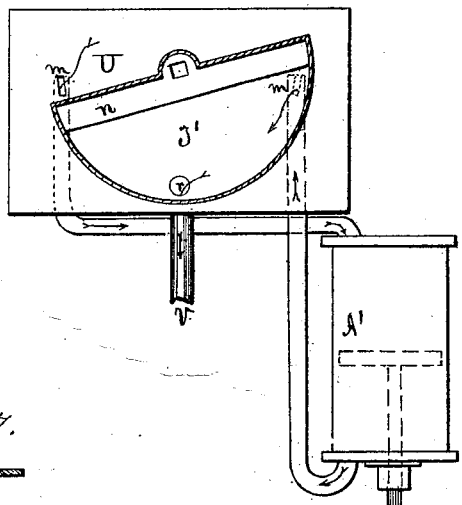


Fig: 7.

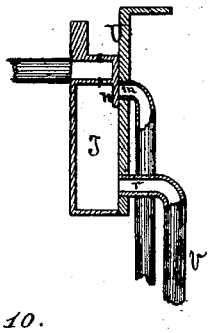


Fig: 10.

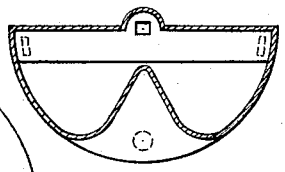
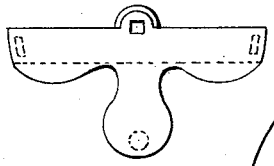
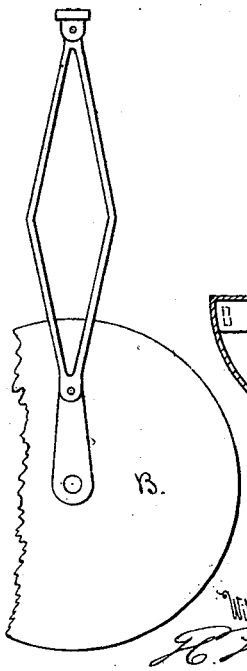
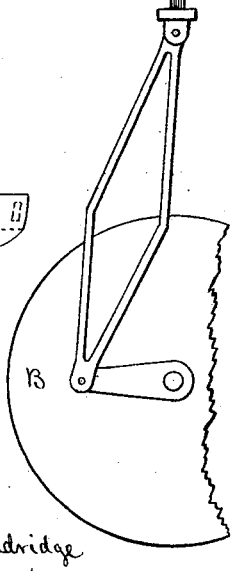


Fig: 11.







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United States Patent Office.

WILLIAM B. DODDRIDGE, OF HEBRON, INDIANA.

Letters Patent No. 108,982, dated November 8, 1870.

IMPROVEMENT IN VALVE-GEAR FOR STEAM-ENGINES.

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

I, WILLIAM B. DODDRIDGE, of Hebron, in the county of Porter and State of Indiana, have invented new and useful Improvements in the Valve-Gear for Steam-Engines, of which the following is a specification.

The first part of my invention relates to the operation of the valves of a steam-engine, by means of hand-wheels pivoted upon a revolving shaft, so that they may be inclined, more or less, to its axis, combined with valve-rods, placed at right angles to said revolving shaft, having terminal arms or forks, which embrace the band-wheels, and are pivoted to the bands thereon at diametrically opposite points. Thus, these bands are held by the arms of the valve-rods pivoted thereto, while the wheels are left free to revolve easily within them; when the band-wheels are turned upon their axes, so that they stand each at a right angle to the axis of the shaft, their revolution with the shaft will produce no movement of the valve-rods, but if they be turned, more or less, upon their pivots, so as to be inclined to the axis of the shaft, their revolution will cause the pivot points of the valve-rods upon the band-wheels to traverse back and forth in the line of said axis, and thus produce a rocking movement of the valve-rods, the extent whereof will be determined by the degree of the inclination of the band-wheels.

The rocking movement thus produced in the valve-rods, and readily controlled, is easily made available for operating the valves of the engines, by means of connecting devices of any suitable character. By pivoting the band-wheels upon the shaft, so that their axes shall be at right angles to each other, as well as to the shaft, an alternate movement of the valve-rods is produced, and a proper consecutive movement of the valves in opening and closing thereby obtained.

The second part of my invention relates to the form of valves which I regard to be best adapted for use in connection with the first part of my invention. These improved valves are attached directly to the ends of the rocking valve-rods, so as to rock therewith, and, by their movements, open and close the parts communicating with the steam-chest and cylinders of the engine, and with their exhaust-pipe.

In the accompanying drawing—

Figure 1 is a plan view of a steam-engine operated by means of my improved valve-gear and valves.

Figure 2, a vertical section, taken centrally, through the main-shaft and the driving-wheels, in the line *x x*, fig. 1.

Figure 3, a horizontal section, likewise taken centrally, through the axis of the main-shaft, showing the band-wheels inclined.

Figure 4, a second central vertical section, taken longitudinally, through the axis of the main shaft, showing the band-wheels thereon inclined in the same position as illustrated in fig. 3.

Figure 5, a detached view of a band-wheel, illustrating more fully the manner of combining the valve-rod therewith.

Figure 6, a detached view, in elevation, of the lever by which the band-wheels are turned upon their pivots.

Figure 7, a central vertical section of one of the valves in line *y y* of fig. 1.

Figures 8 and 9 vertical sections of the two valves operating the engine, taken, respectively, in the lines *w w* and *w' w'* of fig. 3, connected with diagrams illustrating the movements of the two pitmans and cranks under the operations of said valves.

Figures 10 and 11, views of modified forms of valves.

A A' are the cylinders.

B B, the driving-wheels.

C C, the pitman-rods, connecting the wheels to the pistons of the engines.

D, the main driving-shaft, to which the driving-wheels B B are attached.

E E', two band-wheels, having each a rectangular opening at the center thereof, to receive a corresponding rectangular block, *c*, firmly united or secured upon the shaft D.

These band-wheels, being placed upon said blocks, are pivoted thereto at right angles to each other, by means of pins, *t*, inserted from their peripheries, to pass centrally through the blocks and shaft, and project beyond the same into the wheel on the outer side, as illustrated in figs. 2 and 3. The band-wheels are thus left free to turn upon their pivots, so as to be inclined, more or less, to the axis of the shaft, see figs. 2, 3, and 4, or to remain at right angles thereto, see figs. 1 and 2.

a a (see fig. 5) are the bands encircling the peripheries of the wheels E E loosely enough to move freely and easily thereon.

F is a wide flange, projecting from the inner end of a collar, sliding loosely upon the shaft D, but made to revolve therewith by means of a feather or key, *s*, (figs. 2 and 3,) projecting longitudinally from the shaft D into a counterpart notch in the inner perimeter of the collar.

A smaller flange, *f*, is formed upon the outer end of the collar, and the two embrace a sliding bar or box, G, fitted between them, and extending out from the shaft far enough to rest and slide upon ways formed on the upper edge of blocks or supports H H, placed longitudinally upon each side of the shaft, and extending out to the pillar-block supporting its bearing.

I is a second sliding bar, placed upon the shaft, which passes freely through the same, and which rests at either end, and slides, like the first, upon ways on the upper edge of the blocks H H.

The two sliding bars, G and I, are coupled together by the rods extending between them, so that the two slide together, carrying with them the collar and flange F, embraced by the first.

K (figs. 1 and 3) is a link, pivoted, at one end, to the flange F, and at the other to an ear or lug projecting from the side or face of the band-wheel E, at a point in a line at right angles to the pivotal axis of the wheel.

K′ (figs. 2 and 4) is a second link, pivoted, in like manner, at one end to the flange F, at a point thereon removed one-fourth of a circle from the pivot-point of the first link K, and which, extending through an aperture cut for the purpose in the body of the band-wheel E, is pivoted, at its outer end, to an ear or lug projecting from the side or face of the second band-wheel, at a point in a line at right angles to its pivotal axis.

By means of these connecting links a sliding movement of the collar and flange F will cause the two band-wheels to turn upon their pivots in either direction, so as to incline to the axis of the shaft, the one at right angles to the other, as shown in figs. 3 and 4.

L is a plate or bar, sliding upon suitable ways transversely to the shaft D.

In this plate L two or more diagonal slots, *b b*, are cut, at an angle of forty-five degrees to its length, and through these slots pins project from the ways beneath, upon which are placed nuts or plates *e e*, to prevent an upward movement of the plate from its seat.

By means of these inclined slots, and the pins therein, the forward motion of the plate transversely to the shaft produces a simultaneous lateral movement thereof in the line of the shaft.

M is a link pivoted to said plate L and to the sliding bar I, coupled to the collar and flange F, by means whereof the movement of the plate L, in the direction of the shaft, is communicated to said collar, and thence to the band-wheels E E′, for the purpose of turning them upon their pivots and inclining them to the shaft.

N is a connecting-rod, coupling the plate L with an ordinary upright lever O, (see fig. 6,) pivoted to swing in a vertical plane to and from the plate, so that the movement of this lever shall move the plate L, and through it and the intermediate connections, the band-wheels E E′, to turn them as described.

A bell-crank, or other form of bent lever, connected by a link to the sliding collar and flange F, may be substituted for the sliding plate L, operating as set forth, where the operating lever is so placed as to move at right angles to the shaft D, as in the machine herein described; and I contemplate the use of any mechanical appliances for turning the band-wheel so as to incline them, more or less, to their axis of revolution.

P P′ are valve-rods, connected to the loose bands *a a* of the band-wheels E E′, by embracing arms Q Q, secured to said bands by means of pivot-pins *d d*, placed at diametrically opposite points in their circumference, as illustrated in fig. 1.

S is the steam-chest of the engine, into which the valve-rods P P extend with suitably packed joints.

T T′, figs. 2, 7, 8, and 9, are semicircular hollow valves, whose upper straight edges or rims are secured at their central point to the ends of the valve-rods in the steam-chest, so that the rocking movement of the rods will be imparted thereto.

The open face of each valve is made to fit closely against and slide freely upon a face-plate, U, figs. 3, 7, 8, and 9.

In the lower portion of this face-plate an aperture, *r*, is pierced centrally below the axis of the valve, so as to be covered thereby throughout its entire movement, and which is made to communicate with an exhaust-pipe, V, as illustrated in fig. 7.

Two steam-ports, *m m*, are also pierced through the face-plate U, in a horizontal line, just below the upper rim or edge of the valve, so that when the upper straight-edge of the valve is in a horizontal plane, both of these ports will be covered and closed by a plate, *n*, projecting downward from the inner upper edge of the valve, and made wide enough to barely cover them when in said position, (see fig. 8.)

Instead of extending this valve-plate *n* across the entire length of the valve, two separate plates of equal width, one for each port, may be employed.

These two steam-ports *m m* in the face-plate of each valve communicate, by means of suitable pipes, with the either end respectively of one of the cylinders A or A′ of the engine, (see diagrams figs. 2, 8, and 9.) Hence, so long as the upper straight-edge or rim of the valve is in a horizontal plane, so that its inner plate or plates *n* cover both ports *m m*, (see fig. 8,) the connected cylinder is cut off from the steam-chest.

The valves T T′ are so secured to the valve-rods P P′, as that when the two pivots, by which each rod is secured to the band upon its band-wheel on the shaft, are in a line with each other at right angles to the shaft, as shown in fig. 2, (see also E, fig. 4,) the straight-edge or rim of the valve connected to the rod will be in a horizontal or right position, (see dotted line, fig. 2,) covering and closing the steam-ports to the cylinder, and thus shutting off all steam therefrom, as in fig. 8.

The band-wheels are also pivoted upon the shaft at right angles to each other, (see figs. 2, 3, and 4,) with such reference to the position of the cranks of the driving-wheels of the engine as that when either crank and piston is at its dead-point (see diagram fig. 8) the pivots connecting to its band-wheel the valve-rod of the valve controlling the admission of steam to the cylinder on that side will be in a right line with the axis upon which said band-wheel inclines, (see fig. 4,) so that the steam-ports to that cylinder will be wholly closed, as shown and illustrated in fig. 8, while the other band-wheel E′, being inclined upon a pivotal axis at right angles to the first, (see fig. 4,) will turn the valve-rod so as to cause its valve to be thrown open, as shown and illustrated in fig. 9.

Hence, to shut off steam from the engine, it is only necessary to throw the band-wheels into a position at right angles to their shaft. When they are thus placed at right angles to their shaft, as illustrated in figs. 1 and 2, the operating lever is in a perpendicular position, as shown by positive lines, fig. 6.

If, however, the lever be thrown forward, as shown by dotted lines, fig. 6, the two band-wheels will at once be turned and inclined to the axis of their shaft by means of the rod N, plate L, sliding collar F, and links K K′, as hereinbefore described, the one, E, (operating the valve covering the steam-ports of that piston which is at the dead-point,) upon a pivotal axis coincident with a line passing through the pivot-points of its valve-rod P, so that it will not move said rod, nor the valve T connected therewith, (see fig. 8,) the other, E′, (operating the valve of the piston, which is on its center,) upon an axis at right angles to a line passing through the pivots of its valve-rod P′, so as to turn said rod and open the valve J′, as shown in fig. 9. The steam from the steam-chest will pass thus at once to the proper cylinder A′, and start the engine.

So soon, then, as the shaft D begins to revolve, the valve T of the cylinder A whose piston was at its dead-point will open, and in due time the other, T′, will close, the valves being made to open and close alternately by the rotation of the shaft D operating upon the valve-rods P P′, by means of their inclined band-wheels E E′, as described.

It will be observed that the valves are thrown wide

open, or are entirely closed, at a dead-point in the rocking movement of the valve-rods, so that while passing this dead-point the valves are kept momentarily wide open or closed. Also, that while one valve-rod and valve is thus comparatively motionless, the other is passing its center and in full motion.

It will be also observed that the exhausts are at once thrown open the moment the ports admitting steam to the cylinder begin to open, (see dotted lines, fig. 8,) and that they remain open until the steam is entirely shut off from the cylinder.

The valves may be made to open more or less by a change in the inclination of the band-wheels, produced by means of a movement of the lever *o*.

The engine may be reversed by reversing the inclination of said band-wheels, and when the engine is stationary, the direction in which it will move in starting is determined simply by the direction in which the lever *o* is thrown.

As there can be no communication established between the cylinder ports and the exhaust until the valve is inclined to one side or the other, the valve may be made with two lobes, as illustrated in fig. 10, instead of in an entire semicircle; or it may be made of a form as illustrated in fig. 11, or otherwise modified, so as to adapt it to special positions.

The valve-rods P P′ may be made to work in any position, and the band-wheels E E′ may be placed upon a secondary shaft, instead of upon the main shaft.

I contemplate operating any of the well-known forms of slide-valves by means of my band-wheels and rocking valve-rods by simply converting the rocking movement of the rods P P into a reciprocating movement by any well-known mechanical device for this purpose. Hence my invention is applicable to nearly all direct-acting engines, and I contemplate such adaptation and applications thereof.

I claim as my invention—

1. A band-wheel, E or E′, so pivoted upon a revolving shaft at right angles to its axis as to admit of being inclined thereto at pleasure, in combination with a rod pivoted to the band of said wheel, for the purpose of producing, by the revolution of the shaft and wheel, a rocking movement of the rod to operate the valve of an engine, substantially in the manner and for the purpose herein set forth.

2. The two pivoted band-wheels E and E′, arranged substantially as described, and combined with each other and with a revolving shaft, D, valve-rods P P′, and valves T T′, substantially as and for the purpose herein set forth.

3. A lever, O, combined, by means of intermediate mechanical devices, with one or more band-wheels E E′, pivoted upon a revolving shaft to produce and control an inclination of said wheels upon the shaft, substantially as and for the purpose herein specified.

4. The valve-plate *n* of a hollow valve, T, which has free communication with an exhaust-pipe, in combination with ports *m m* in a face-plate, U, the whole being inclosed within a steam-chest, S, and made to operate substantially as herein set forth.

The foregoing specification of my improvements in steam-engines signed by me this 14th day of March, A. D. 1870.

WM. B. DODDRIDGE.

Witnesses:
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H. H. YOUNG.