(No Model.)

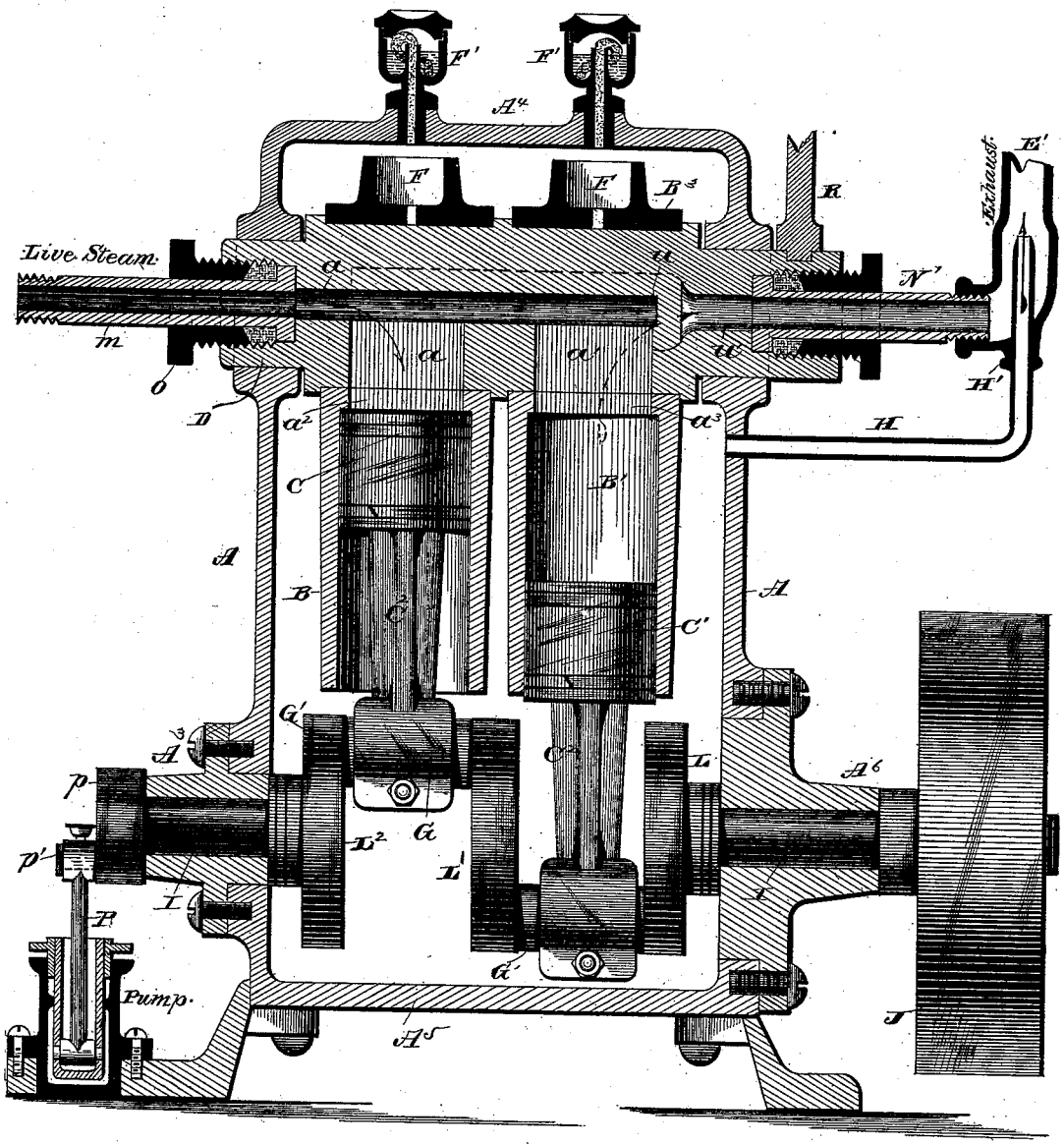
3 Sheets—Sheet 1.

W. L. TODD.

OSCILLATING ENGINE.

No. 357,248. Patented Feb. 8, 1887.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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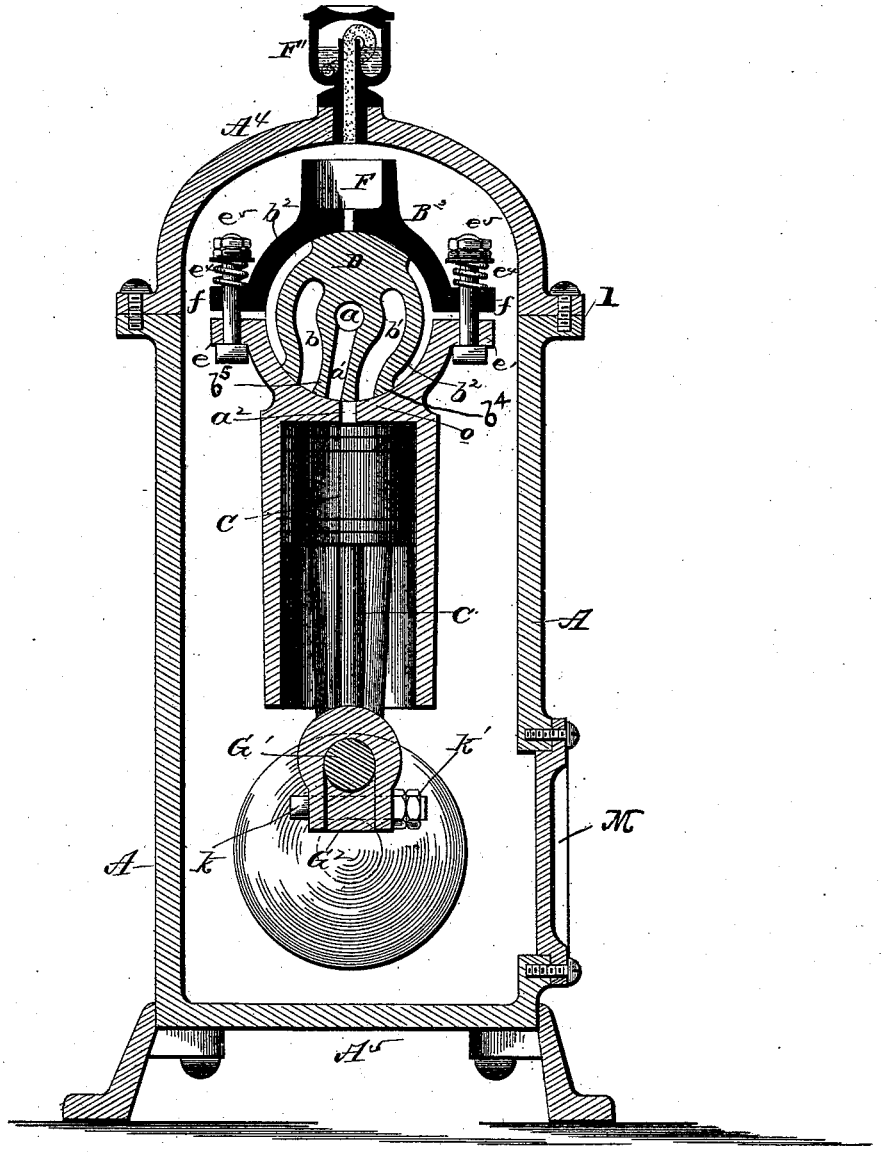
Fig. 2.



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3 Sheets—Sheet 3.

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Fig. 3.

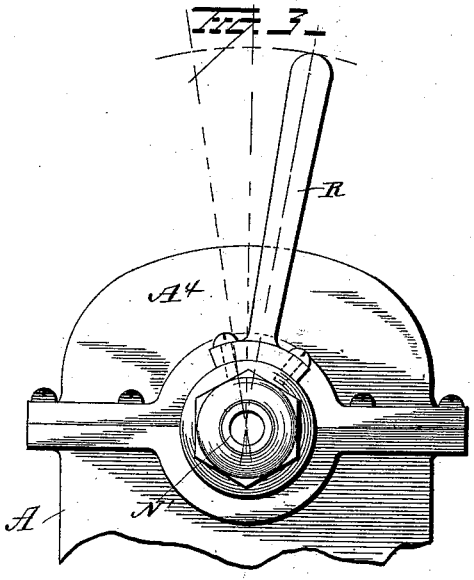


Fig. 4.

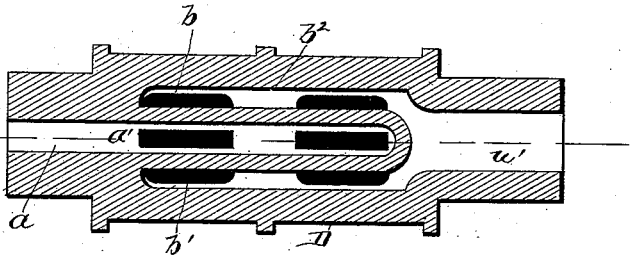


Fig. 5.

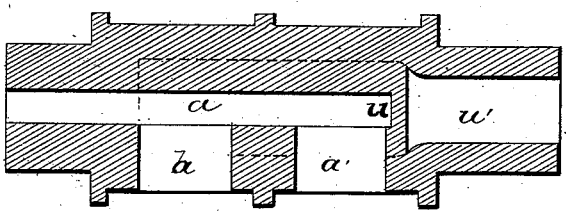
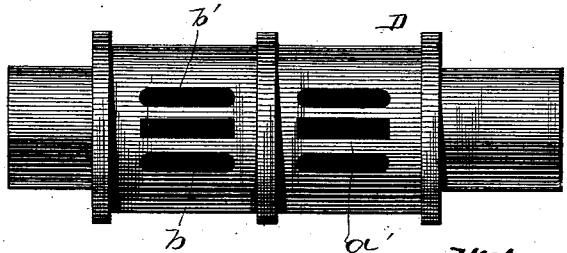


Fig. 6.



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UNITED STATES PATENT OFFICE.

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OSCILLATING ENGINE.

SPECIFICATION forming part of Letters Patent No. 357,248, dated February 8, 1887.

Application filed October 23, 1886. Serial No. 217,039. (No model.)

To all whom it may concern:

Be it known that I, WILMER L. TODD, of Summerville, in the county of Berkeley and State of South Carolina, have invented certain new and useful Improvements in Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to high-pressure steam-engines, and more particularly to the type known as "pendulum" or "vibratory" engines.

The object of my invention is to produce a vibratory steam-engine that is compact, has few working parts, and that will be capable of great rapidity of motion without liability to jar or thump in its working-connections.

A further object is to produce a vibratory steam-engine that is capable of instant reversal of rotative motion of its axle without special valve-gear to effect this change.

A further object is to produce a quick-speed compact vibratory engine that will be neat in appearance, and having but few machine-finished parts, can be produced at a low initial cost.

With these ends in view my invention consists in certain features of construction and combinations of parts, as will be hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a longitudinal sectional view of the engine. Fig. 2 is a transverse vertical section of the same. Fig. 3 is an end view of the upper portion of the engine-case, showing reverse-lever in place. Figs. 4 and 5 are longitudinal views in section through the center of the trunnion, to show steam and exhaust passages and ports leading from same. Fig. 6 is a perspective view of the trunnion, showing the steam and exhaust ports on its lower side.

A is the casing of the engine. It subserves the twofold purpose of a sustaining-frame for the working parts of the engine and a concealing-chamber that prevents the objectionable spatter of lubricating material and condensed water from the cylinders.

The form of the case A is preferably rectangular, as shown in the views. The top A^4 of the case A is arched, as shown in Figs. 1 and 2, and is fastened by screws or bolts to the flange. At a point in the ends of the casing A, midway between the sides of the same and a proper distance from the surface of the top A^4, two diametrically-opposite circular apertures are formed. These orifices are bored out to provide true bearing-surfaces for the turned ends of the trunnion D. It is essential that a steam-tight joint should be secured between the surfaces of these parts. The axial center of the trunnion D is in the same horizontal plane with the junction line of the flanges on the cap A^4 and casing A, so that the trunnion-box bearings in the casing will be divided on a center line, the cap A^4 having the upper halves of the boxes formed in it. This mode of construction permits the ready adjustment in steam-tight position of the trunnion D by its end bearings in the case A. The trunnion is turned or otherwise smoothly finished on its surface, so as to produce a true cylindrical body. A steam-passage, *a*, is formed in the center of the trunnion D. This extends a suitable distance and terminates at the point *u*. (See Figs. 4 and 5.) Two exhaust-passages, *b b'*, are also formed in the trunnion D. These are made parallel to the central steam-passage, *a*. The grooves *b b'* are concentric with it for a portion of their depth. These exhaust-conduits extend toward the end of the trunnion opposite to the steam-inlet *a* and unite to form a common escape-passage at the point *u'*.

Upon the trunnion D are vibratorily suspended the twin cylinders B B'. These cylinders are constructed as is shown in Figs. 1 and 2. Their bodies are of equal length and diameter. They are bored to receive suitable spring-packed pistons, C C'. These are made in any preferred manner to be effective. The lower ends of these cylinders are open below the piston-heads C C'. The upper ends are closed, with the exception of two steam-ports, a^2 a^3, that are made in them, as will be explained.

The upper walls of the cylinders are extended to form curved flanges *e e'*. These flanges at their tops extend laterally to correspond with similar lugs, *f*, that extend from the curved shells B^3, and are superimposed upon the flanges *e e'*. (See Fig. 2.) The shells or half-

clamps B^3, when in position upon the upper ends of the cylinders C C', form with these ends a complete circular bearing upon their inner faces. These are intended to rest on the body of the trunnion D, and they should be bored out to fit this with a steam-tight sliding joint. The two parts of each of these box-bearings B^3 are connected by neatly-fitting bolts, that are inserted in holes in the lugs e' f, and are held in position by jam-nuts e^5, that are secured to their threaded ends. Spiral springs of proper strength are placed over the bolts, and the jam-nuts impinge on washers that are placed upon the top ends of the springs e^4.

The nuts e^5 should be so adjusted as to cause a steam-tight fit between the bearing-surfaces of the trunnion-body and the corresponding seats on the cylinders that hang below and in contact therewith, and it is evident that the springs e^4 must have sufficient strength to properly support the weight of the cylinders and permit the secured movable contact of the surfaces, as before mentioned.

The trunnion D is perforated on its lower portion to form live-steam and exhaust ports. These are shown in Figs. 1, 2, 4, 5, and 6. The steam-ports a a' (see Fig. 1) extend from the central passage, a, downwardly to intersect similar-sized ports a^2 a^3, made in the solid upper heads of the cylinders B B', these heads by their conformation becoming each a valve-seat. The exhaust-ports b b' are extended downwardly in the body of the trunnion D, so as to form two sets of parallel ports, that are located upon each side of the central live-steam ports. This construction, as will be seen in Fig. 5, produces a set of three ports for each cylinder, that will by the vibration of the cylinders be brought into correct lining position with the steam-passages a^2 a^3, that perforate the fixed heads o of each.

The trunnion-body D is reduced throughout its length upon each opposite side, as shown at b^2 in Fig. 2. This depression of the contact-surface does not intersect the exhaust-ports b b', but permits a bar, b^4, to stand at each outer edge of the exhaust-ports as a wearing-face for the cylinder-seat. The two bars b^5, that separate the center steam passage or port from the contiguous exhaust-ports, are of a proper width to just cover the steam-passage a^2 in the head o of a cylinder. This applies equally to each cylinder and its respective ports.

The end of the trunnion D is made to extend on the live-steam side a short distance outside the case A, and the steam-passage is enlarged to form a stuffing-box, in which is seated the flanged end of a steam-pipe, m, which is secured fixedly by the threaded packing follower-nut O, suitable steam-packing being introduced between the end of this nut and the flange of the pipe m to make a tight joint at this point. On the opposite or exhaust side of the trunnion D its projecting end has a similar provision for securing the exhaust-pipe N', and also for the accommodation of the lever R, (see Fig. 1,) this lever R being secured to the upper side of the trunnion D, as shown in Fig. 3. At a proper point the vertical exhaust-pipe E' is attached to the pipe N' by an L-fitting. This portion of the exhaust-pipe has a projecting threaded pipe-socket, H', made integral with its body, to accommodate the waste-steam pipe H, that taps the case A at a point near the top beneath the horizontal exhaust-pipe N' and parallel to it until it bends to enter the tapped socket H'.

The pistons C C' have depending projections C^2, made preferably integral with the spiders of these piston-heads. The depending bodies of the connecting-rods C^2 are webbed to produce stiffening-flanges that radiate from a common center on four sides, or, in other words, are each made up of four flat longitudinal ribs joined in a center line. This method of construction affords maximum strength with a minimum use of material.

The lower ends, G, of the connecting-rods C^2 are enlarged to form a half-box with parallel faced open jaws that open downwardly, as shown in Fig. 2. A movable half-box, G^2, is made to fit these jaws on each of the rods, and they are held in an adjusted position in relation to the crank-pin they bear upon by taper pins or keys k, that are held in proper position beneath their respective boxes by passing through holes or slots made for their reception in the jaws of the half-boxes G and the use of the jam-nuts k', that are placed upon their projecting threaded ends.

At a suitable distance from the bottom A^5 of the casing A, at opposite points on the sides, the crank-shaft bearings A^3 A^6 are located. These are either projecting perforated bosses, as shown, or they may be separated to produce a cap on each that may be attached to the lower half-box by any approved method. These boxes may also be made by simply boring holes of proper size for the crank-shaft to fit into in the solid metal, as is here shown, or they may be recessed to produce cellars for the reception of any suitable anti-friction metal—such as Babbitt metal—or thimbles of phosphor-bronze may be fitted into place as a bearing or wearing surface.

The casing A is cut away at the points where the boxes A^3 A^6 are introduced. One of these openings, A^6, in the case is of a size to permit the introduction into the case of the crank-disks L, the opening in the case being closed properly by a flange or plate that is formed integral with the box A^6, and extended to bear on the edges of the orifice to which this flange is properly secured by bolts or screws to form a tight joint, a recess or shoulder being provided to permit the inner face of the box to come flush with the common surface of the inside of the chamber A at this point. The opposite box, A^3, is also flanged, as shown, and secured in place in a similar manner to A^6, just described. The orifice in the case on this side is considerably smaller than the opposite one, it being unnecessary

to provide more than one aperture for the insertion of the crank-disks L. These separable boxes are of advantage in the way of executing the machine-work in their fitting up, as the parts can be bored out more conveniently when removed from the case A.

The crank-shaft I is made to fit the boxes A^3 A^6, and a thorough lubrication of the working parts of the cylinders and cranks, as well as the shaft-journals, is effected by filling the crank-case A partly full of oil, a removable bonnet-plate, M, being provided to afford access to the interior of the case.

The crank-disks L L^2 are of a proper diameter to afford the necessary throw to the crank-pins G', that are rigidly attached to their opposing faces, near the peripheral edges of said disks L L^2. A third disk, L', is placed midway between the faces of the cranks L L^2, as shown in Fig. 1, and this crank-disk is connected at two diametrically-opposite points to the crank-pins that project from the faces of the disks L L^2. This method of construction gives the pins G' a position in the same vertical plane with the crank-shaft I, and consequently at equal distances from the axial center of the shaft I, the cranks both having the same length from the center of the shaft to the centers of the pins.

It is essential that the added length of a crank and cylinder, as shown in Fig. 2, should be such in relation to the diameter and center of the trunnion D and width of the ports and intervening bars in the body of the trunnion that the full vibration or side movement of the cylinders B B', caused by crank action, will move the port a^2 in the bearing-face of the head of the cylinder so as to line alternately with the live-steam port in the trunnion D and one of the exhaust-ports in the same at every half-revolution of the crank that is attached to this cylinder. This method of construction, it is obvious, applies to each of the twin cylinders.

The fly-wheel J is mounted on a projecting end of the crank shaft I and secured there. At the opposite end of the shaft I a small crank-disk, p, is fixed to bear against the box A^3, and a pin, p', is secured in its face to have a proper throw to operate the vertical plunger-pump P, this being secured to an extension of the base-plate A^5 of the case A, made for its accommodation. Any suitable style of feed-water pump may be utilized that is susceptible of being operated as just described.

The shells B^3, that form the wearing-surfaces of the vibrating cylinders B B', are furnished with sponge-boxes F. These receive the lubricant that is fed regularly by the oilers or cups F' that are mounted immediately above the boxes F upon the top side of the case-cap A^4.

The lever R is intended to change the position of the steam and exhaust ports in the trunnion D in regard to the steam-passages a^2 a^3 in the heads of the cylinders B B'. This lever R is of a convenient length, and may be vibrated a limited distance, so as to cause the parts to be changed as just stated. It may be secured at a desired point by an arch and set-screw; but in small engines the friction of the trunnion D in its bearings will be sufficient to hold the lever at an adjusted point.

This engine, strictly speaking, is compound in action, having two cylinders that receive steam at their upper ends alternately, the live steam that enters the trunnion D being admitted through the center port that extends to these by its lateral branches, so that the piston-head of each cylinder will be depressed successively. When one piston is moving down by the action of the live steam upon its upper face, the other piston is being elevated by this motion and the exhaust-steam is being expelled. This exhaust expulsion is provided for by the disposition of the exhaust ports and passages. If the lever R is moved over to the right side, (see Fig. 2,) the crank-shaft will be made to revolve from right to left. While the lever remains in this position the exhaust-ports on but one side of the center or live-steam port will be in use in alternate connection with each cylinder to discharge used steam. When the lever is thrown in an opposite direction, the live steam will at once enter the opposite cylinder and reverse the direction in which the engine-shaft is revolving, so that it will revolve from left to right hand, and the opposite set of exhaust-ports will be brought into use. This will be plain when it is remembered that the live steam has direct connection with and can enter but one cylinder while the other is exhausting, and this operation alternates at each one-half revolution of the crank-shaft, so as to produce uninterrupted motion of the fly-wheel in either direction, as may be desired.

It will be noted that the pressure and consequent strain upon the working parts of this engine are all downward, so that a high speed with remarkable smooth action can be attained. Further, the extreme shortness of the lateral steam-passages to the cylinders, and the protection from condensation afforded by the method of incasing the cylinders and trunnion, give economical results as to steam consumption.

Any escape-steam that enters the crank-case A will be withdrawn by the drawing action of the exhaust-steam in its escape-pipe, to which is attached the smaller steam-waste pipe H that taps the case A.

The compact form and complete inclosure of the working parts of this engine, and consequent prevention of escape of water or oil therefrom, together with the perfect lubrication of all its working parts, are notable features of advantage embodied therein.

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

1. In a vibratory steam-engine, the combination, with a trunnion having a live-steam passage and exhaust passages formed in it, of

two vibratory steam-cylinders that receive steam and exhaust it through a single port in each cylinder-head, substantially as set forth.

2. In a vibratory steam-engine, the combination, with two steam-cylinders adapted to vibrate upon one trunnion, of a trunnion having a central steam-passage and two exhaust-passages to connect with a single port in the head of each cylinder, substantially as set forth.

3. In a vibratory steam-engine, the combination, with two steam-cylinders suspended upon the same trunnion and adapted to alternately receive steam through ports in this trunnion, of a trunnion having a central steam-passage, lateral ports to this steam-passage, two exhaust-passages, ports to these exhaust-passages, and a direct means of changing the position of the trunnion by partial rotation on its end bearings, substantially as set forth.

4. In a vibratory steam-engine, the combination, with two steam-cylinders vibratorily suspended upon the same trunnion, and provided with ports to receive steam at their upper ends, of a trunnion having a central steam-passage extending longitudinally from one end into the body of the trunnion a portion of its length to supply live steam, and two exhaust-passages located opposite to each other and parallel to the central live-steam passage, and joining in a common axial escape or exhaust passage that perforates the opposite end of the trunnion, substantially as set forth.

5. In a vibratory steam-engine, the combination, with two steam-cylinders supported free to vibrate upon a single trunnion, and receive steam and exhaust it through this trunnion, of a lever to change the position of the trunnion by partial rotation, two piston-heads and their depending limbs, boxes on the lower ends of the limbs, two cranks set diametrically opposite, and a crank-shaft, substantially as set forth.

6. In a vibratory steam-engine, the combination, with two steam-cylinders supported free to vibrate upon a single trunnion, and receive live steam from one end of this trunnion and exhaust it from the other end, of a lever to change the position of the trunnion by its partial rotation, two piston-heads and their depending limbs, crank-pin boxes on the lower ends of these limbs, two cranks placed opposite each other, a crank-shaft, and a fly-wheel, substantially as set forth.

7. In a vibratory steam-engine, the combination, with two steam-cylinders supported free to vibrate upon a single trunnion, and that receive their live steam at one end of the trunnion and exhaust it from the opposite end of the trunnion, of a lever to change the position of the trunnion by its partial rotation, two piston-heads, their depending limbs, a fixed but adjustable box on each of the lower ends of these limbs, two cranks that lie in the same plane, but directly opposite each other, a crank-shaft, a fly-wheel, and a close containing-case, substantially as set forth.

8. In a vibratory steam-engine, the combination, with a trunnion having a central live-steam passage and two exhaust-passages formed in it, of a close casing that forms steam-tight bearings for the trunnion at its ends, substantially as set forth.

9. In a vibratory steam-engine, the combination, with a horizontal trunnion perforated with steam and exhaust passages, of a frame supporting the trunnion at its ends and divided on a line in the same plane with the axial center of the trunnion to permit its easy adjustment in position, substantially as set forth.

10. In a vibratory engine, the combination, with a close casing, of a trunnion, cylinders mounted thereon, an exhaust-passage leading from the cylinders, and a supplemental exhaust-passage leading from said close casing to the main exhaust-passage, for the purpose set forth.

11. In a vibratory engine, the combination, with two steam-cylinders, adapted to vibrate upon one trunnion, of a trunnion having a central steam-passage, and two exhaust-passages with outlets formed in its body to connect with a single port in the head of the cylinders, the said cylinders being mounted on the trunnion and held in contact therewith by a yielding or spring pressure.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

WILMER L. TODD.

Witnesses:
L. B. FITZSIMMONS,
H. A. MIDDLETON.