(No Model.)

2 Sheets—Sheet 1.

C. W. FOSTER.

STEAM ENGINE.

No. 418,003. Patented Dec. 24, 1889.

Fig. 2.

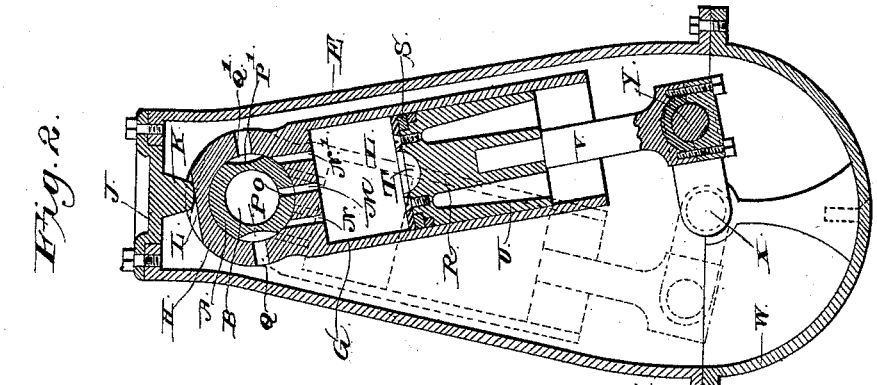
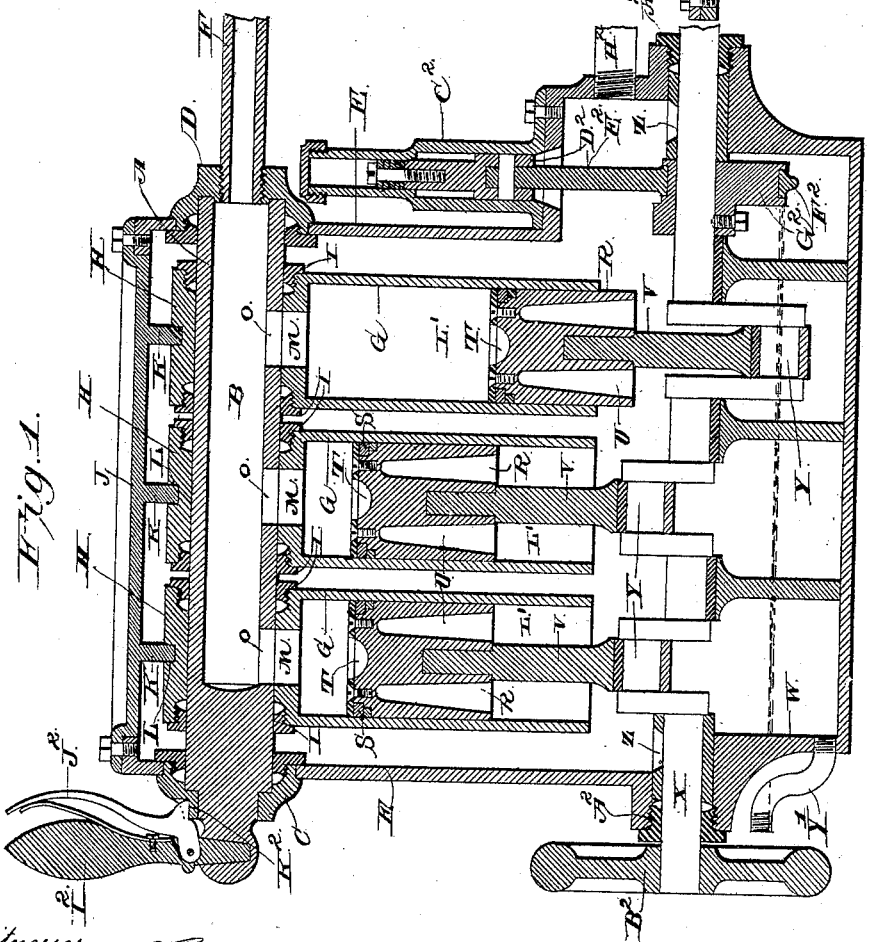


Fig. 1.



Witnesses
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Wm. Bagger.

Inventor
Charles W. Foster
By his Attorneys
A. Snow & Co

(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

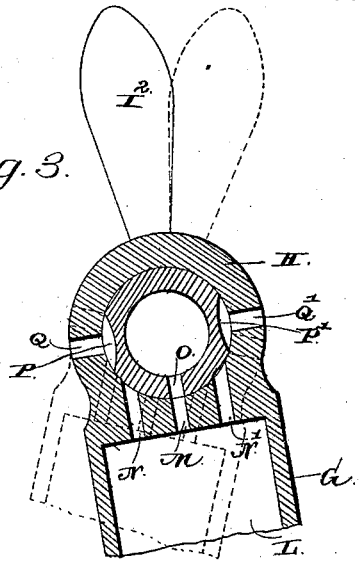


Fig. 4.

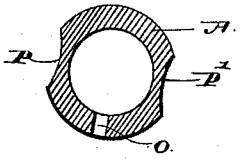


Fig. 6.

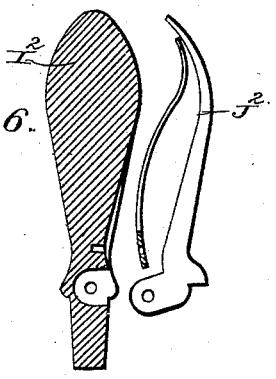
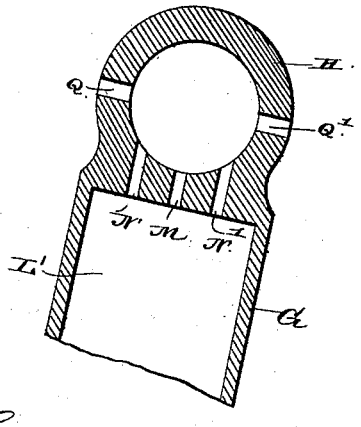


Fig. 5.



Witnesses

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UNITED STATES PATENT OFFICE.

CHARLES W. FOSTER, OF NEW HAVEN, CONNECTICUT.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 418,003, dated December 24, 1889.

Application filed May 7, 1889. Serial No. 309,855. (No model.)

To all whom it may concern:

Be it known that I, CHARLES W. FOSTER, a citizen of the United States, residing at New Haven, in the county of New Haven and State of Connecticut, have invented a new and useful Steam-Engine, of which the following is a specification.

This invention relates to steam-engines; and it has for its object to construct a single-acting engine in which the cylinders shall be hung upon and practically suspended from trunnions or pivots, so as to oscillate under the combined action of the reciprocating pistons and the cranks of the driving-shaft.

A further object of my invention is to so construct the said engine that the parts of the same shall be interchangeable, that the engine may be readily reversed, and that an engine of comparatively high power may be built occupying comparatively small space.

The invention consists in the improved construction, arrangement, and combination of parts, which will be hereinafter fully described, and particularly pointed out in the claims.

In the drawings, Figure 1 is a longitudinal vertical sectional view of a steam-engine embodying my improvements. Fig. 2 is a vertical transverse sectional view of the same. Fig. 3 is a vertical transverse sectional view taken through the upper portion of one of the cylinders and the steam-chest. Figs. 4, 5, and 6 are detail views illustrating parts of the invention.

The same letters refer to the same parts in all of the figures.

A designates the trunnion, which also constitutes the steam-chest of my improved steam-engine. Said trunnion, which is provided with a longitudinal bore B, is journaled in packing-boxes C D at the upper end of a base or casing E, which will be hereinafter more fully described. To the packing-box D, at the open end of the bore or steam-chest B, is connected the steam-pipe F, through which live steam is conveyed to the steam-chest.

G G designate the cylinders, of which in the drawings hereto annexed three have been shown. Said cylinders are provided at their upper ends with perforated heads H, by which they are hung or suspended upon the trunnion A. The transverse bore of each of the cylinder-heads is provided at each end with a packing-gland I to prevent all leakage of steam. In order to retain the cylinders in their proper respective positions upon the trunnion A, a cap J, suitably secured to the casing of the machine, is provided with downwardly-extending lugs K, working in slots L in the cylinder-heads, and thereby preventing the latter from being displaced laterally. The longitudinal bore or main chamber L′ of each of the cylinders is connected with the transverse bore in the cylinder-head by a centrally-located steam-port M and two exhaust-ports N N′, located on either side of the said steam-port. The trunnion or steam-chest A is provided with steam-ports O O, adapted to register with the steam-ports of the cylinders, and the sides of said trunnion are provided with recesses P P′, forming exhaust-passages and adapted to register with the exhaust-ports Q Q′, formed transversely in the cylinder-heads. The lower ends of the cylinders are open, as will be seen in the drawings, and in the said cylinders work the pistons R, which are provided in the usual manner with packings S, and in the inner ends of which are cup-shaped recesses or depressions T, registering with the steam-ports. The pistons are provided with annular flanges U, of considerable length, for the purpose of affording substantial guides or bearings for the piston-heads.

V V designate the piston-rods, which are connected directly with the crank-shaft without the intervention of pitmen.

W designates the base of the casing E, which is provided at its ends with boxes or bearings for the crank-shaft X, which is in the present instance provided with three cranks Y Y, formed at an angle of one hundred and twenty degrees to each other. The upper portion E of the casing is bolted tightly to the base W, so as to form a steam-tight compartment, and the said base W constitutes an oil-chamber, in which the lubricant floats upon the water of condensation. For the escape of the latter a tube Y′ is connected to the lower end of the base and curved upwardly to the proper level. The lubricant which flows on top of the water will thus be maintained at the proper level, inasmuch as the condense-water will escape through the

tube Y′ as rapidly as it is formed, only enough of it remaining in the casing to compensate for the lubricating material which is being used. The cranks Y Y are arranged to dip into the lubricant at each revolution, and are thereby amply supplied with lubricating material. The boxes or bearings for the ends of the crank-shaft X have cup-shaped lubricating-openings Z formed in their upper sides, in which lubricant is collected by the agitation caused by the crank-shafts in sufficient quantity to provide for the ample lubrication of the bearings of the crank-shafts. Packing-boxes A^2, of the ordinary well-known construction, are provided at each of the bearings of the crank-shaft X, and the latter is provided at one end with a hand-wheel B^2.

C^2 designates the pump, which is mounted upon the base or casing, and the piston of which D^2 is connected by a pivoted rod E^2, having a strap F^2, with an eccentric G^2, mounted upon the crank-shaft X within the casing and near one end of the same. An exhaust-pipe H^2, which may lead to a condenser, is connected to the casing near the lower end of the latter.

The trunnion A, which constitutes the steam-chest of the machine, is provided at its closed outer end with a hand-lever I^2, having a spring-catch J^2, adapted to engage any one of a series of recesses K^2 in the collar of the packing-box C at the end of the casing. By means of said hand-lever and spring-catch the trunnion may be adjusted to any desired position for the purpose of starting, reversing, or stopping the engine, as may be required.

The operation of my improved steam-engine will be readily understood from the foregoing description, taken in connection with the drawings hereto annexed. When the trunnion A, forming the steam-chest, is arranged in the position in Fig. 3 of the drawings, the cylinders will take steam through the ports O M and the exhaust will take place through the ports N Q and passage P. The crank-shaft will then revolve in the direction indicated by the arrow. When the position of the trunnion is reversed, the exhaust will be through the ports N′ Q′ and passage P′, and the motion will be reversed. By the operation of the crank-shaft an oscillating motion will be imparted to the cylinders, so as to cause the steam and exhaust ports to be alternately brought into alignment. The exhaust-steam escapes through the ports Q Q′ into the chamber formed by the casing E and base W, and escapes from thence through the pipe H^2 to the condenser. It will be seen that by means of the hand-lever I^2 the operation of the engine may be very conveniently and quickly governed. The trunnion A is, as has heretofore been stated, mounted pivotally in its bearings, in order that it may be conveniently reversed or adjusted to any desired position, and this may be done without conflicting with the live-steam connection at the outer end of said trunnion. The entire casing of the engine is steam-tight, and the construction is such that there will be little or no leakage or waste of steam. It will also be observed that all of the working parts are completely inclosed within the casing. They are thereby protected from injury, and partly by reason of the said casing my improved engine will be found to operate almost noiselessly. The several cylinders may be readily interchanged, and it will be observed that only comparatively a very few parts are required in the construction of my improved engine, which may be therefore manufactured at a moderate expense.

Having thus described my invention, I claim—

1. The combination, with the casing, of the trunnion mounted in packing-boxes in the same and having a longitudinal bore closed at one end and connected with a steam-supply at its other end, said trunnion being provided with steam-ports and exhaust-passages, and the cylinders having transversely-perforated heads, whereby they are mounted to oscillate upon said trunnion, and having steam and exhaust ports adapted to register with the ports and passages of the trunnion and to convey the exhaust-steam through the passages in the trunnion and the ports in the cylinder-heads direct into the surrouuding casing, substantially as set forth.

2. The combination of the trunnion closed at one end, connected with a steam-supply at the other end, and provided with steam-ports on its under side and with recesses or cavities forming exhaust-passages on its sides adjacent to said steam-ports, with the cylinders having transversely-perforated heads, whereby they are mounted to oscillate upon said trunnion, each cylinder being provided with a centrally-located steam-port and two exhaust-ports connecting its longitudinal bore with the transverse perforation in its head, and adapted to register with the steam-ports and exhaust-passages in the trunnion, substantially as set forth.

3. The combination of the casing, the trunnion mounted in packing-boxes therein and having the bore or steam-chest, the steam-port and exhaust-passages, as described, the cylinders having transversely-perforated heads, whereby they are mounted to oscillate upon said trunnion, and provided with the steam and exhaust ports, and the packing-glands mounted upon the trunnion and fitted in the ends of each cylinder-head, substantially as set forth.

4. The combination of the casing, the trunnion mounted pivotally in the same and having a longitudinal bore or steam-chest, the cylinders suspended from and arranged to oscillate upon the said trunnion, and the cap provided with downwardly-extending lugs working in transverse slots in the cylinder-heads, substantially as set forth.

5. The combination of the casing, the pack-

ing-boxes at each end of the same, the trunnion mounted pivotally in said packing-boxes and having the longitudinal bore or steam-chest, the cylinders suspended from and arranged to oscillate upon the said trunnion, the packing-boxes at the ends of the cylinder-heads, and the cap mounted upon the casing and having downwardly-extending lugs working in transverse slots in the cylinder-heads, substantially as set forth.

6. The combination of the casing, the trunnion mounted pivotally on the same and having the longitudinal bore or steam-chest and the steam-exhaust ports, and provided in its outer sides with cavities or exhaust-passages, and the cylinders suspended from and arranged to operate upon the said trunnion and having steam and exhaust ports adapted to register with the steam and exhaust ports in the said trunnion, and the exhaust-ports formed in the cylinder-heads and adapted to register with the cavities or exhaust-passages in the trunnion, substantially as herein described, and for the purpose set forth.

7. In a steam-engine of the class described, the combination of the casing, the trunnion having a longitudinal bore and mounted pivotally in packing-boxes at the ends of said casing, a live-steam pipe connected to the packing-box at the open end of the bore of said trunnion, the reversing-lever attached to the opposite end of said trunnion and having the spring-catch adapted to engage recesses in the collar of the gland or packing-box, the cylinders suspended from and arranged to oscillate upon the said trunnion and having steam and exhaust ports adapted to register with corresponding ports in the said trunnion, and exhaust-ports adapted to register with cavities in the sides of the latter, the crank-shaft journaled in the ends of the casing below and parallel to the trunnion, the pistons arranged to reciprocate in the cylinder and having rods connected directly to the crank-shaft, an exhaust-pipe connected to the exhaust-chamber formed by the casing, and an escape-pipe for condense-water connected to the lower end of the face of the casing and curved in an upward direction, substantially as and for the purpose herein shown and specified.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in presence of two witnesses.

CHAS. W. FOSTER.

Witnesses:

EARLLISS P. ARVINE,

EDWIN C. DOW.