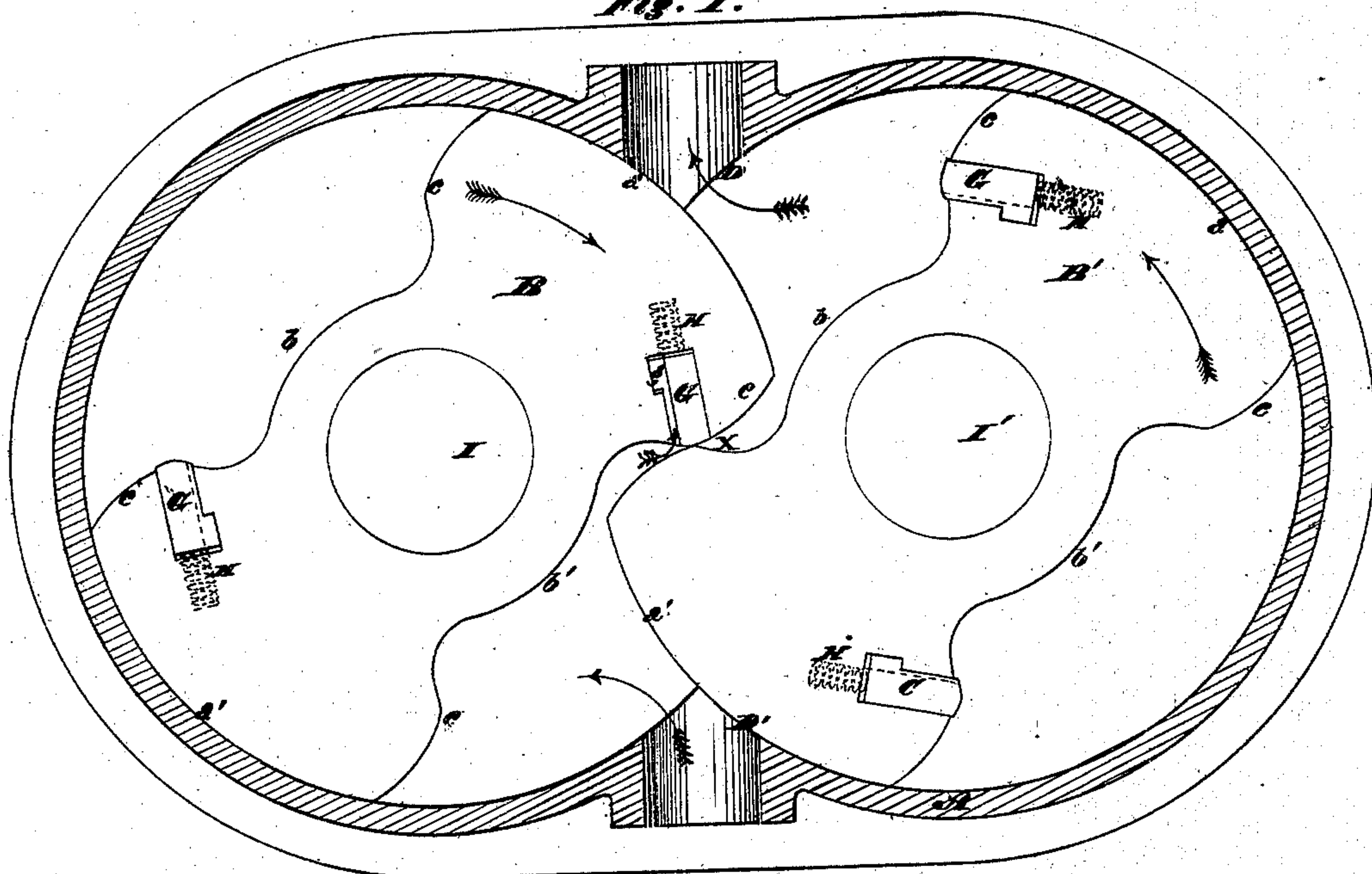
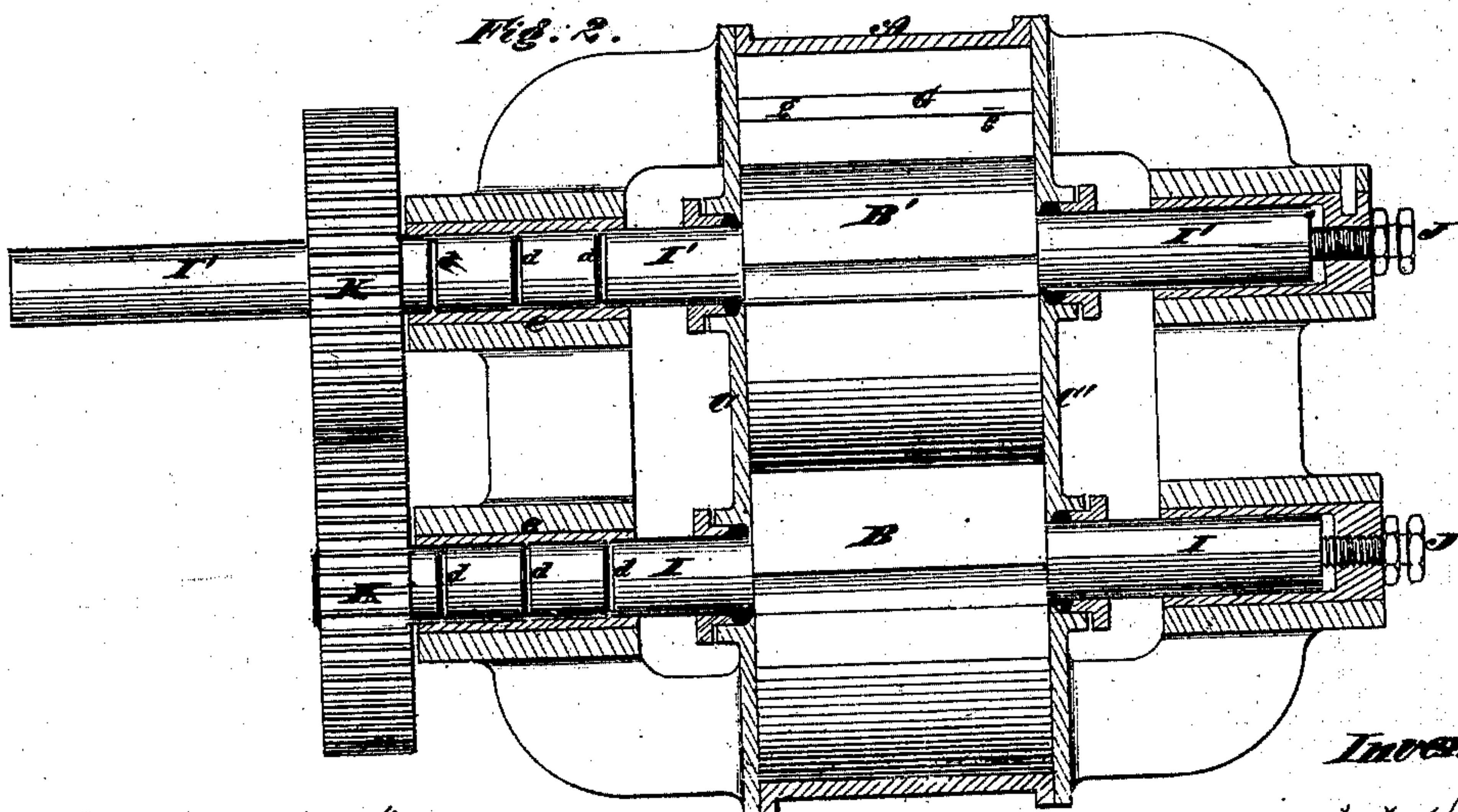


*Hardy & Morris,*  
*Rotary Pump,*  
*No 60,366,* *Patented Dec. 11, 1866.*

*Fig. 1.*



*Fig. 2.*



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*D. D. Hardy*  
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*By Knight, atty.*



# United States Patent Office.

## IMPROVEMENT IN ROTARY PUMPS AND ENGINES.

D. D. HARDY AND J. J. MORRIS, OF CINCINNATI, OHIO.

*Letters Patent No. 60,366, dated December 11, 1866.*

The Schedule referred to in these Letters Patent and making part of the same.

### TO ALL WHOM IT MAY CONCERN:

Be it known that we, DEXTER D. HARDY and JOHN J. MORRIS, both of Cincinnati, Hamilton county, State of Ohio, have invented certain new and useful Improvements in Rotary Engines and Pumps; and we do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, making part of this specification.

Our invention consists in the employment in a double cylinder, having inner tongues or projections, (as patented in combination by us, March 5, 1861,) of rotary pistons, formed by arcs of circles of different diameters, connected by epicycloid or other suitable curves, the epicycloid faces being supplied with elastic gibs.

Our invention further consists in the employment of set screws, to prevent the lateral play and wear of the pistons.

In the accompanying drawings—

Figure 1 is a cross section of a rotary engine or pump, embodying our invention.

Figure 2 is a sectional plan of the same.

A is the case or cylinder, having the inner projections D D', as fully described and patented by us in combination, with a peculiar shaped piston, bearing date March 5, 1861. B B' are the rotary pistons, formed, as shown, by arcs of circles,  $a a'$  and  $b b'$ , of different diameters, connected by epicycloid or other suitable curves  $c$ . The pistons B B' are turned to fit accurately the diameter of the cylinder and length between the heads C C', and are adapted to make a joint between each other on line X, by the close contact of the large and small arcs  $a b$ . In operation as an engine the line X remains tight, by reason of the pistons necessarily revolving at that point in the opposite direction to the inward current of steam, and steam cannot escape past the arcs  $a a'$ , in consequence of its partial condensation causing it to water pack in passing through such an extended surface. In operation as a pump no leakage of consequence can occur, and as the surfaces barely touch, there is no perceptible friction or wear. As it is practically impossible to make the epicycloid faces  $c$  make a joint without danger of striking hard in rotation, we provide these faces with elastic gibs G, slotted at  $g$ , to allow the water or steam pressure to balance. The gibs G have springs H fitted behind them, to give the necessary elasticity.

We have found by experience that when the shafts I I' are not confined laterally in their journals, the steam or water pressure will force the pistons B B' hard up against one or other of the heads C C', thereby causing an immense amount of friction and considerable wear. To prevent this lateral play we provide the frame of the machine, or shaft bearings, with "set-screws" J, against which the ends of both shafts are made to revolve and keep in place. In the accompanying drawing the set-screws J are shown but to one end of the machine, and a modification of the same is shown at the opposite end, consisting of turned V's in the shafts at  $d$ , and corresponding "babbited boxes"  $e$ , the "babbit metal" fitting the V's of the shafts and preventing lateral play.

We do not desire to confine ourselves to the use of two arcs,  $a a'$  or  $b b'$ , to each piston B B'. A greater or less number of arcs and epicycloids may be used at will, but preference has been given by us to the form as shown. The gear wheels K connect the shafts I I' together, and preserve the pistons B B' in the same relative position.

We claim as new herein, and of our invention—

1. Constructing the rotary pistons, B B', of arcs of circles  $a a' b b'$ , of different diameters, connected by epicycloid faces  $c$ , in the described combination with the elastic gibs G, as and for the purpose specified.

2. We claim, as arranged with the above combination, the "set-screws" J, for preventing lateral play of the shafts and pistons, as set forth.

In testimony of which invention we hereunto set our hand.

DEXTER D. HARDY,  
JOHN J. MORRIS.

Witnesses:

CHAS. H. FISK,  
W. D. DALTON.