(No Model.)

J. HILL.

ROTARY STEAM ENGINE.

No. 507,128. Patented Oct. 24, 1893.

Fig. 1.

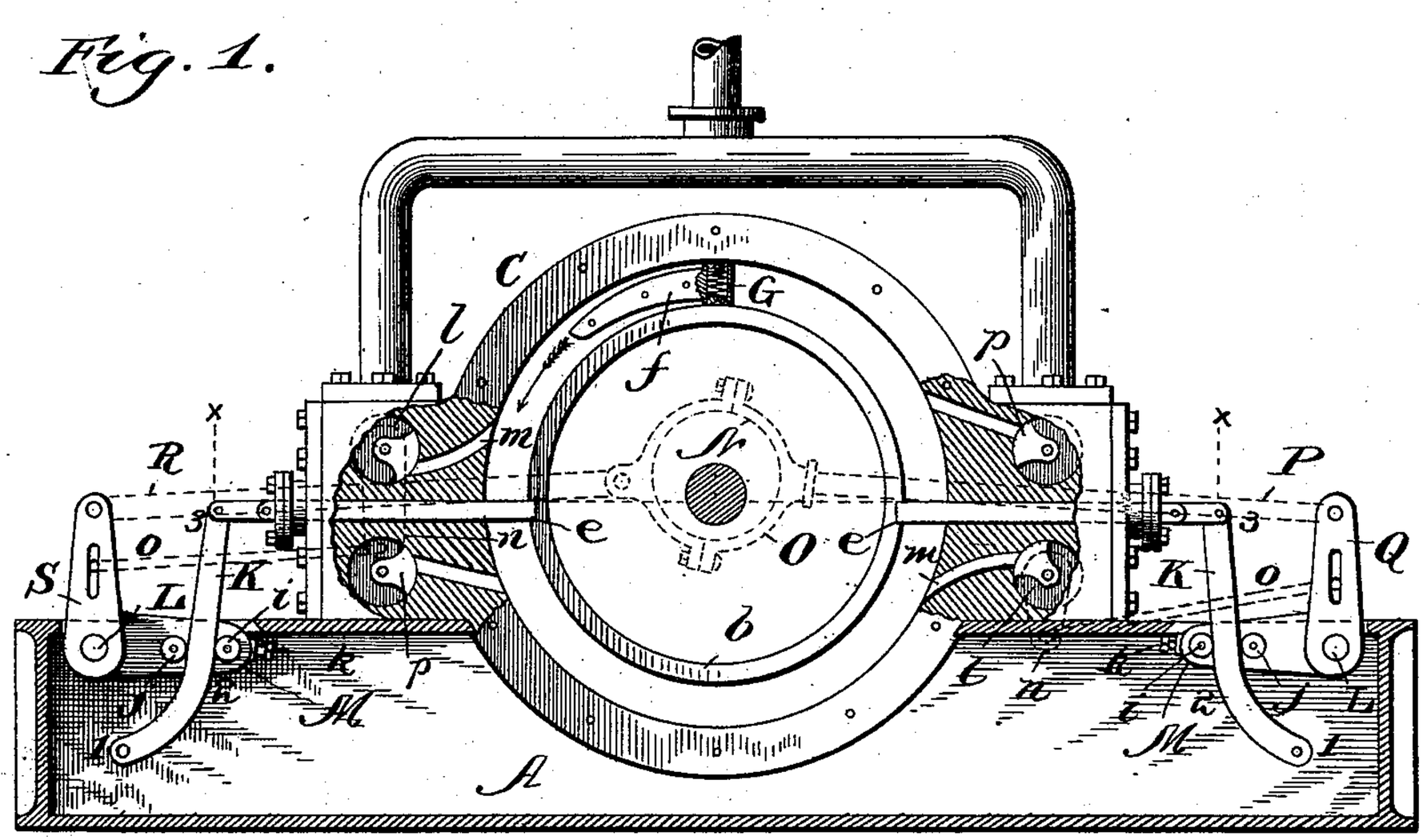


Fig. 2.

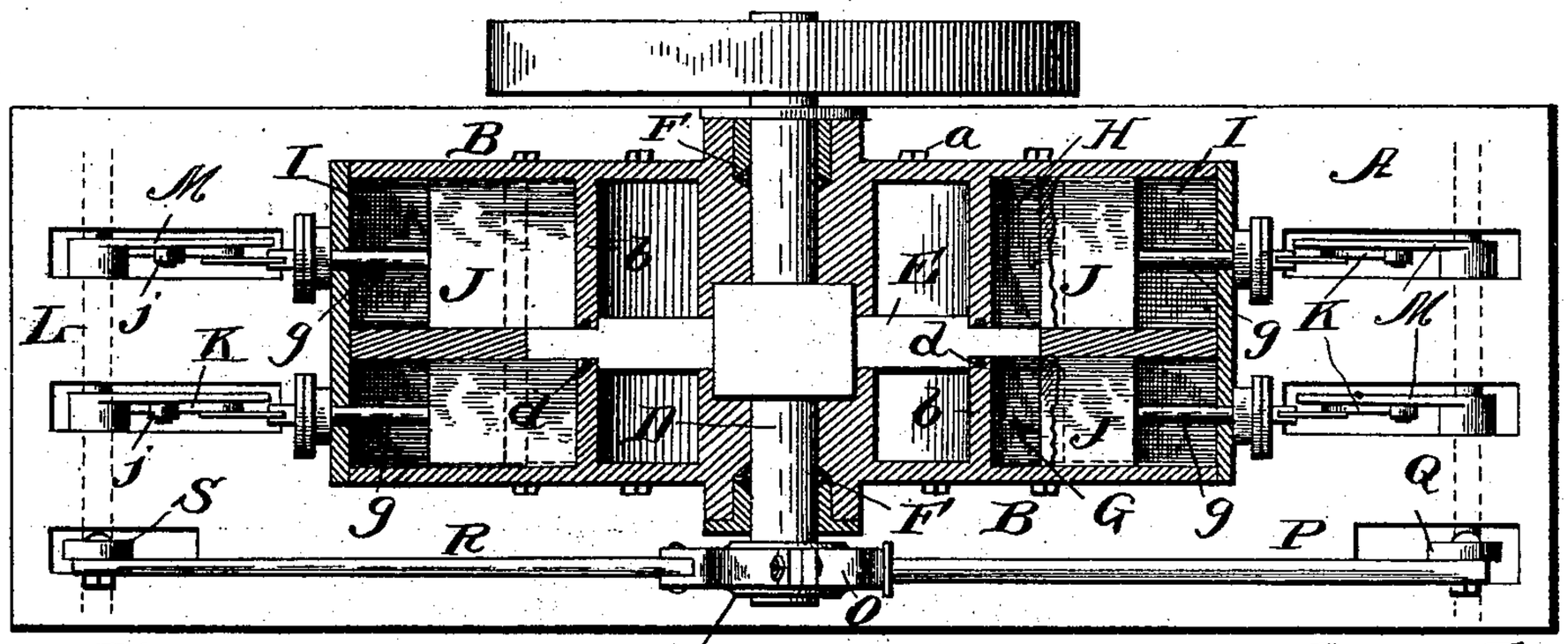
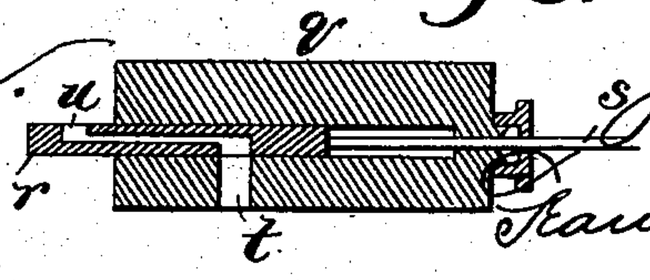


Fig. 3.



Witnesses:
J. B. McGirr.
Wm. McCarthy

Inventor:
Joseph Hill.
by
Laurence L. Dyer.
Attorney

UNITED STATES PATENT OFFICE.

JOSEPH HILL, OF WILLIAMSPORT, PENNSYLVANIA.

ROTARY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 507,128, dated October 24, 1893.

Application filed May 11, 1893. Serial No. 473,753. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH HILL, a citizen of the United States, residing at Williamsport, in the county of Lycoming and State of Pennsylvania, have invented certain new and useful Improvements in Rotary Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to various new and useful improvements in rotary steam engines, either single, compound, or triple expansion.

The objects of the invention are to provide a rotary steam engine which will possess a high efficiency and which will have but few wearing parts, both as to the piston or wings and as to the valves.

In order that my improvement may be understood, attention is directed to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a cross sectional view of the engine; Fig. 2 a cross sectional view on the line X—X of Fig. 1, showing a compound rotary steam engine built on my improved principles, and Fig. 3, a detached sectional view of one of the gate valves for the low pressure cylinder, in compound engines.

A, represents the bed plate of the engine made of cast metal in any suitable way.

B, B, are the cylinder heads of the engine. These cylinder heads are secured to the cylinder C, by means of bolts *a*, as shown in Fig. 2. Each cylinder head is provided with a circumferential ring *b*, thereon, each being of the same diameter, but the ring *b*, for the low pressure cylinder is considerably wider than the corresponding ring for the high pressure cylinder. Each cylinder head B, is also provided with an integral bearing for the shaft D of the engine which bearing may, however, be a separate element. The shaft D carries a disk E thereon, and this disk fits within the cylinder C and bears against the edges of the rings *b*. The rings *b*, are packed at *d*, to prevent leakage at the disk E.

From the construction just described, it will be understood that I have obtained steam spaces on each side of the disk E, between the cylinder C and the rings *b*, the space being greater in a low pressure cylinder than in the high pressure cylinder. When the parts are thus assembled, the two rings *b*, bearing against the disk E constitute a center core for the machine, which expression will be used hereinafter to designate those two rings. The shaft D is packed at the ends F, in the usual way.

G, is a wing or partition which is carried by the disk E, at one point of its periphery, as shown in Fig. 2. This wing G, bears against the cylinder C, the center core *b* and one of the cylinder heads B, and is to be packed at those points, in any way, to prevent leakage of steam.

H, is another wing which is secured to the disk E, and which works in the low pressure space in the same way, being packed to prevent leakage, like the wing G. For convenience I shall describe these two wings G, and H, as being secured to the disk E at parallel points, but it will be understood that these wings may be secured to the disk E, at other points, which may be necessary to prevent the formation of a dead center in the engine.

I, I, are the valve chests, which are secured at opposite points to the cylinders C, and which offer convenient supports for the engine within the bed plate A.

J, J, are gate valves arranged at diametrical points, which work in the valve chambers I, and which are adapted, at certain points in the rotation of the engine, to be forced in through the steam spaces of both the high and low pressure cylinders of the engine to form stops for the steam to work against. It will be observed from an inspection of Fig. 1 that these gate valves work in a slide in the cylinder heads B, and when forced for the full distance into the steam spaces, engage with a small recess *e*, formed in the center core. The gate valves J, are suitably packed where they touch the disk E, to prevent leakage at that point. In order that the wings G and H, which are secured to the disk E, may be suitably strengthened, I brace the same by means of a bracket or supporting arm *f*, bolted to the disk E and to said wings G, and H, as shown in Fig. 1. The gate valves J, are each provided with a stem *g*, passing through a packing box *h*, in the end of the valve chests.

K, K, are cam levers, which are pivoted within the bed plate, in line with the gate valves J, J. The construction of these cam levers K, K, will be understood by reference to Fig. 1. Each cam lever K, is, theoretically, composed of two parts, the lower part, extending from 1 to 2, being formed in the arc of a circle, and the upper part, from 2 to 3 being practically straight or of less curve than the part from 1 to 2.

L, L, are rocker shafts which are mounted in the bed plate A, on each side of the engine.

M, M, are rocker arms which are secured to the rocker shafts, and each rocker arm M, is provided with rollers *i*, *j*, thereon, engaging the cam levers K.

It will be understood, that, instead of making use of one rocker arm M, carrying the rollers *i*, and *j*, two rocker arms may be used, mounted side by side, and carrying rollers between them. One of these rollers, (the roller *i*, being designated in Fig. 1) is movably mounted with respect to the rocker arm M, and is adapted to be moved toward or away from the cam lever K, by means of a set screw *k*, so that any wear may be taken up thereon.

Upon one side of the engine is placed an eccentric N, having an eccentric strap O thereon, in the usual way.

P. is an eccentric rod, which extends from one side of the eccentric strap O, to the rocker lever Q, secured to the rocker shaft L. R, is another eccentric rod on the other side of the eccentric strap O, and which extends from the eccentric strap O to a rocker arm S, secured to the other rocker shaft L, at the left hand side of the engine. The eccentric arm P, is secured to the eccentric strap O, by a rigid connection, such as by a sleeve, as shown, so as to hold the eccentric strap O in its proper position, and the eccentric rod R, at the other side, is secured to the eccentric strap O, by a knuckle joint, as shown, to allow for the proper movement of the engine.

l, *l*, are exhaust valves mounted within the valve chests I, and adapted to open and close the exhaust ports *m*, *m*, formed within the cylinder C, as shown in Fig. 1.

The exhaust valves *l*, are illustrated in Fig. 1 as being ordinary rotary valves, but slide valves or other varieties of valves may be used.

One of the exhaust ports *m*, opens into the steam space at one side, beneath one of the gate valves J, and the other of the exhaust ports *m*, opens into the steam space above the other gate valve J. In Fig. 1, I have shown the exhaust port *m*, at the right of the engine, as opening into the steam space below the gate valve, and the exhaust port *m*, at the left, as opening into the steam space above the gate valve J, on that side.

The exhaust valves *l*, are provided with rocker arms *n*, placed outside of the valve chest, with the stem of the valve passing through an ordinary stuffing box. The connecting rods *o*, *o*, connect the ends of the rocker arms *n*, with the rocker arms Q, and S. The valve chests I, are also provided with live steam valves *p*, controlling live steam ports, which enter the steam space above the gate valves J, at one side, and below the gate valve J, at the other side, as shown in Fig. 1. I have illustrated these live steam valves *p*, as being ordinary rotary steam valves, but it is evident that any other kind of a valve may be substituted, without departing from the spirit of this invention. These live steam valves *p*, may be controlled by the movements of the rocker arms Q and S, but it is desirable that they should be controlled by the movements of another eccentric, placed at the other side of the engine, and regulated by any desirable and convenient form of governor and by means of which the amount of steam introduced into the engine will be regulated according to the speed thereof, so that the speed of the engine will be governed.

These parts of the engine that have been described are all that is necessary for a single engine, the operation of which will be readily understood. As shown in Fig. 1, the engine is practically on a dead center and will not start, since both live steam valves *p*, are closed. For convenience, let it be supposed that the engine is started in the direction of the arrow by hand, so that the wing G, will move to the left. This will cause the eccentric N, to be moved to the left, so as to carry the eccentric strap O, in the same direction. The connecting rod R, will move the rocker arm S, away from the engine, moving the connecting rod at the left of the engine accordingly. This will move the exhaust valves *l*, at that side, so as to cover the exhaust port at the left of the engine. This movement will also partially rotate the rocker shaft L, at the left, so as to elevate the rocker arm M, at that side, carrying up the rollers *i*, and *j*, against the straight portion of the cam lever K, at that side and thus opening the gate valve J, at the left of the engine, so as to allow the wing G, to pass the same. These movements of the parts at the left of the machine will also tend to keep the live steam valve *p*, at that side, over its port, covering the same. Referring to the right hand side of the engine, it will be observed that the gate valve J, at that side is closed and is resting in the recess *e*, in the center core. The movement of the eccentric strap toward the left, will move the connecting rod P, accordingly, also moving the rocker arm Q. This rocker arm Q, will actuate the connecting rod *o*, which will open the exhaust valve *l*, at the right hand side of the engine, which will carry the rocker arm M, at that side downward. The rollers, *i*, and *j*, on the said rocker arm M, will engage with the curved portion 1—2 of the cam lever K, at the right, and since the curve of that portion is equal to the path of movement of these rollers, the cam lever K, at that side will not be moved, and the gate valve J, at that side

will remain closed, and in engagement with the center core. The movements of the parts of the engine will also open the live steam valve *p*, at the right hand side, which will admit live steam in the space formed above the gate valve J, and behind the wing G. The live steam entering this space will force the wing G, around through the steam space, carrying, of course, the disk E, with it, until the wing has reached the extreme left hand position of its path of movement. At this point the parts are placed in the position just described, that is to say, upon the left hand side of the engine the gate valve J, will be opened, and the exhaust and live steam valves will be closed, and on the right hand side of the engine, the gate valve J, will be closed, and both the live and exhaust steam valves will be opened. When the wing G reaches a position diametrically opposite to that shown in Fig. 1, and as the said wing G, continues to approach the right hand side of the engine, the gate valve at that side will be gradually opened, in exactly the same manner as the gate valve J, at the left side of the engine was opened, and the live and exhaust steam valves will be closed. At the same time, the gate valve J, at the left of the engine, will be unaffected since the rollers *i*, and *j*, at that side, will work on the curved portion of the cam lever K, at that side, and the exhaust and live steam valves will be opened at that side, so that live steam will be admitted behind the wing G, into the space formed behind the wing G, and the gate valves at the left of the engine. It will be observed that as the gate valves J are moved back and forth, there will be equal pressure on each side thereof, so that the said gate valves will be balanced and there will be no wear thereon. At the moment the gate valves enter either of the recesses *e*, of the inner core, there will be a greater pressure on the side thereof on which the exhaust steam bears, but this pressure, it will be observed, will only be the difference in pressure between the live steam and the exhaust steam.

An obvious advantage of this engine for the economy of steam is this: It will be observed from Fig. 1, that the wing G, occupies a position one-fourth of a revolution from the gate valve J, at the right of the engine and that the live steam port at this side is closed. As the wing G, moves around a short distance, which we will assume is one-third of a revolution from the gate valve J at the right of the engine, the live steam valve at that side opens and allows live steam to enter the steam space behind the wing G. It is obvious that this space will be occupied by steam that has been introduced behind the wing, which is exhaust steam, so that this steam will tend to act expansively to force the wing G, in its path of movement. Therefore in this engine, it will be seen, that I use, approximately, one-third of the exhaust steam, which in other engines is allowed to escape without being converted into useful energy.

I have mentioned before that this engine is especially adapted for use as a compound or triple expansion engine, and in Fig. 2, I have illustrated, in section, a compound engine working upon the general principles of my invention just described. It will be observed from Fig. 2 that the steam space at the right of the machine in which the wing G, works is much smaller in capacity than the steam space at the left of the machine in which the wing H, works. It is obvious that the smaller space is for the high pressure steam, and the larger space is for the low pressure steam. It is also obvious that this engine is to work, like all compound engines, by utilizing the exhaust steam from the high pressure cylinder in the low pressure cylinder.

In Fig. 3, I have shown in section, a form of slide valve which is to be used for introducing the steam into the low pressure steam space. *q*, represents a valve chest in section; *r*, the gate valve working therein, and *s*, the connecting rod for this gate valve by which it is operated, either from the cam lever K, or a similar cam lever actuated from the crank shaft L. The steam inlet port *t*, communicates with the exhaust *l*, of the high pressure cylinder. The gate valve *r*, is provided with a steam port *u*, therein, substantially of the form shown, so that when the gate valve *r*, is moved out in the lower pressure steam space, and it engages with the recess *e*, in the center core, the steam port *u*, therein will be coincident with the steam port *t*, from the exhaust of the high pressure cylinder, and that exhaust will be admitted into the low pressure cylinder behind the wing H, and will actuate the same precisely in the same way that the wing G, is actuated by the live steam. The exhaust steam is to be taken out from the low pressure cylinder by any convenient arrangement of exhaust ports operated by the same exhaust valves already described.

It is obvious that the exhaust steam from the high pressure cylinder to the low pressure cylinder may be controlled by other arrangements of valves, from that shown. Such a change however, is a matter for the skill of a mechanic and not for the ingenuity of the inventor, and would not affect in any way the scope of this invention. It is also obvious that by placing the wing H, at a point, say, one fourth of a revolution ahead of or behind the wing G, that the engine would operate with equal facility and without the danger of dead centers.

What I claim is—

1. In a rotary steam engine, the combination of an outer cylinder or casing; a center core; a disk mounted within said cylinders or casing; a wing carried by said disk and rotating within the space between said cylinder or casing and said center core; gate valves J, J,

arranged diametrically within said cylinder or casing, and adapted to be moved into and out of engagement with said center core; a cam lever K, mounted adjacent to each gate valve and connected therewith; and an eccentric on the main shaft for actuating said cam levers, substantially as set forth.

2. In a rotary steam engine, the combination of an outer cylinder or casing; a center core; a disk mounted within said cylinder or casing; a wing carried by said disk and rotating within the space between said cylinder or casing and said center core, gate valves J, J, arranged diametrically within said cylinder or casing and adapted to be moved into and out of engagement with said center core; a cam lever K, mounted adjacent to each gate valve and connected therewith; the rocker shaft L mounted in the base of the engine adjacent to each cam lever K; a rocker arm M, on each rocker shaft L, and carrying rollers *i*, and *j*, engaging each cam lever K; a rocker arm, S, Q, on each of the rocker shafts L; an eccentric N, on the engine shaft; and connections from the eccentric N, to the rocker arms S, and Q, substantially as described.

3. In a rotary steam engine, the combination of an outer cylinder or casing; a center core; a disk mounted within said cylinder or casing; a wing carried by said disk and rotating within the space between said cylinder or casing and said center core; gate valves J, J, arranged diametrically within said cylinder or casing and adapted to be moved into and out of engagement with said center core; a cam lever K, mounted adjacent to each gate valve and connected therewith; the rocker shaft L, mounted in the base of the engine, adjacent to each cam lever K; a rocker arm M, on each rocker shaft L, and carrying rollers *i*, and *j*, engaging each cam lever K; a rocker arm S, Q, on each of the rocker shafts, L; an eccentric N, on the engine shaft; an exhaust valve *l* on each side of the engine; connecting rods *o*, from said exhaust valves to said rocker arms S, Q, and connecting rods P. R. from said eccentric to said rocker arms S. Q. substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOSEPH HILL.

Witnesses:
HUGH GILMORE,
JOHN O. KARICHER.