(No Model.) 4 Sheets—Sheet 1.

C. H. GIFFORD.

STEAM ENGINE.

No. 598,627. Patented Feb. 8, 1898.

FIG. 1.

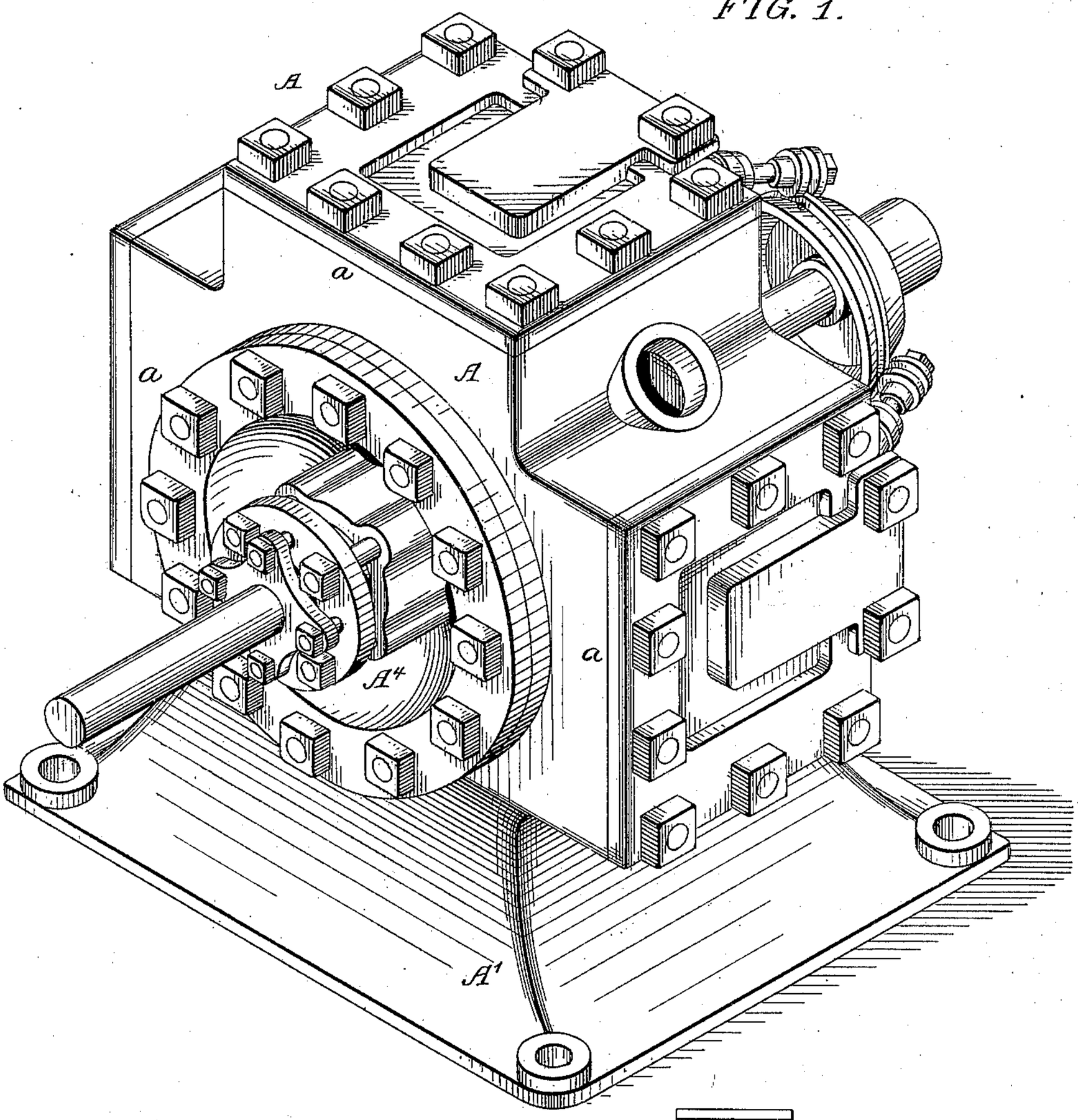


FIG. 8.

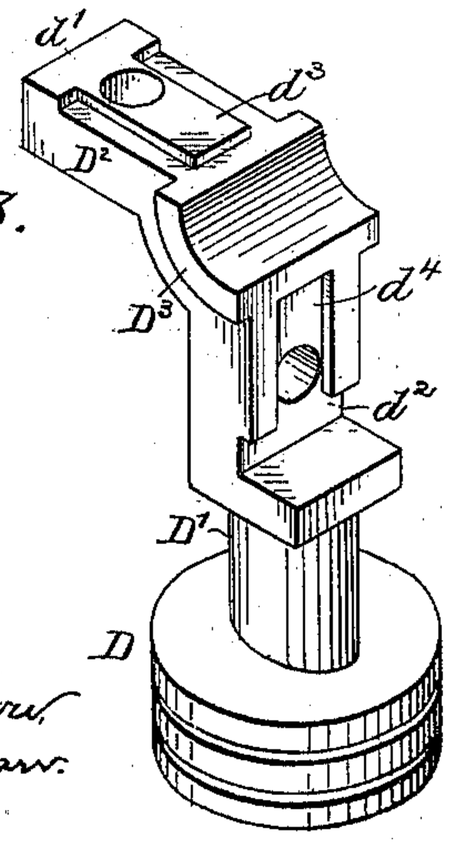
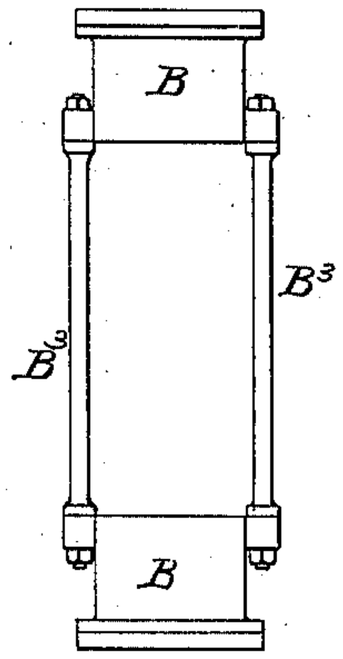


FIG. 9.



Witnesses:
Charles De Bow
Wm. A. Barr.

Inventor:
Charles H. Gifford
by his Attorneys
Howson & Howson

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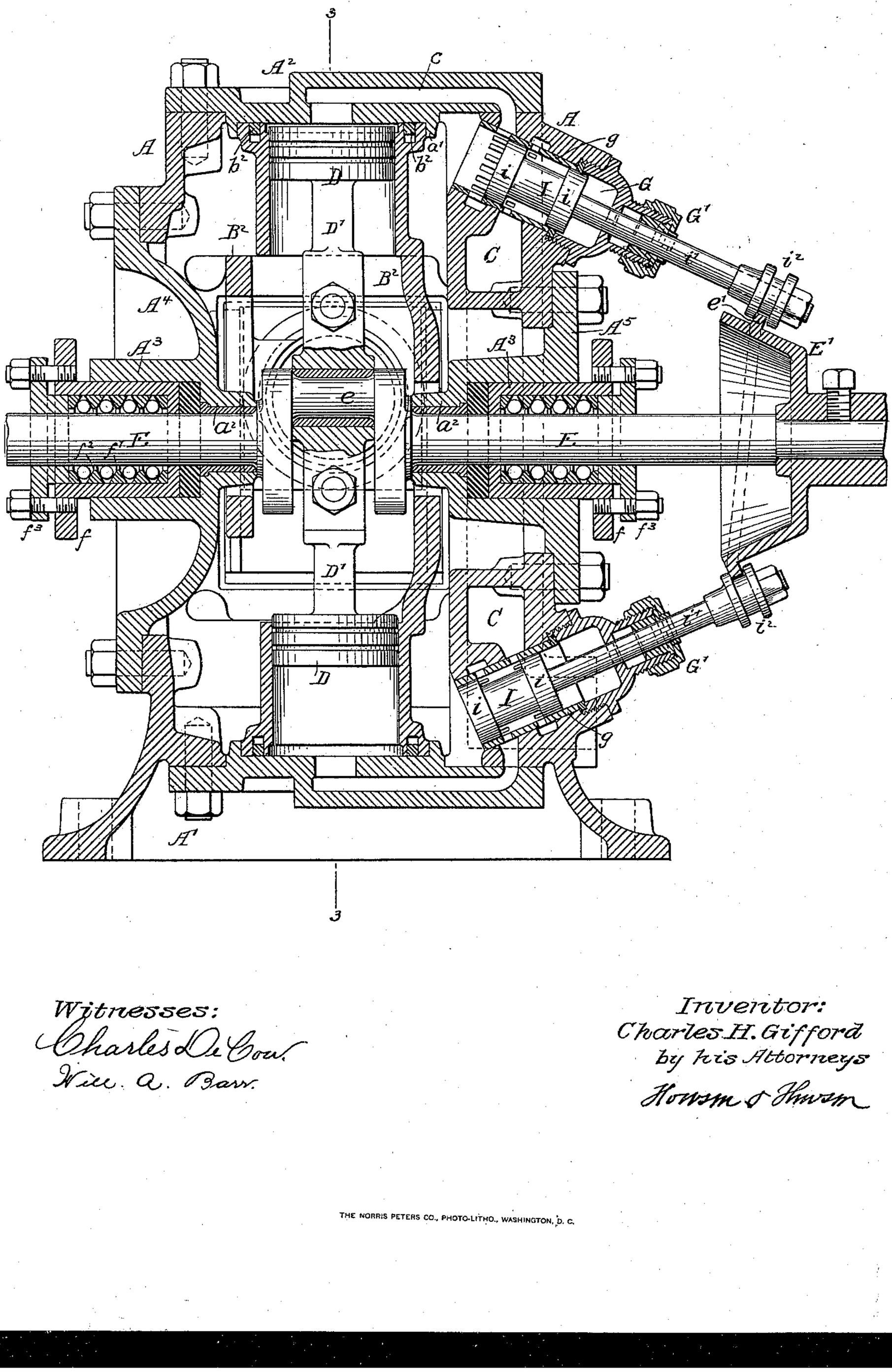
FIG. 2.



Witnesses:
Charles De Cow.
Wm. A. Barr.

Inventor:
Charles H. Gifford
by his Attorneys
Howson & Howson

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C. H. GIFFORD.

STEAM ENGINE.

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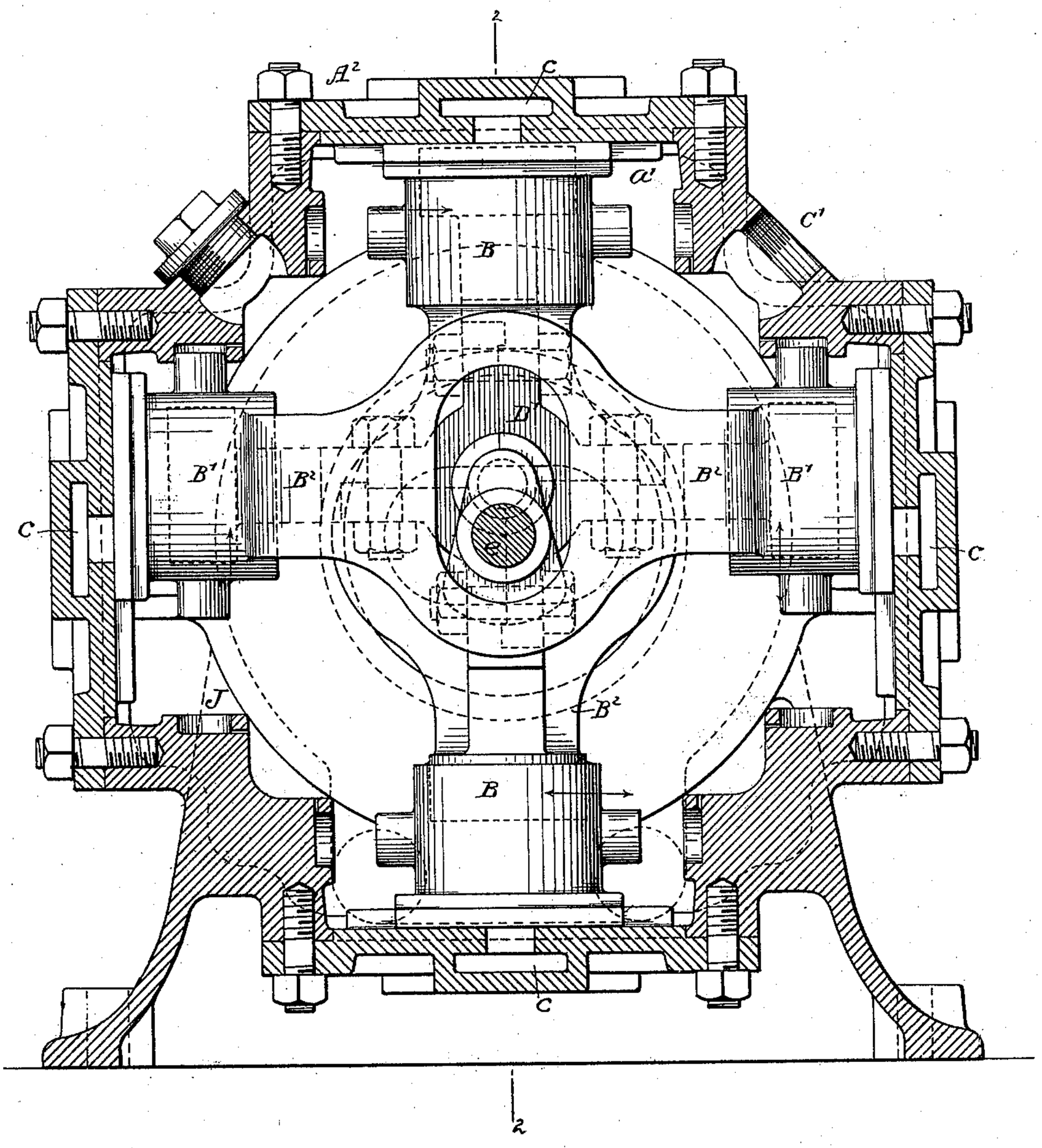
FIG. 3.



Witnesses:
Charles De Cow.
Wm. A. Barr.

Inventor:
Charles H. Gifford
by his Attorneys
Howson & Howson

(No Model.) 4 Sheets—Sheet 4.

C. H. GIFFORD.

STEAM ENGINE.

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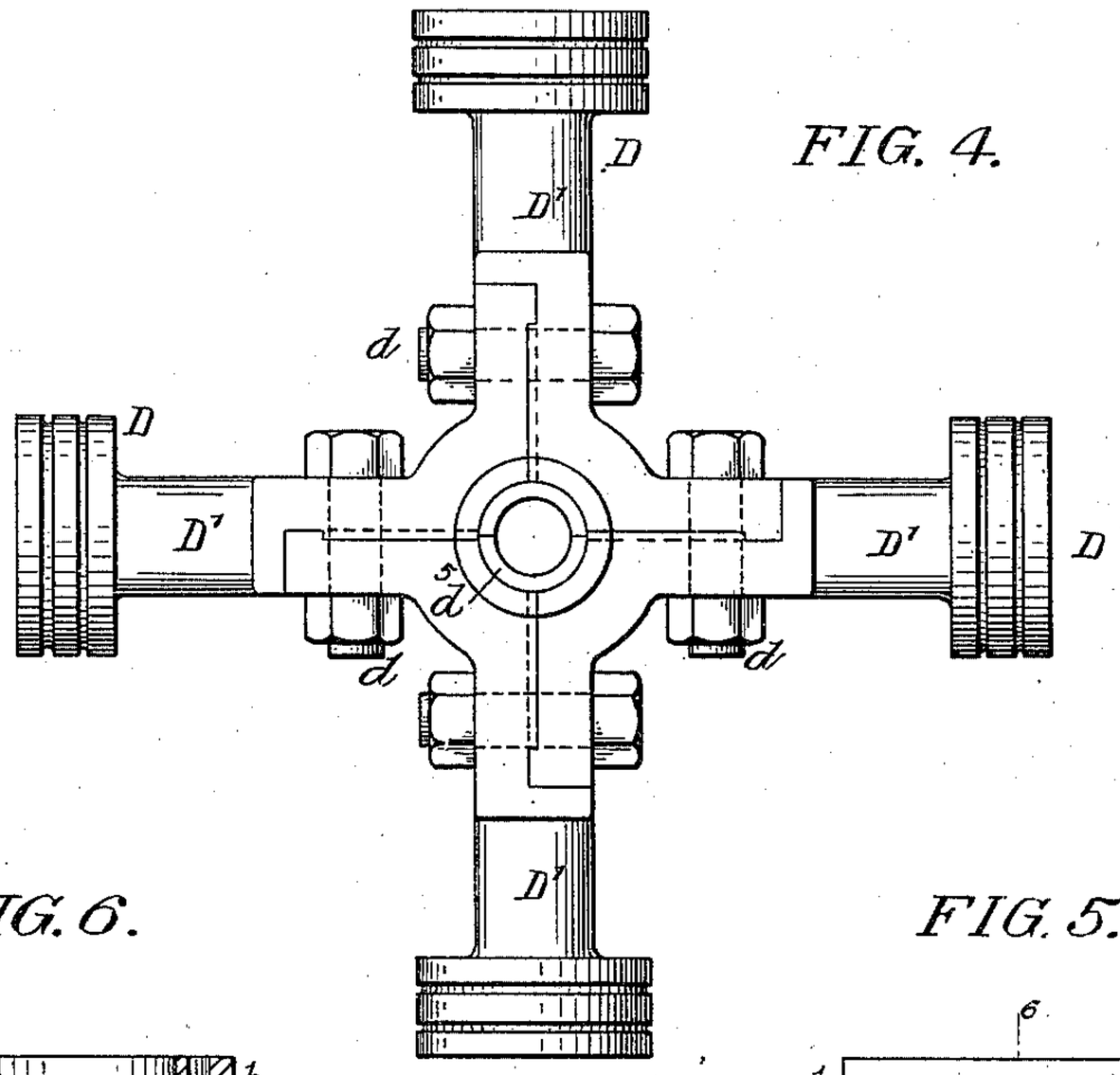


FIG. 4.

FIG. 6.

FIG. 5.

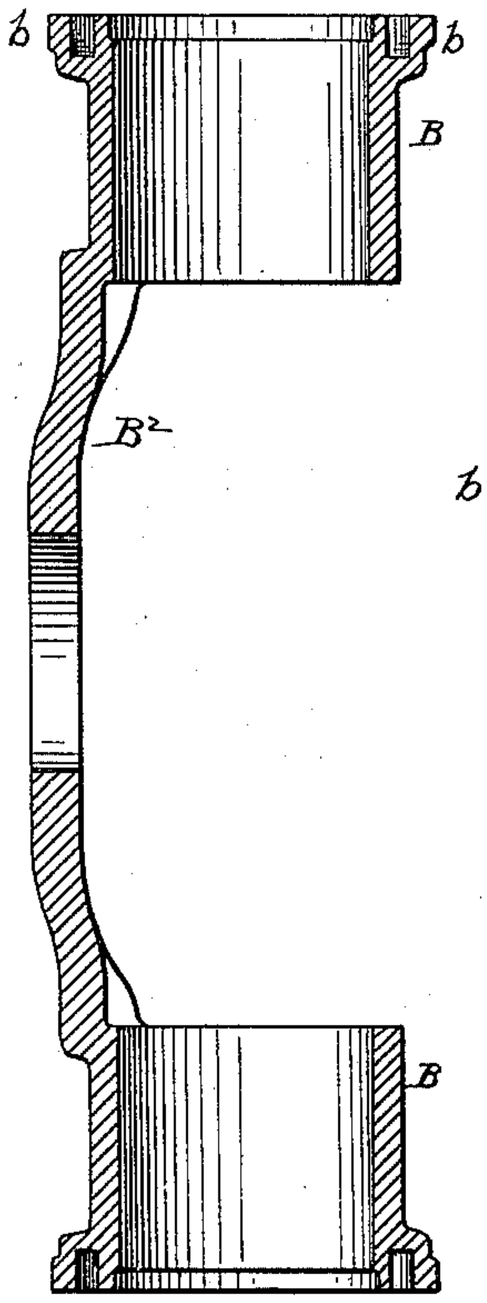
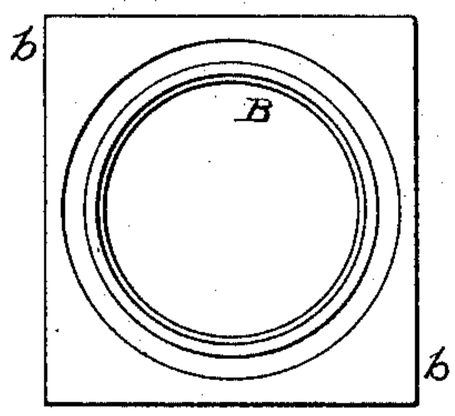
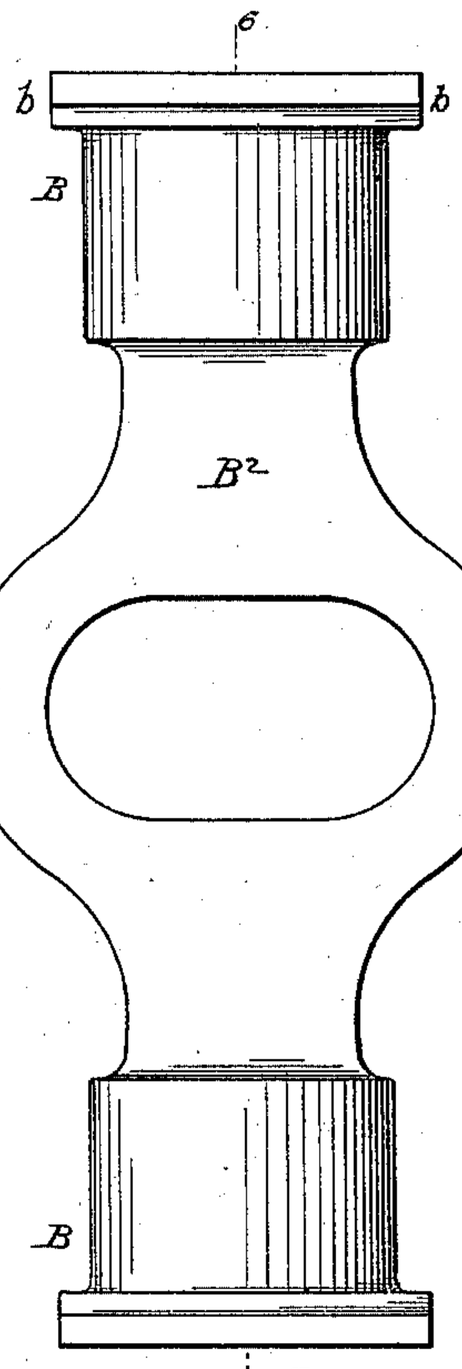


FIG. 7.





Witnesses:
Charles De Cow.
Wm a. Barr.

Inventor:
Charles H. Gifford
by his Attorneys
Hinson & Hinson

UNITED STATES PATENT OFFICE.

CHARLES H. GIFFORD, OF PHILADELPHIA, PENNSYLVANIA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 598,627, dated February 8, 1898.

Application filed April 28, 1896. Serial No. 589,458. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. GIFFORD, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Steam-Engines, of which the following is a specification.

The object of my invention is to construct a four-cylinder single-acting steam-engine in which the cylinders reciprocate on given planes to accommodate the movement of the crank, the piston-rods being connected directly to the crank, the usual connecting-rods being dispensed with.

A further object of the invention is to construct the engine in such a manner as to reduce the friction and to balance the cylinders; and a still further object is to make the engine in a compact form, as fully described hereinafter.

In the accompanying drawings, Figure 1 is a perspective view of my improved steam-engine. Fig. 2 is a longitudinal sectional view on the line 2 2, Fig. 3. Fig. 3 is a transverse sectional view on the line 3 3, Fig. 2, with the cylinders not in section. Fig. 4 is a detached view of the pistons and piston-rods. Fig. 5 is a side view of one of the cylinder-sections. Fig. 6 is a section on the line 6 6, Fig. 5. Fig. 7 is a plan view of Fig. 5. Fig. 8 is a perspective view of a piston and piston-rod. Fig. 9 is a view of a modification of one of the cylinder-sections.

A is the casing of the engine, which is shaped as clearly shown in the perspective view, Fig. 1, and mounted on the base A'. The casing has four sections *a* at right angles to each other, in which the cylinders are mounted. Caps A^2 are secured to the casing by bolts and have ways *a'*, on which travel the cylinders B B'. The body of each cylinder is cylindrical, while the base *b* is quadrangular, as shown in Fig. 7. This quadrangular base is adapted to the ways *a'* on the cap A, so that the cylinders will reciprocate in one direction only, as indicated by the arrows in Fig. 3. In order to balance these cylinders, I connect the opposite cylinders in pairs by yokes B^2 and slot the center portion of the yokes to allow for the free movement of the crank, and in the base of the cylinders are packing-strips b^2, which make a steam-tight joint between the cylinder and its cap.

D are the pistons, one for each cylinder, and these pistons are connected together by their rods D' in the manner clearly shown in Figs. 4 and 8. Each piston-section comprises the piston proper, D, the piston-rod D', the right-angled extension D^2, and the segmental box D^3, so that when the four sections are placed together they will interlock, as shown in Fig. 4, and when secured by the bolts *d* are held rigidly in place. To insure their proper alinement, I form a lip *d'* on the section D^2, which rests in a recess d^2 in the section D' of the adjoining piston-rod, and I also form a projection d^3 on the section D^2, adapted to a groove d^4 in the section D', so that when the parts are adjusted and secured in position the strains are not taken altogether by the bolts. A suitable bushing d^5 is mounted in the central opening for the crank *e* of the shaft E. This shaft is adapted to suitable bearings A^3 in the casing, and I have shown in the drawings a bearing-box *f*, having a series of balls and wedge-shaped segments *f' f²*, held in place by a cap f^3, although it will be understood that any form of bearing may be substituted for the ball-bearing shown. The shaft also fits snugly the portions a^2 of the case, which are suitably bushed for the reception of the shaft. These portions a^2, as well as the bearings A^3, form part of caps A^4 A^5, the cap A^4 being secured to the front of the casing and the cap A^5 being secured to the rear of the casing.

I will now describe the valve mechanism by which steam is admitted to and exhausted from the several cylinders. It will be understood that this mechanism may be modified without departing from the main features of my invention.

The valves in the present instance are of the cylinder type and the chests G are arranged at an angle in the rear of the casing A and have bushings *g*, provided with suitable ports communicating one with the passage *c*, extending to the base of the cylinder, the other communicating with the exhaust-chamber C, the interior of the casing itself being the steam-chamber in the present instance, steam being admitted to the chamber through the passage C'.

The piston-valve I has two heads *i i* and a rod *i'*, which passes through a suitable packing-box G' and has on its end a grooved head i^2.

On the shaft E is a cam E′, having the rib e', engaging with the heads i^2 of each valve-rod. The contour of this rib is such that it will reciprocate the rods and their valves at a given time, so that steam will be admitted to the cylinders to properly rotate the shaft in the most economical manner.

It will be understood that in some instances the engine may be so constructed that the space C may be the steam-space and the engine may exhaust to either the atmosphere or into the casing A, which may be connected to a suitable exhaust-pipe.

In small engines the two opposite cylinders and the yoke may be cast in one piece, but in larger engines I prefer to make the cylinders in separate castings, as shown in Fig. 9, and tie them together by rods B^3 instead of the yoke B^2.

In order to cushion the cylinders at each end of the stroke when the engine is running at a high speed, I may form dash-pots J in the casing, as shown in Fig. 3, and provide the cylinders with plungers j, adapted to the dash-pot, thus overcoming to a considerable extent the inertia of the parts of the engine.

The operation of the engine is as follows: The steam is admitted through the ordinary throttle-valve to the casing and the valves are so set that motion will be imparted to the pistons direct by the steam entering the cylinders in rotation. The movement of the crank will reciprocate the cylinders on their seats through the medium of the pistons and piston-rods, so that while the pistons have a longitudinal reciprocation the cylinders themselves will have a lateral reciprocation, and as the opposite cylinders are tied together they are counterbalanced, thus obviating the defect in engines of this type where the pressure of steam forces the cylinders hard upon their seats.

The passages to the cylinders are very simple. The cylinders in this case do not act as valves and are, therefore, not complicated. The valve mechanism is entirely independent of the cylinders and the valves can be set from the outside without dismantling the engine.

It will be understood that the engine may be modified to act compounding by enlarging some of the cylinders and rearranging the valve mechanism.

I claim as my invention—

1. The combination in a four-cylinder single-acting engine, of the casing, the cylinders arranged in pairs, the opposite cylinders being rigidly coupled together and adapted to reciprocate laterally, pistons and piston-rods, and a crank-shaft to which the rods are coupled so that the pistons and their rods move with the crank-shaft and reciprocate the cylinders, with valve mechanism controlling the flow of steam to and from the cylinders, substantially as described.

2. The combination of the casing, the four removable caps secured to the casing, steam-passages in each cap, valve mechanism for governing the flow of steam through these passages, four cylinders, each cylinder adapted to ways on a cap, the opposite cylinders being connected together, pistons and piston-rods and a crank-shaft to which said piston-rods are coupled, substantially as described.

3. A multiple piston for a four-cylinder steam-engine made up of four sections, each section consisting of a piston-rod having a piston at one end, a right-angled extension at the opposite end and a quarter-bearing for a crank-shaft, the right-angled extension being secured to the rod of an adjoining piston, the whole when assembled forming the bearing for the crank-shaft, substantially as described.

4. The combination in a multiple-cylinder single-acting engine, of the casing, four removable caps adapted to the casing having steam-passages therein and ways for the cylinders, cylinders adapted to slide on the ways of the caps, the opposite cylinders being rigidly coupled together, a four-arm piston structure adapted to the cylinders, a crank-shaft to which the piston structure is coupled, four valve-chests in the casing, valves therefor, means for operating said valves, the casing of the engine forming the steam-chamber, an exhaust-chamber at one side of the casing, the said valves regulating the flow of steam to the several cylinders from the steam-chest, and from the cylinders to the exhaust-chest, substantially as described.

5. The combination of a piston structure for multiple-cylinder engines, the four sections, each section consisting of a piston, a piston-rod and a right-angled extension, the extension of one piston-section being adapted to be coupled to rods of an adjoining section, lips on one part adapted to enter recesses on the other part, and bolts securing the parts together, substantially as described.

6. The combination in a multiple-cylinder single-acting engine, of the casing, removable caps, each cap adapted to a section of the casing and having ways for the cylinders, steam-passages in each cap, front and rear caps having bearings for the crank-shaft, cylinders adapted to reciprocate on the ways, a piston structure adapted to each cylinder, a crank-shaft adapted to the bearings in the front and rear caps and connected to the piston structure, with valves actuated by the said crank-shaft and governing the flow of steam through the passages to and from the cylinders, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES H. GIFFORD.

Witnesses:
WILL. A. BARR,
JOS. H. KLEIN.