4 Sheets—Sheet 1.

P. BROTHERHOOD.

Triple Cylinder Steam-Engine.

No. 196,070. **Patented Oct. 16, 1877.**

Fig. 1.

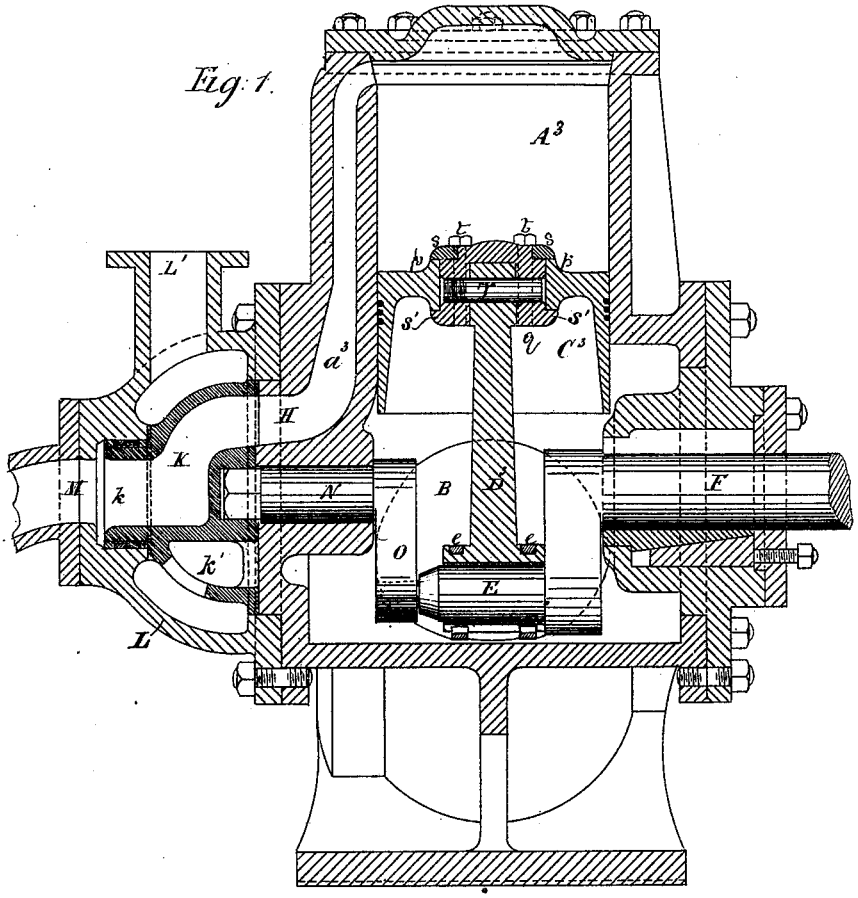

Fig. 3.

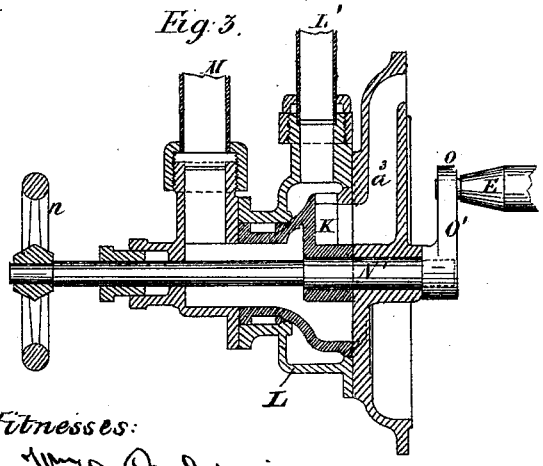

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Fig. 2.

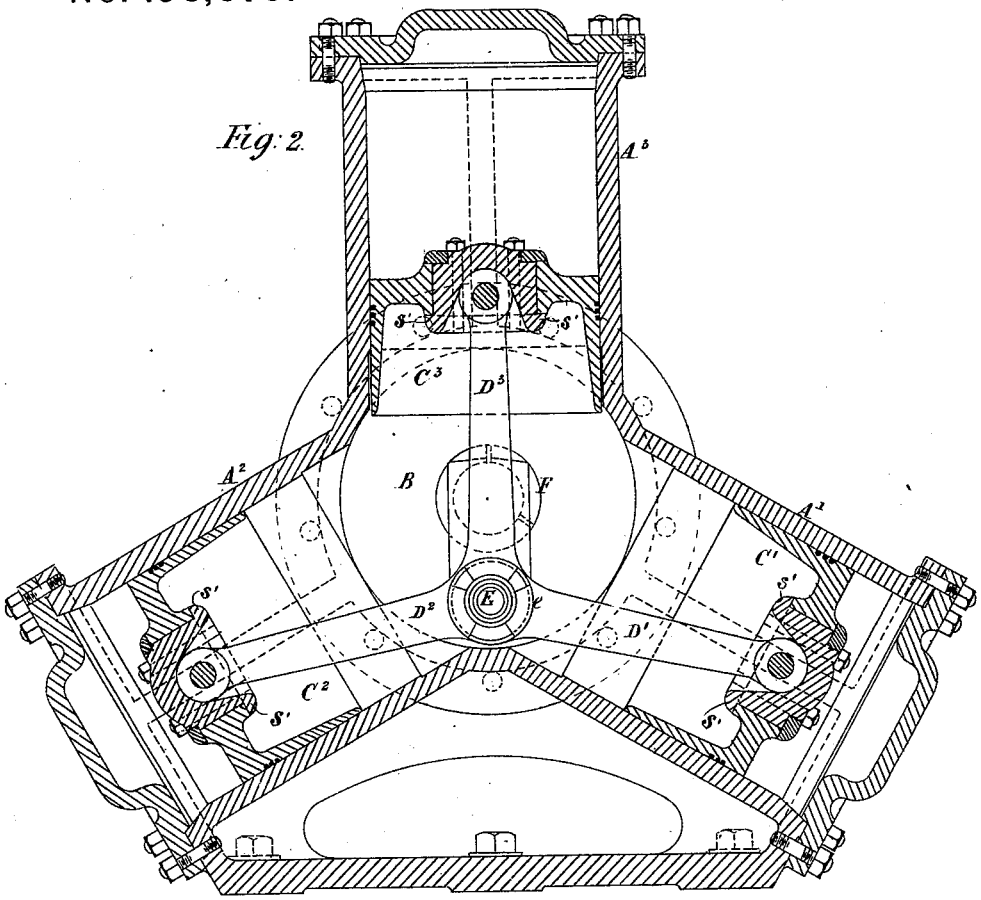
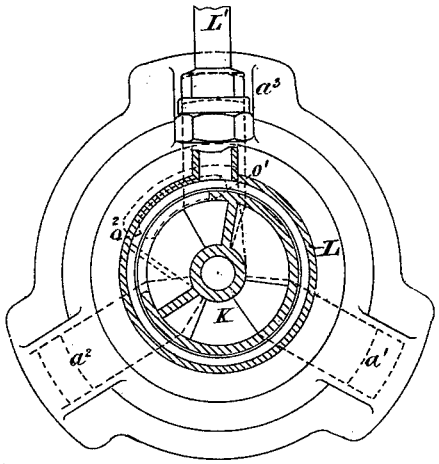


Fig. 4.



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P. BROTHERHOOD.

Triple Cylinder Steam-Engine.

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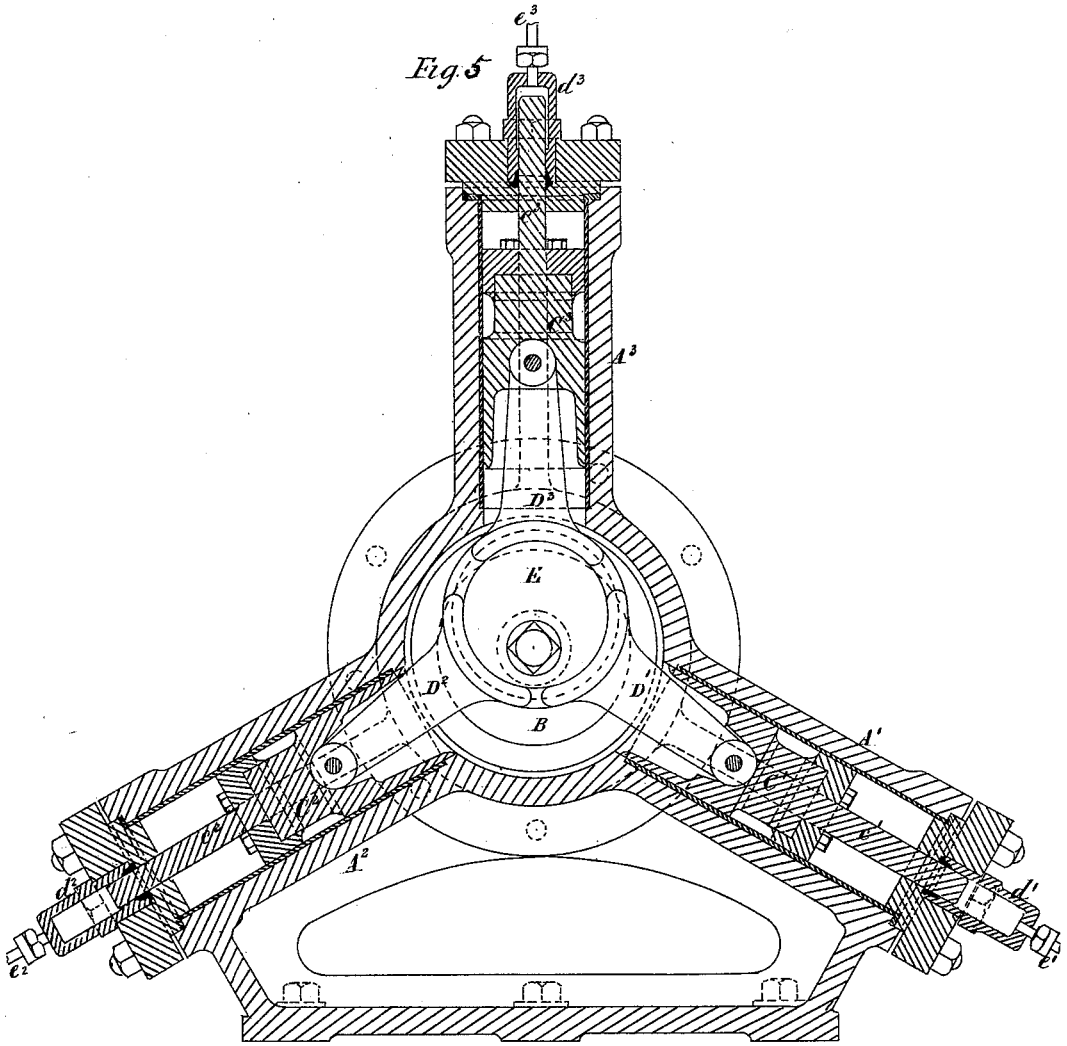
Fig. 5



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4 Sheets—Sheet 4.

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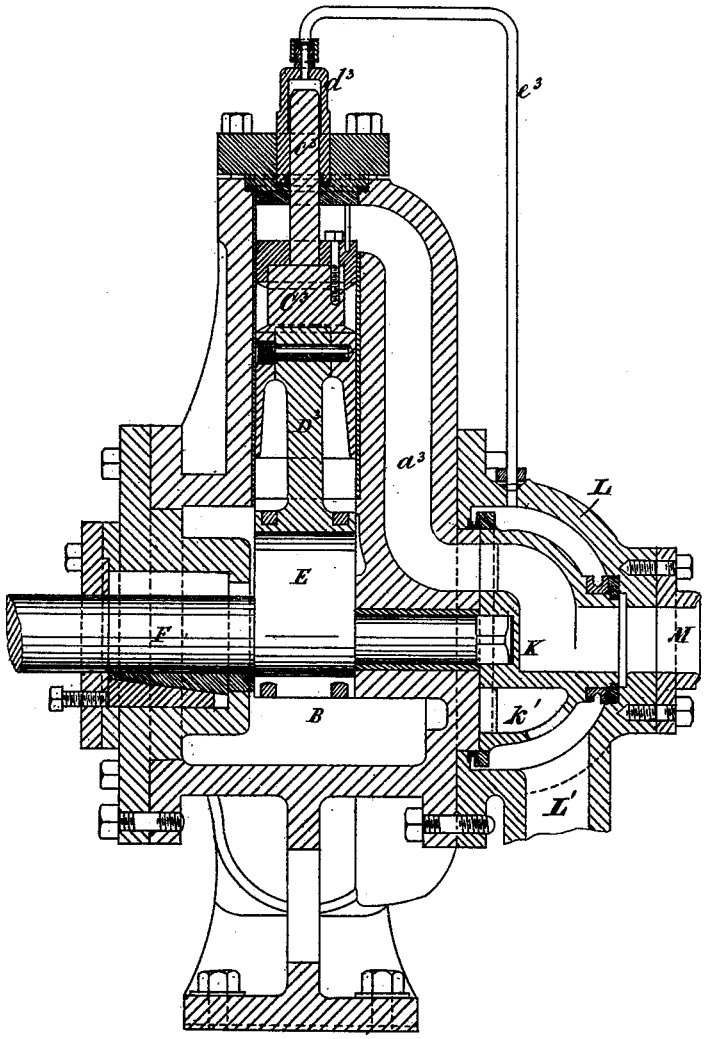
Triple Cylinder Steam-Engine.

No. 196,070. Patented Oct. 16, 1877.

Fig. 6



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UNITED STATES PATENT OFFICE.

PETER BROTHERHOOD, OF NOTTING HILL, ENGLAND.

IMPROVEMENT IN TRIPLE-CYLINDER STEAM-ENGINES.

Specification forming part of Letters Patent No. **196,070,** dated October 16, 1877; application filed June 23, 1875. Patented in England, June 5, 1873, for fourteen years.

To all whom it may concern:

Be it known that I, PETER BROTHERHOOD, of No. 25 Ladbroke Gardens, Notting Hill, in the county of Middlesex, England, have invented certain new and useful Improvements in Triple-Cylinder Steam-Engines, of which improvements the following is a specification, the same being patented in England June 5, 1873, as No. 2,003.

My invention relates, first, to an improved rotary valve, specially adapted to the triple-cylinder engine described in the Letters Patent of the United States issued to me under date of December 23, 1873; second, to certain modifications of my said engines, whereby the steam-passages may be more direct; third, to certain modifications of the connection between the pistons and connecting-rods of my said engine, whereby the length of the connecting-rod may be increased; and, fourth, to certain modifications of my said engine, whereby the connecting-rods may be maintained under compression when desired.

The objects of my improvements are to relieve the pressure upon the face of the valve to any extent, the fluid under pressure surrounding the valve in this respect differing from the high-pressure valve described in my patent of December 23, 1873, in which the fluid under pressure is confined to the interior of the valve, and in which this pressure upon the face of the valve could be relieved only to a limited extent; also, to simplify the construction and increase the strength of the central chamber and the efficiency of the engine, while diminishing the weight, also, to increase the length of the connecting-rods without increasing the distance of the cylinder from the crank-shaft; and to so arrange the connection between the pistons and their respective connecting-rods that the surface to sustain wear shall be increased, while means for adjustment shall be provided, and all dependence upon the position or character of the packing avoided; also, to maintain the connecting-rods under pressure, so as to dispense with the necessity of connecting these rods to the driving crank or eccentric, and perform the work by merely abutting them against the said crank or eccentric, thereby diminishing the length of the crank-pin; also, to confine the fluid under pressure to the cylinders, thereby diminishing the weight of metal that would be required to sustain this pressure in the central chamber, and avoid the liability to leak around the crank-shafts.

The subject-matter claimed will be hereinafter specifically designated.

In the accompanying drawings, which make part of this specification, Figure 1 represents a vertical transverse section of a triple-cylinder steam-engine, showing the application of my improved rotary valve thereto, and also showing the improved passage from the valve to the cylinder. Fig. 2 is a vertical longitudinal section of the same engine. Fig. 3 represents, in longitudinal section, a modification of my improved valve to admit of reversing the engine. Fig. 4 represents the same valve in transverse section. Fig. 5 represents, in vertical longitudinal section, my triple-cylinder engine arranged as a pump, showing the application of my improvements for maintaining the connecting-rods under pressure. Fig. 6 represents a vertical transverse section of the same, showing the application of my improved rotary valve adapted to the use of water, and also showing the improved passage from the valve to the cylinder.

For the purposes of this specification it is deemed necessary only to refer to my aforesaid patent of December 23, 1873, for the details of construction of my triple-cylinder engine. The following description, therefore, is confined to those parts involved in the improvements herein claimed.

The rotary valve adapted to the work to be performed is represented in Figs. 1, 3, 4, and 6, and is hemispherically formed, having a central and a circumferential inlet and outlet passage, as shown at K and *k'*. These extend through the valve to its face, so as to communicate successively with the triple-cylinder passages a^1 a^2 a^3. (See Fig. 4.) The upper or outer end of this valve is cylindrical, to receive the packing, as shown at *k*, Figs. 1 and 6. It is inclosed within a cover, L, which has nozzles M and L' for the admission or escape of fluid, as the connecting-rods are intended to be in tension or under compression, the flow in one case being the reverse of that in the other. The cylindrical end of the valve enters a short distance within the cover, at which point it is suitably packed according as it is to be used

with steam or water. Fig. 1 represents the arrangement for steam; Fig. 6 for water. The difference in area between this cylindrical part of the valve and the circular valve-face will represent the portion of the valve exposed to the inward pressure of the fluid. It is evident these might be made equal, so that the surrounding fluid could exert no pressure upon the valve-face. The valve could, therefore, be balanced to any admissible extent. The highest fluid-pressure, whether the connecting-rods are in tension or under compression, must in all cases be upon the exterior of the valve, so that the conditions in either case will be the same, and for this reason several applications and adaptations which I contemplate in this feature of my invention are shown in the drawings.

As shown in Figs. 1 and 6, the central chamber B, in which the crank rotates, is formed by a cylindrical casting, closed at one end by a head cast with this cylinder. In this head are the passages leading to the ends of the cylinders, in which the pistons operate, and the outer surface of this head forms the valve-seat in which the said passages terminate.

It will be observed that, by this construction, the passages in the central chamber-cover and in the cylinders are in the same plane, and have a single bend, which leads to the cylinder, and another to the valve-seat, in this respect differing from my above-mentioned former patent, in which there are two bends between the valve and the cylinder-passage, and two in the cylinder-passage itself. Through the center of this head a shaft, N, rotates, operated from the crank-pin E by means of a pin projecting into the crank O on the shaft N. The other end of this shaft is provided with a square projection, which fits into a corresponding recess in the rotating valve, so that the revolutions of the crank-shaft F and of the valve will be coincident, and the operation will be the same as that described in my above-mentioned former patent. It will be observed, however, that by forming the passages in the head which closes one end of the central chamber these passages can be made not only less tortuous, but also shorter, which accomplishes the second object of my invention.

To increase the length of the connecting-rods in my aforesaid engine, I provide the pistons C^1 C^2 C^3 with a central boss, *p p*, in the closed head of same, to receive a circular block or socket-piece, *q*, provided with a flange, *s'*, through which the thrust of the piston is transmitted to the outer or socketed end of the connecting-rod, while the pin *r* merely retains the parts in position in case the engine should be turned by hand without the admission of steam. To maintain the socket-piece in position with the piston, and to prevent the escape of steam through the joint between the boss *p p* and the socket-piece *q*, I provide a ring, *s s*, which fits accurately upon the outer surface of the boss and a corresponding surface upon the socket-piece, and is secured to the socket-piece by screw-bolts *t t*. By this arrangement the wear upon the pin at the point of connection between the connecting-rod and piston is transferred to the circular end of the connecting-rod, whereby the surface to sustain this wear is largely increased; but, should detrimental wear occur under these circumstances, it may be taken up by packing-pieces between the boss and the flanges above described. Moreover, the pin-connection between the piston and its connecting-rod being thus wholly confined to the central boss above described, the character and position of the steam-packing will not be affected by the pin-connection shown in my above-mentioned former patent.

To maintain the connecting-rods under compression, I provide upon the outer end of each piston C^1 C^2 C^3 a compression-plunger, c^1 c^2 c^3, which projects from its piston through the cover of the cylinder into a chamber on the back of each cylinder-cover. Between this chamber and the cylinder I provide suitable packing to prevent the fluid from entering the cylinder from the chamber.

In the present case an ordinary cup-leather is employed. Each chamber is of sufficient diameter to permit its plunger to play back and forth freely, and a communication is established between each chamber and the interior of the valve-cover L by means of the pipes e^1 e^2 e^3, so that the fluid-pressure surrounding the rotary valve will be also exerted upon the ends of the compression-plungers c^1 c^2 c^3. The area of these plungers must be so proportioned to the pressure in the interior of the valve-cover as to enable this pressure to overcome the friction or other resistance to the movement of the piston toward the center of the crank-shaft. This will not only avoid all shocks and jars incident to lost motion, which must occur when the connecting-rods are alternately subjected to compression and tensile strains, but it will also confine the fluid under pressure to the cylinders and their passages alone, in this respect differing from my above-mentioned former patent, where the connecting-rods were under tension, and both the central chamber and cylinders were subjected to pressure.

It is obvious that with high pressures the arrangement herein described will materially diminish the strains upon the central chamber and the liability to leak around the crank-shaft.

Having thus described the nature and objects of my invention, what I claim therein as new is—

1. The combination of three cylinders, the rotary valve having a central and a circumferential opening and inlet and outlet passages, the triple-cylinder passages communicating with said valve-passages, the central chamber from which the cylinders radiate and which has a closed head, the passages in said head, the valve-driving shaft passing through this head, and the valve-inclosing cover, in

which the end of the valve is mounted, these members being constructed and operating conjointly, substantially as hereinbefore set forth.

2. The combination of the piston, provided with a central opening and a boss surrounding said opening, the flanged socket-piece, the ring fitting upon the outer or top surface of the boss and a corresponding surface of the socket-piece, and the connecting-rod pivoted to the socket-piece, these members being constructed and operating, substantially as hereinbefore set forth, to transfer strain from the pivot to the end of the connecting-rod and compensate wear between the rod and socket-piece by the insertion of packing between the boss and flange of the socket-piece.

3. The combination, substantially as hereinbefore set forth, of the cylinder, the piston, the compression-plunger, and the fluid-supply pipe connected with the plunger-chamber.

4. The combination of the rotary valve, the cylinders, their pistons, the compression-plunger chambers, and the supply-pipes leading from the valve-chamber to the plunger-chambers, these members being constructed and operating substantially as hereinbefore set forth.

In testimony whereof I have hereunto subscribed my name.

PETER BROTHERHOOD.

In presence of—
GEORGE MESSENGER,
GEORGE H. FERRY.