W. & T. Schnebly,

Rotary Steam Engine.

No. 5,732. Patented Aug. 24, 1848.

Fig 3.

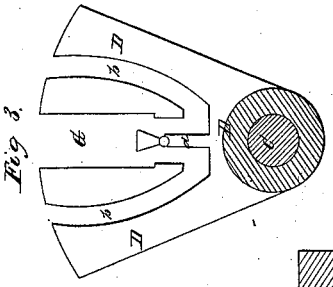


Fig 2.

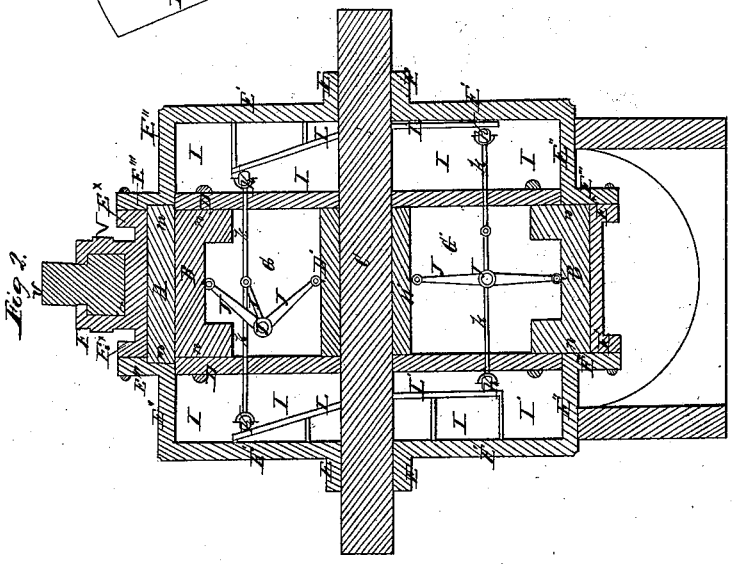
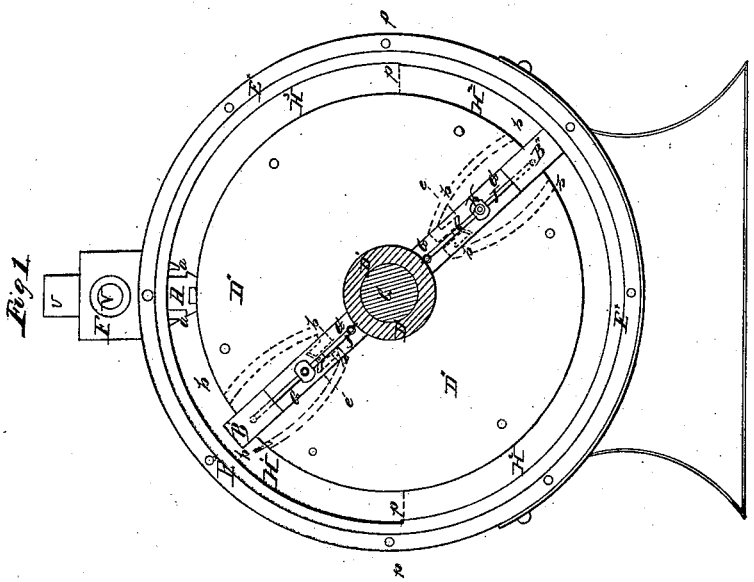


Fig 1.



UNITED STATES PATENT OFFICE.

WILLIAM SCHNEBLY AND THOMAS SCHNEBLY, OF HAGERSTOWN, MARYLAND.

ROTARY ENGINE.

Specification of Letters Patent No. 5,732, dated August 24, 1848.

To all whom it may concern:

Be it known that we, WILLIAM SCHNEBLY and THOMAS SCHNEBLY, of Hagerstown, in the county of Washington and State of Maryland, have invented certain new and useful Improvements in Rotary Steam-Engines, and we do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings, making part of this specification.

Our rotary engine consists of two radial pistons on a rotary wheel, within a permanent steam chamber, extending entirely around the piston wheel, being provided with one steam stop and a steam port on one side, and an exhaust port on the other side. The two pistons divide the circle in two equal parts and are alternately acted upon by the steam which during the action of the engine is continually issuing from the steam port.

The object of our invention, is so to improve the general principle of this engine as to overcome the practical objections heretofore found to exist in such engines.

It is important in an engine of this kind that steam shall act alternately on the two pistons, and at no one time on more than one of them. And although this has heretofore been attained, yet it has not been so effected as to have a continuous induction of the steam. As for instance, it has been effected by having the pistons work in a sectional steam chamber instead of a continuous one as employed by us, in which case the induction of steam is intermittent instead of continuous, causing a waste of steam at each induction and eduction. And where it has been effected in a continuous steam chamber to avoid the objection to the intermittent induction of steam, the steam chamber has been so formed as to cause the pistons to make friction during their entire circuit.

The first part of our invention consists in enlarging that part of the continuous steam chamber in which the pistons are not acted upon by the steam to avoid the friction which would otherwise be produced, and at the same time render available all the advantages of a continuous induction of the steam. As the pistons slide in and out in recesses formed in the steam wheel when they are being forced into the steam chamber the pressure of the steam on their outer end must as heretofore made, be overcome by the mechanism which operates them, this pressure causing much friction and wear.

The second part of our invention to avoid this, consists in making steam passes in the steam wheel leading to the inner end of the pistons, that while the pistons are being carried out, the steam from the steam chamber shall pass to and make pressure against the inner end of the piston and balance the pressure on the outer end. But as all engines must for all practical purposes be susceptible of being reversed, such passes must be established on each side of each piston, and as the steam would when so made, pass from one side of the piston to the other, the effective action of the engine would be by this means destroyed, and therefore to avoid this difficulty, this part of our invention consists in combining with these passages a valve interposed between the two to prevent the passage of the steam from one side to the other. In all engines of the class specified, in which the pistons are moved in and out by some positive motion, the mechanism which gives these motions has been so arranged that the centrifugal force of the pistons in their rotation, either make friction against the outer periphery of the steam chamber, or on the mechanism that moves them.

The last part of our invention to avoid this defect consists in connecting the pistons with the shaft or hub of the steam wheel by means of toggle joint levers of such length that when the pistons are entirely protruded, the toggle levers shall be drawn out to their full length, and thus hold the pistons within the determined diameter, and to resist the centrifugal force the said toggles being operated by connecting rods extended out against appropriate cams which give the required motion.

To understand the following, please refer to the drawings annexed, where Figure 1, shows an end or longitudinal elevation, and Fig. 2, a transverse section. Fig. 3, being a section of the piston wheel showing steam passages in the same.

A, represents the steam abutment between which and the piston the steam acts—B′ B″ the pistons—C the shaft to which the piston wheel D″ D″ Fig. 1, is keyed. D′ D′ the piston wheel hub being the only part of the wheel seen in Fig. 2. D, D′ the disks or side plates of the piston wheel which are

fastened to it by bolts or screws (seen only in Fig. 2).

D″ D″ in Fig. 1 shows the piston wheel with the side plate D removed so as to expose the pistons B′, B″, and the piston chambers G, G, and toggle joints I, I, colored red on the drawing.

K, K, are friction rollers on the ends of the guide rods *k*, *k*, in Fig. 2. These rollers are seen in Fig. 1, as if in the piston chamber, but they are not: the line in which they are viewed, causes this appearance.

E×, E×, is the stationary cylinder or outer case of the engine.

E‴, E″, E′, E Fig. 2 represent different portions of the caps or end plates which close the ends of the cylinder E×. E‴ being the flanch of the cap through which bolts pass to fasten the cap to the cylinder. E″, E″ being the cylindrical part of the cap, and E′, E′, the disk; and E, E, the stuffing box on the outside of the same through which the shaft C passes, and in which it revolves. F, the steam chest, on the top of the stationary stem cylinder V, the four way cock Figs. 1 and 2.

G, G, represents the piston chambers, H H seen only in Fig. 1, shows the steam chamber between the face or periphery of the piston wheel and the stationary cylinder.

I I I I Fig. 2. represents the hollow space within the cap or end plates between the disk of the piston wheel and the disk of the cap. J. J. the toggle joints.

L. L. are rail or guide ways on the inside face of the disk portion of the cap or head plate, situated in the space I. I. I. I. These rail ways give direction to the guide rods *k*, *k*, and through them either bend or straighten the toggle joints which actuate the pistons.

a. *a*. Fig. 1. are steam passages from the steam chest either of which may be used as an induction or eduction way.

b. *b*. Figs. 1 and 3 are passages from the piston chamber under the pistons to the steam chamber above them for the purpose of admitting steam to the under ends of the pistons to equalize the pressure during the protrusion of the pistons.

C. C. is a valve between the right and left passages, leading from the under ends of the pistons in the piston chambers to the steam chamber above, which prevents the steam from passing to the exhaust side of the piston, after it passes the horizontal line *p*. *p*.

k, *k*, are the guide rods.

m, *m*, Fig. 2, shows the width of the steam abutment and also the width of the steam chamber above the horizontal line *p*. *p*. in Fig. 1, where the pistons are not acted upon by the steam.

n, *n*, with the dotted line between, represented on the pistons B. B. in Fig. 2. shows the width of the piston, which is exactly the width of the steam chamber below the horizontal line *p*. *p*. The difference between the width of the steam abutment and the width of the piston as contrasted at *m*. *m*. *n*. *n*. Fig. 2. shows the difference between the size of the steam chamber above and below the horizontal line *p*. *p*.

Before describing the above features, it is necessary that we should specify certain modifications in the arrangement and forms of the stationary cylinder and piston wheel which are important to the success of our improvements above mentioned.

Construction of the stationary cylinder.— The stationary cylinder is formed in the ordinary way with a flanch on each end for the attachment of the end plates. The end plates, instead of being simple disks or flat surfaces, are hollow caps, each having a flanch to match the flanch of the cylinder. In the drawing Fig. 2, these caps are alluded to as consisting of three parts—1st, of a disk or end E′ E′; 2nd, a cylindrical part or rim E″ E″, and 3rd, a flanch E‴ E‴. In the model and drawings the caps are represented as having the flanch and cylindrical portions in one piece—the disk being separate, but fastened together by bolts. It is manifest that the whole may be cast in one piece.

Construction of the piston wheel.—The piston wheel is of simple construction, being solid from the center to the circumference, or made of a hub and rim connected by arms, or a disk, or leaves of any convenient shape and size; piston chambers being formed within the wheel for the reception of the pistons. We make the width of the wheel at its periphery exactly equal to the width of the steam chamber below the horizontal line. The pistons are of the same width as the wheel and the piston chambers are of the same width as the pistons, consequently the piston chambers cut clean through the wheel from one side to the other. The open ends of the piston chambers are closed by the disks D D Fig. 2, one being on each side of the wheel which when bolted to it, form part of the wheel. The diameter of the disk, and the diameter of the wheel are alike. Each disk is packed on its periphery (the packing being regulated by adjusting screws) which revolves steam tight against the inner surface of the cylindrical portion of the end plate or cap E″ E″ Fig. 2.

Having thus shown the points wherein our piston wheel and cylinder differ from those of similar design, we proceed to describe our improvement in the steam chamber. This consists of a semi-annular channel sunk in the inner face of each flanch of the caps which form the sides of the steam chamber as seen at *m*. *m* on the abutment A. Fig. 2. By this device, the upper half of the

steam chamber is rendered wider than the lower half in which the pistons work steam tight. As the piston on the exhaust side of the steam chamber leaves the horizontal line *p*. *p*. Fig. 1, and commences being withdrawn, it evidently need not be in contact on its sides with the sides of the steam chamber. (Note. The enlarged sides of the steam chamber can not be represented fully in a drawing, and are therefore not seen on Fig. 1, and only partially at *m*. *m*. at the abutment A Fig. 2.) It is likewise evident that the piston after passing the abutment and beginning to protrude, needs not to be in contact on its sides with the sides of the steam chamber until it reaches the line where it becomes horizontal. By enlarging the chamber as above described, we prevent a large amount of friction and consequent loss of power.

We proceed now to describe our method of equalizing or balancing the pressure of steam on the ends of the pistons, taking the protruding piston B′ Fig. 1. as an illustration, which is seen on the drawing as having passed the stop or steam abutment, and is moving toward the line *p*. observing by the way that the pressure of steam being equal in all directions, must operate as a retarding force against the end protruding into the steam chamber unless it is likewise admitted to the opposite end which is concealed within the recess of the rotary cylinder, in which it slides in and out. Steam has indeed been admitted into the piston chamber to operate against the inclosed end of tne piston, for the purpose of forcing it out when the steam has been exhausted from the steam chamber at the opposite end. Between this device and ours, there is, therefore no analogy.

Fig. 3, represents a section of a portion of the piston wheel D″ sliced vertically from the periphery to the shaft so as to expose the steam passages *b*, *b*, Figs. 1 and 3 one on the right, and the other on the left of the piston, leading from the under side of the pistons B′, B″, in the piston chambers G′, G, Fig. 2, to the steam chamber H Fig. 1. The partition D Fig. 3, separates the passages so as to allow the valve C Figs. 1 and 3 to close that passage which is on the exhaust side of the piston, after having passed the horizontal line *p*, Fig. 1. The valve *c* is located on the top of the partition *d*, and hinged in a manner familiar to machinists. In passing from the abutment to the horizontal, the steam being equal in both passages *b*, *b*, it is evident that the valve *c* will not close either of them, but on the piston B′ Fig. 1, reaching the horizontal line *p*, *p*. Fig. 1, steam will be exhausted from the passage on the under or exhaust side of the piston, and consequently the valve *c* will be pressed over so as to close that passage and thus prevent the escape of steam. When the piston B″, Fig. 1, has reached the horizontal line *p*, *p*, on the exhaust side of the steam chamber H^3, it is manifest that the steam from the passages *b*, *b*, will exhaust simultaneously with the steam from the chamber H^2, H^2, below the horizontal line.

Toggle-joint movement of the pistons.— Before describing this, let us direct attention to the spaces within the hollow caps or end plates designated on Fig. 2, by the letters I I I I. Within these spaces and against the inner faces of the disk portion of the caps are formed guide or rail ways L L L L Fig. 2; pressing against which are the rollers K, K, on the ends of the guide rods *k*, *k*, *k*, *k*, by the lateral motion of which guide rods, the toggle joints J, J, are brought into a straight line as at B″ or changed from a straight into a bent line J, J, J, as in B′, and by which the pistons are either advanced or withdrawn. Each guide or rail way is a circular track formed of two planes, the lower of which L′ L′ stands perpendicular, while the upper L L is inclined at an angle of several degrees from the perpendicular. The variation in the rail ways from the perpendicular to the inclined plane has reference not only to the movement of the pistons, but also to the periods of their motion in reference to the steam pressure upon them. The perpendicular planes L^1 L^1 being of such depth as to cause each piston to be fully extended just before leaving the enlarged space H Fig. 1; of the steam chamber, and kept fully extended during its entire movement through the contracted portion of the same H^2, H^2, and until it passes out therefrom above the horizontal line *p*, *p*, into the exhaust portion H^3, when the steam pressure being removed from the piston the guide rod *k*, *k*, simultaneously enters upon the inclined plane L L and commences contracting the toggle joint J, J, J, which withdraws the piston B′. The toggle or knee joint is constructed in the usual manner; each piston being operated by one which is located in the center of the piston chamber G, directly underneath the piston as seen in both Figs. 1 and 2. The toggle-joint in the lower chamber G^1, shows the piston B″ advanced and occupying the steam chamber H^2 H^2 below the horizontal line as seen in Fig. 1, the toggle joint J′ J′ being fully extended and consequently held between the perpendicular planes L′ L′ Fig. 2 of the rail ways.

The toggle-joint J J J Fig. 2, in the upper piston chamber G, shows the piston B′ withdrawn, and just underneath the abutment A, which stands across the upper or enlarged portion of the steam chamber as seen at *m*, *m*, Fig. 2, the toggle-joint J, J, J, being entirely contracted and consequently held between the inclined planes L L Fig. 2. One end of each toggle joint as seen in

Fig. 2, is attached to the under side of the pistons by means of bolts passing through holes in the ends of the toggle joints and stationary studs or eyes fast to the pistons. The opposite end of each toggle joint is attached by similar fixtures to the bottom of the piston chamber. A connecting piece $J^{\times}$ shown in the upper piston chamber G in Fig. 2, is attached by suitable means, one end to the knee of the toggle joint, and the other end to the guide rod *k*, *k*, (Fig. 2). This guide rod *k*, *k*, completes the toggle joint arrangement. The guide rod extends completely across the piston chamber as seen in Fig. 2, passing through the disks D, D, of the piston wheel just below the pistons B′ B″ nearly midway between the top and bottom of the piston chamber G, G′, the holes through which they pass being properly packed to prevent the escape of steam. The guide rods are armed at each end with friction rollers which are in contact with the rail ways L L′ L L′ Fig. 2.

From this description it is seen that the motion of the guide rods is lateral and at right angles with the motion of the pistons.

What we claim and desire to secure by Letters Patent, is,

1. The enlarging of the sides of the steam chamber from the point where the pistons begin to be drawn in, to the point where they are entirely protruded, to avoid friction in that part of the circuit of the pistons in which they are not acted upon by the steam substantially as herein described, in combination with a steam chamber which entirely surrounds the piston wheel, whereby the steam from the steam post acts alternately on the two pistons, and in a portion of the circuit passes by the piston that has not yet been entirely protruded to act on the one that is protruded and which is within that half of the chamber which is not enlarged.

2. The method of overcoming or balancing the pressure of steam on the outer ends of the piston while being forced in and out by means of steam ways leading from the steam chamber on each side of the pistons to the inner ends of the pistons, that the steam from the steam chamber may have access thereto, in combination with a valve placed between the two to prevent the steam from passing around from the steam chamber to the exhaust chamber substantially as described.

3. We claim connecting the movable pistons with the shaft or hub of the steam wheel by means of toggle joint levers substantially as herein described in combination with the connecting rods and cams substantially as described, whereby the pistons when forced out are held by the toggle joints, and are thereby prevented from making friction against the periphery of the steam chamber by centrifugal force as described.

WM. SCHNEBLY.
THOMAS SCHNEBLY.

Witnesses to the signature of W. Schnebly:
A. P. Browne,
E. A. Peters.

Witnesses to the signature of T. Schnebly:
S. W. Conn,
Adam Bohn.