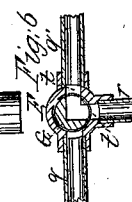
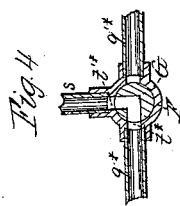
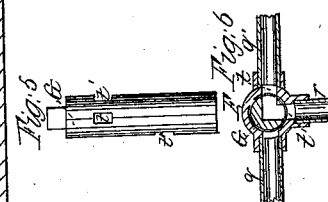
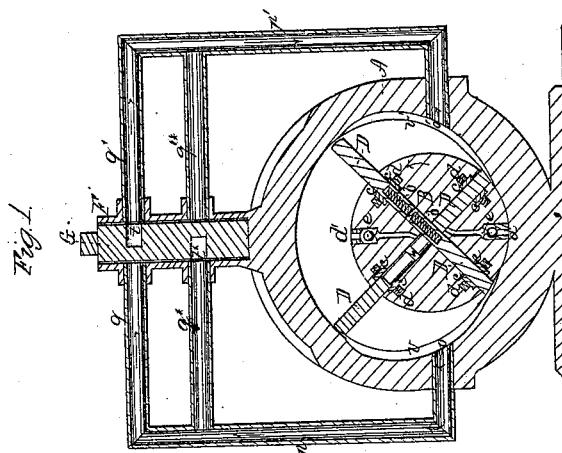
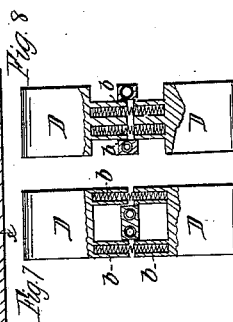
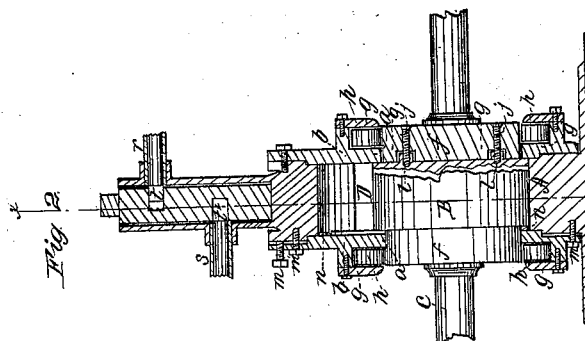
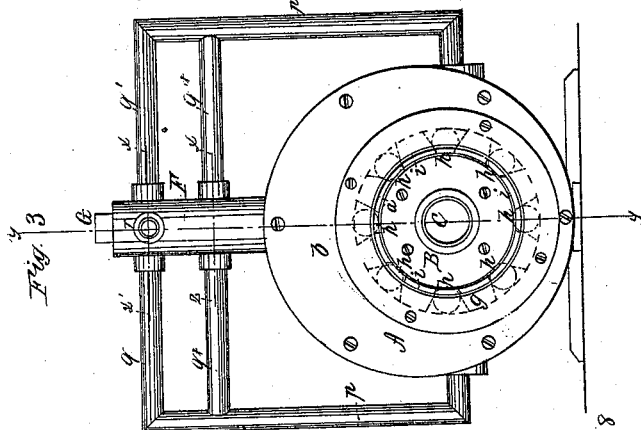


Hall & Bugbee,
Rotary Steam Engine.
No 55,092. Patented May 29, 1866.



Witnesses
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UNITED STATES PATENT OFFICE.

SAML. G. HALL AND GEO. W. BUGBEE, OF NORWICH, CONNECTICUT.

IMPROVEMENT IN ROTARY STEAM-ENGINES.

Specification forming part of Letters Patent No. **55,092**, dated May 29, 1866; antedated May 21, 1866.

To all whom it may concern:

Be it known that we, SAMUEL G. HALL and GEORGE W. BUGBEE, of Norwich, in the county of New London and State of Connecticut, have invented a new and Improved Rotary Engine; and we do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 represents a transverse vertical section of this invention, taken in the plane indicated by the line *x x*, Fig. 2. Fig. 2 is a longitudinal vertical section of the same, the line *y y*, Fig. 3, indicating the plane of section. Fig. 3 is a front elevation of the same. Fig. 4 is a transverse section of the valve and its seat detached, the plane of section being indicated by the line *z z*, Fig. 3. Fig. 5 is a side elevation of the same. Fig. 6 is a transverse section of the same in the plane *x' x'*, Fig. 3. Figs. 7 and 8 are sectional face views of the slides or valves detached from the piston-wheel.

Similar letters of reference indicate like parts.

This invention relates to a rotary engine or pump of that class in which a piston-wheel with four (more or less) slides is placed eccentrically into a stationary cylinder which is generally bored out eccentrically.

The improvements which form the subject-matter of this invention consist, first, in the arrangement of one or more automatically-acting steam-valves in the body of the piston-wheel, in combination with the slides, in such a manner that by the steam admitted to the interior of the cylinder a pressure is exerted on the inner ends of said slides, and thereby the pressure of the steam on the outer ends of the slides is counterbalanced; second, in combining with the piston-wheel a series of friction rollers and blocks held in position by annular grooves in the cylinder-heads in such a manner that the friction created by the piston-wheel is reduced to its minimum and an engine is obtained which works with the least possible loss of power from that source; third, in the arrangement of annular grooves in the heads of the piston-wheel to receive corresponding projections rising from the sides of the

quarters of said piston-wheel in such a manner that by said annular grooves the quarters are securely held in position and the screws which serve to fasten said heads to the quarters are relieved of a great portion of the strain to which they would otherwise be exposed; fourth, the combination, with one of the cylinder-heads, of a thin layer of Babbitt's metal or other suitable composition, which is applied by casting it into the cylinder and rendered steam-tight by swaging, in such a manner that said head can be moved slightly in and out without allowing the steam to escape, and that it can be set up close to the end of the piston-wheel and to the edge of the slides by a double set of screws, one set being applied to draw the head up and the other to force the same off from the flanges of the cylinder, and if the piston-wheel or slide wear out the fault can be readily corrected; fifth, in a double set of pipes extending from opposite sides of the cylinder up and branching off in two arms each, which terminate in a chamber or seat turned out to take a plug-valve with two sets of openings, one set to correspond to the upper branches and one to the lower branches of the pipes leading from the cylinder, in such a manner that by turning the valve either of the branches can be made to perform the functions of steam supply and exhaust pipe, and the motion of the engine thereby reversed with ease and facility.

A represents the cylinder, which is bored out eccentrically, as clearly shown in the drawings. The piston-wheel B is mounted on a shaft, C, which passes freely through openings *a* in the cylinder-heads *b*, and these openings are eccentric with the centers of said heads, so that the piston-wheel touches the inner circumference of the cylinder at the bottom part thereof, leaving a crescent-shaped space between its outer circumference and the inner circumference of the cylinder. The bottom part of the inner surface of the cylinder, and also its top part, form segments of circles described from the center of the piston-wheel, and thereby a good bearing is provided for said piston-wheel at the bottom, causing the same to pack itself, and at the same time the slides D, which pass transversely through the piston-wheel, and which are intended to be

constantly in contact with the inner circumference of the cylinder, are not moved in or out while being exposed to the pressure of steam.

Said slides are forced apart by springs *b'* bearing on their inner edges, and their sides are packed by strips *c*, which are let into cavities in the body of the piston-wheel, and which are held in steam-tight contact with the surfaces of said slides by springs *d* bearing on their inner sides, as clearly shown in Fig. 1 of the drawings.

In order to balance the pressure of the steam on the ends of the slides steam is admitted to the interior of the piston-wheel through holes *d'*, which are closed and opened by ball-valves *e*. These valves operate automatically as the piston-wheel revolves, and require no further attention.

The piston-wheel is provided with two heads, *f*, which are somewhat smaller than the body of the same, and which extend through the openings *a* in the cylinder-heads, said openings being intended to form guides for the piston-wheel.

In order to reduce the friction between the heads *f* and their bearings the cylinder-heads are provided with annular cavities *g* around the openings *a*, and these cavities are filled with a series of friction-rollers, *h*, and intervening blocks *i*, as shown particularly in Fig. 3. Said friction-rollers project beyond the edges of the openings *a*, and form the bearings for the heads *f*, the blocks *i* being interposed simply to keep the rollers apart. The heads *f* also serve to keep together the four parts or quadrants which constitute the piston-wheel, and between which the slides are fitted.

Screws *j* hold the heads in position, and in order to reduce the strain on these screws and prevent the quadrants from getting displaced an annular groove, *g'*, is turned in each of the heads *f*, and these grooves are made to fit corresponding projections *l*, rising from the quadrants of the piston-wheel.

The quadrants of the piston-wheel are made precisely of the same width as the slides *D*, and they project beyond the heads *f* sufficiently to make bearing-surfaces, which work against the inner sides of the cylinder-heads *b*. One of these heads is screwed up tight against the flange of the cylinder, but the other head is adjustable by means of a double set of screws, *m m'*, one set being used to draw the head in and the other to push it out. By this arrangement the piston-wheel and slides can be made to work steam-tight against the inner surfaces of the cylinder-head, and if the parts wear out the movable head can be readily readjusted; but in order to prevent leakage of steam, it is indispensable that the cylinder-head shall be made to fit steam-tight into the cylinder. This object, which would be very easily effected if the cylinder was bored out in a regular shape, is effected by casting on the cylinder-head, while the same is in its place, a thin layer, *n*, of Babbitt's metal or other suitable

material. This layer is swaged or otherwise worked round the corner, so as to produce a steam-tight joint and allow of moving the cylinder-head a short distance in or out without permitting the steam to escape.

The cylinder *A* is provided with two holes, *o o'*, in its circumference, on opposite sides of the piston-wheel, as shown in Figs. 1 and 3. From these holes emanate pipes *p p'*, each of which divides in two branches, *q q** *q' q'**, which extend from the main branches to the chamber *F*, the branches *q q'* being on a level with the supply-pipe *r*, and the branches *q* q'** on a level with the exhaust-pipe *s*, both the steam-pipe and the exhaust-pipe passing through the side of said valve-chamber. This chamber is bored out to form the seat for the plug-valve *G*, which is provided with two sets of ports or openings, *t t' t* t'**, one set being on a level with the steam-pipe *r* and the other with the exhaust-pipe *s*. If the valve is turned to such a position that the opening *t'* registers with the branch pipe *q'*, the aperture *t* will register with the steam-pipe *r*, the aperture *t** with the branch pipe *q**, and the aperture *t'** with the exhaust-pipe *s*, and consequently steam will be admitted to the cylinder through the pipe *p'*, and exhaust through the pipe *p*, the branch pipes *q* and *q** being closed, and the piston-wheel turns in the direction of the arrow marked on it in Fig. 1. By reversing the valve the motion of the engine can be reversed at any moment, and in this case the branch pipe *q* will be in communication with the steam-pipe, the branch pipe *q'** with the exhaust-pipe, and the pipes *q* q' q'* will be closed.

From the ports *o o'* in the cylinder extend cavities *v v'* in either direction to the circular parts of the cylinder, allowing the steam which passes in through either of said ports to pass around the edge of the slide. The steam, therefore, will not begin to act on the piston-wheel until one of the slides has passed the cavity and entered the circular part of the cylinder above the piston-wheel, and it will begin to exhaust as soon as the slide leaves this circular segment. While being exposed to the pressure of the steam the slide will not move in or out, and all loss of power from that source is avoided.

It is obvious that this engine can be used for a rotary pump as well as for a steam-engine. Its operation is simple. It works with comparatively little friction, and it is not liable to get out order.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. The valves *e* in the body of the piston-wheel *B*, in combination with the slides *D*, substantially as and for the purpose specified.

2. The friction-rollers *h* and intervening blocks *i*, in combination with the heads *f* of the piston-wheel, and with annular grooves *g* in the cylinder-head, constructed and operating substantially as and for the purpose set forth.

3. The annular grooves g' in the heads f of the piston-wheel, in combination with corresponding projections l , rising from the quadrants composing said piston-wheel, substantially as and for the purpose described.

4. The thin layer of Babbitt's metal, or other suitable material, fitting steam-tight into the end of the cylinder, in combination with one of the cylinder-heads and with adjusting-screws m m' , substantially as and for the purpose specified.

5. The pipes p p' , with branches q q^* q' q'^* , in combination with the openings t t' t^* t'^* in the valve G , and with the valve-chamber F and steam and exhaust pipes r s , substantially as and for the purpose set forth.

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GEO. W. BUGBEE.

Witnesses:

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