(No Model.) 3 Sheets—Sheet 1.

J. H. EICKERSHOFF.

SINGLE ACTING COMPOUND ENGINE.

No. 407,184. Patented July 16, 1889.

Fig. I

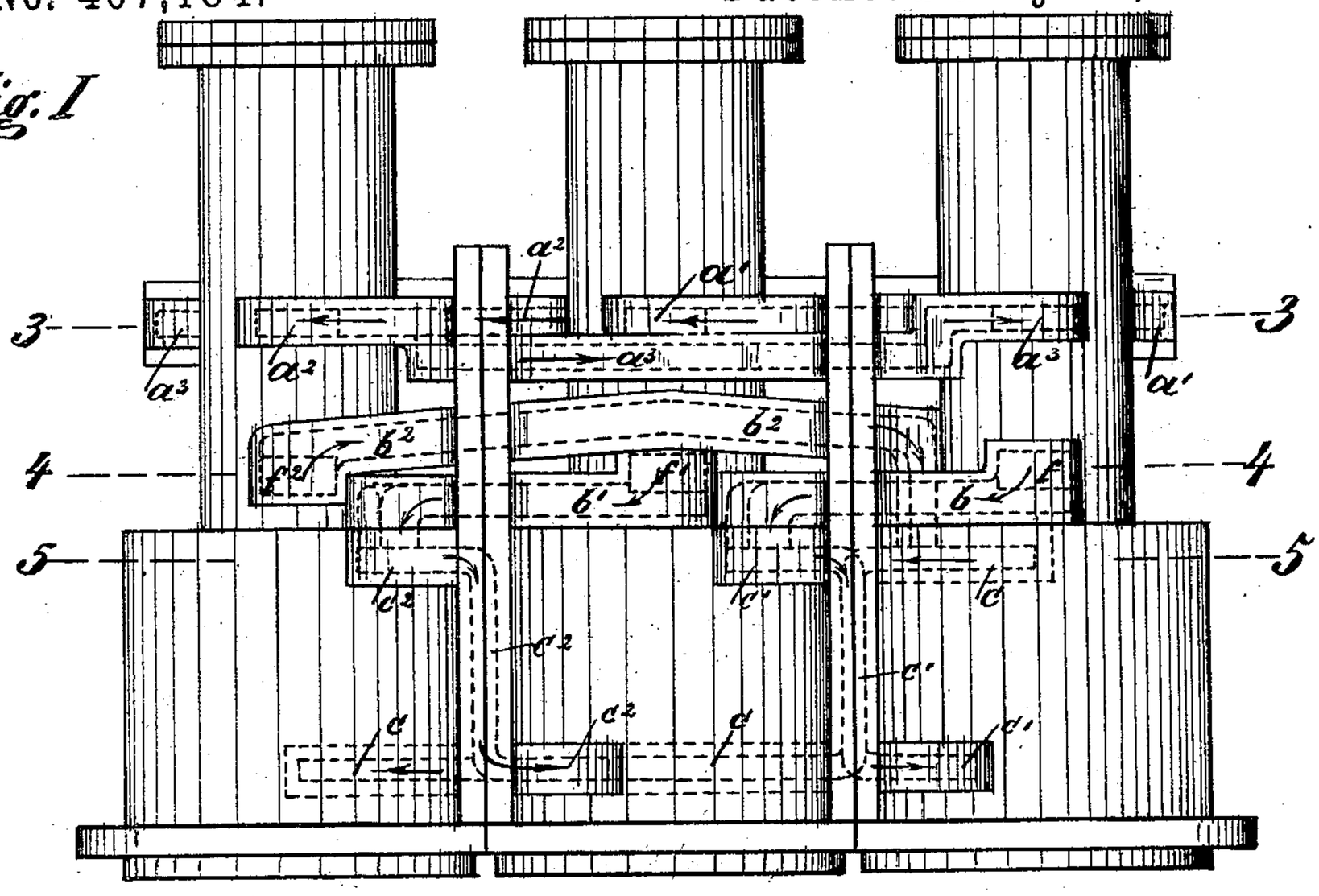


Fig. III

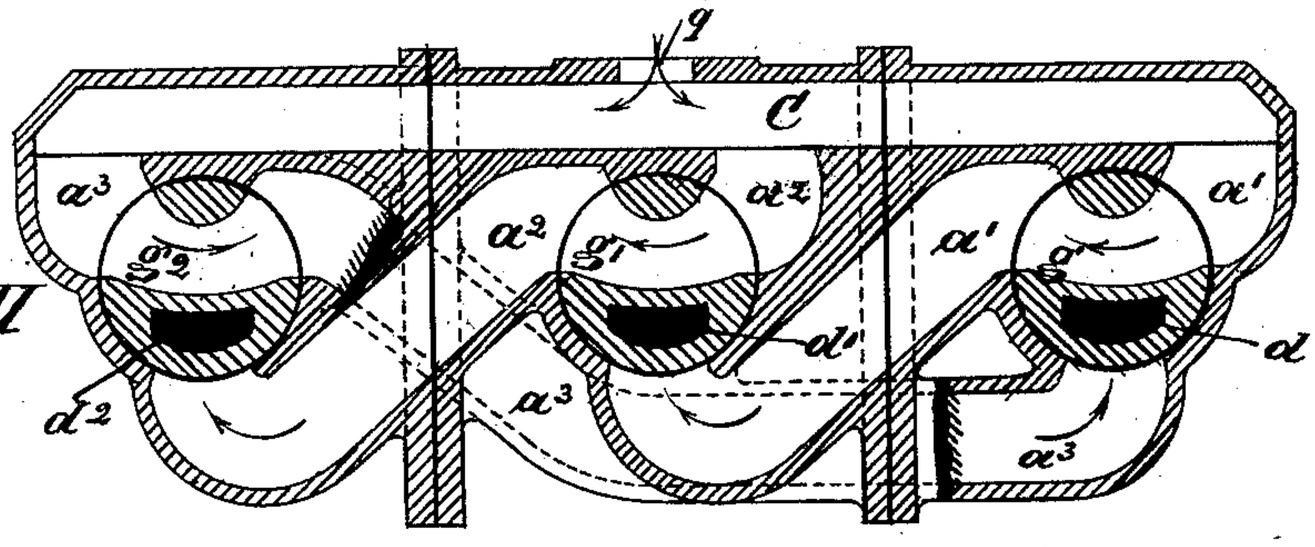
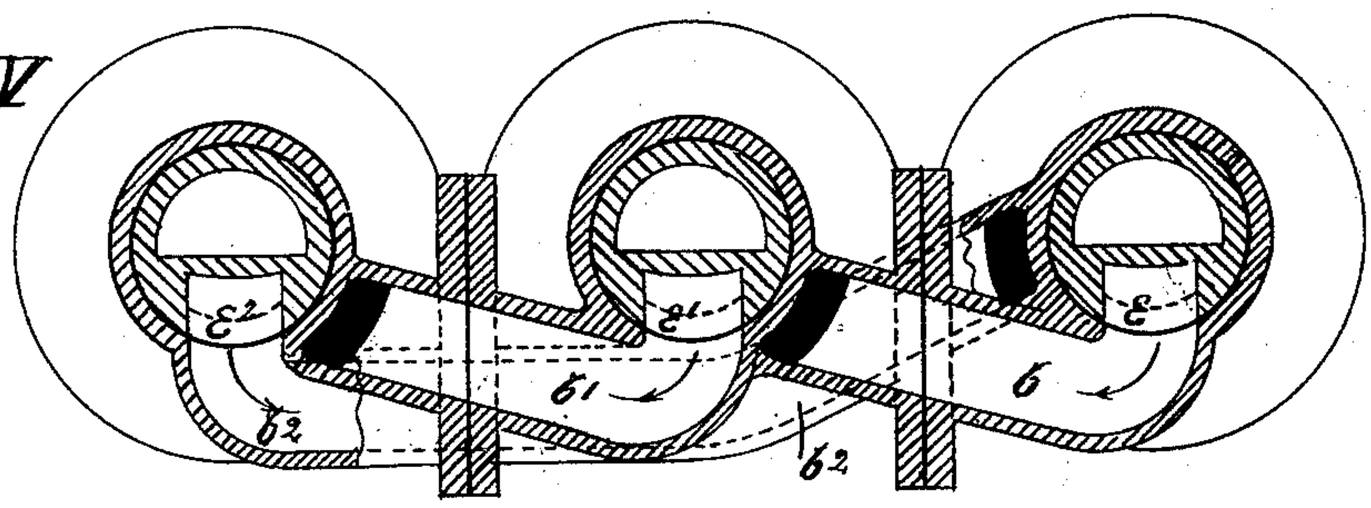


Fig. IV



WITNESSES,
Jas. Newton Ramsey
August F. Herbsleb.

INVENTOR.
John H. Eickershoff
By Frank O. Lovland ATTORNEY.

(No Model.) 3 Sheets—Sheet 2.

J. H. EICKERSHOFF.

SINGLE ACTING COMPOUND ENGINE.

No. 407,184. Patented July 16, 1889.

Fig. II

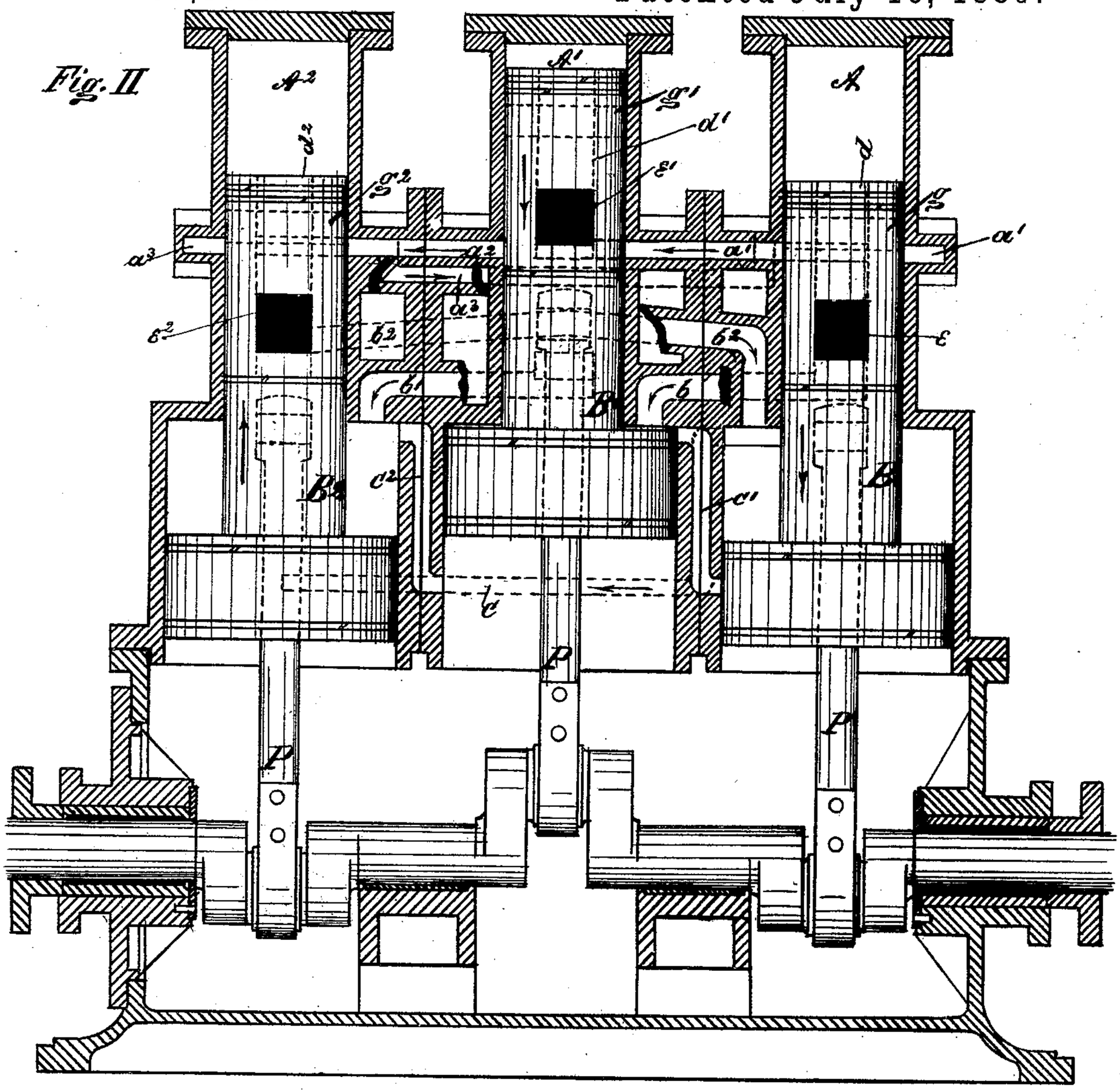
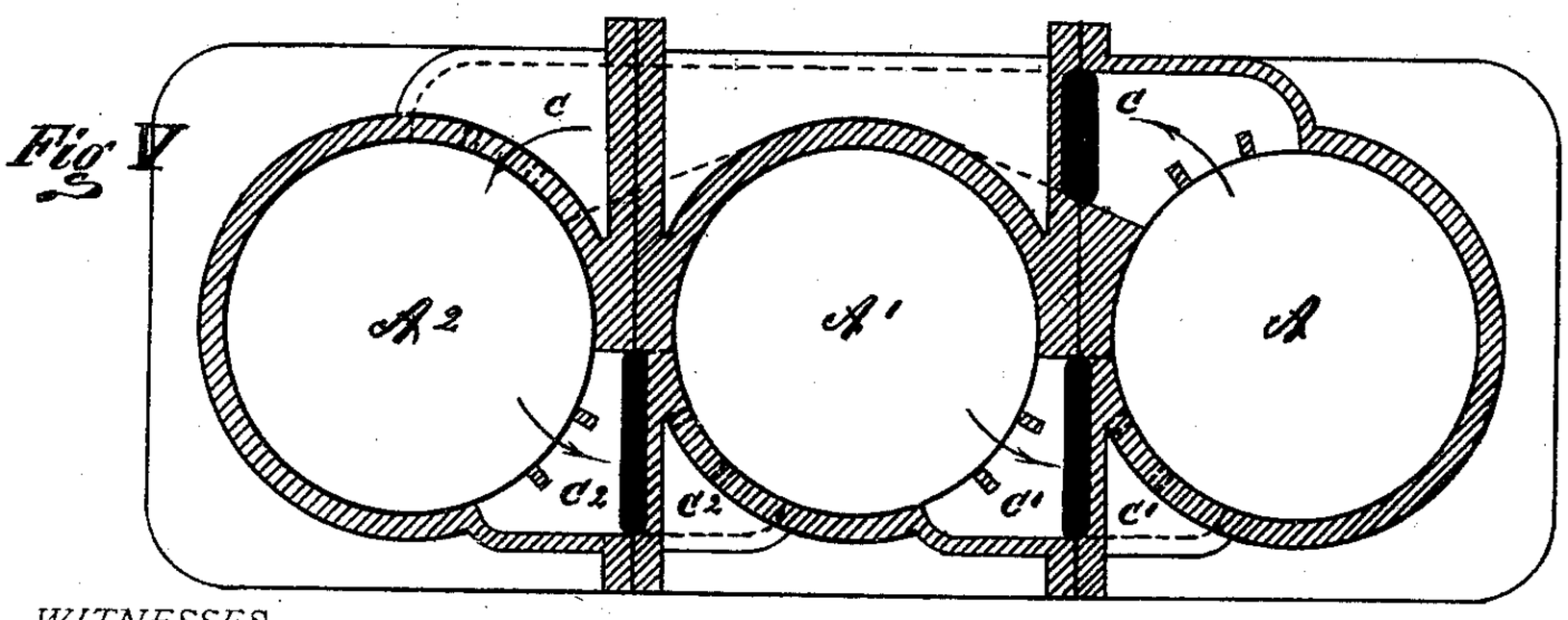


Fig V



WITNESSES.

Jas. Newton Ramsey

August T. Herbsleb

INVENTOR.

John H. Eickershoff

by Frank O. Loveland

ATTORNEY.

(No Model.) 3 Sheets—Sheet 3.

J. H. EICKERSHOFF.

SINGLE ACTING COMPOUND ENGINE.

No. 407,184. Patented July 16, 1889.

Fig. VI

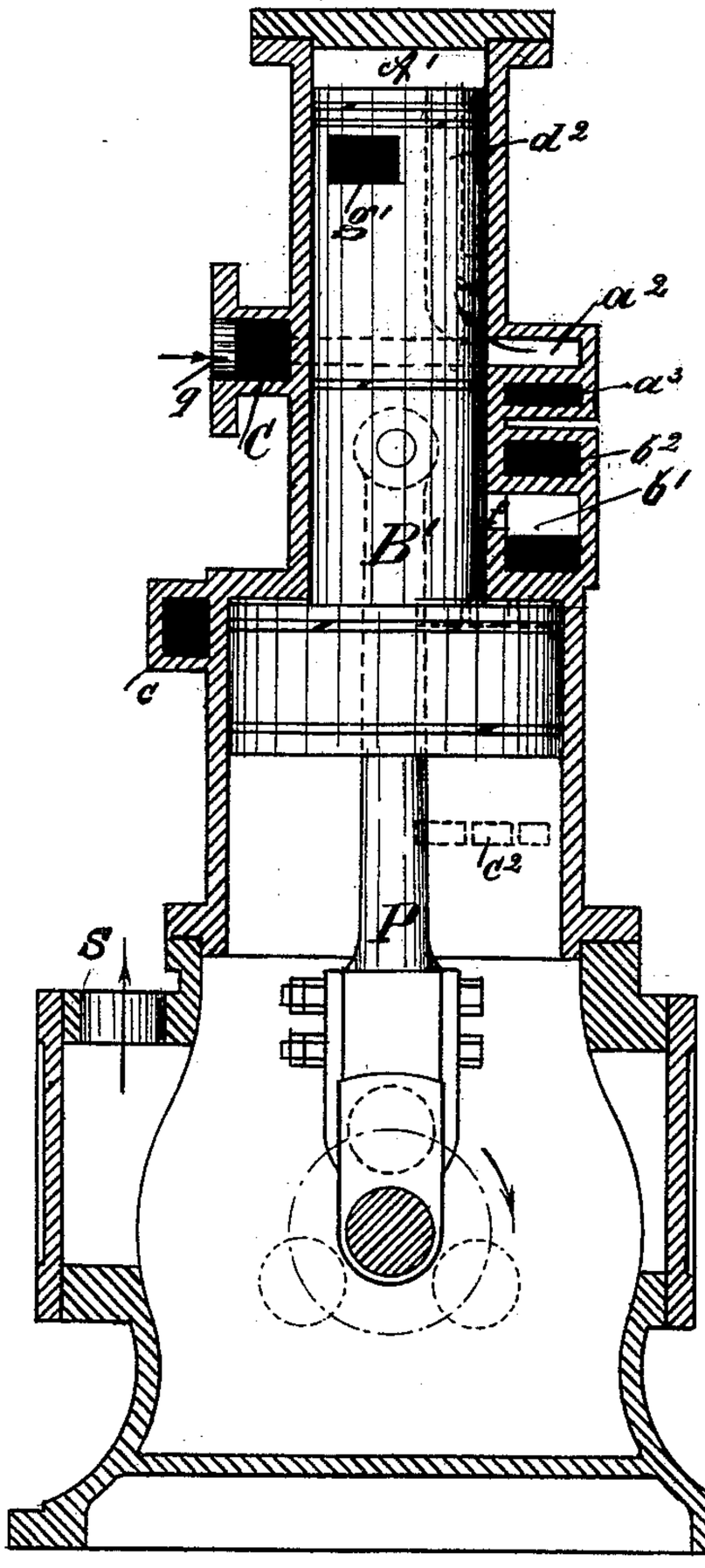
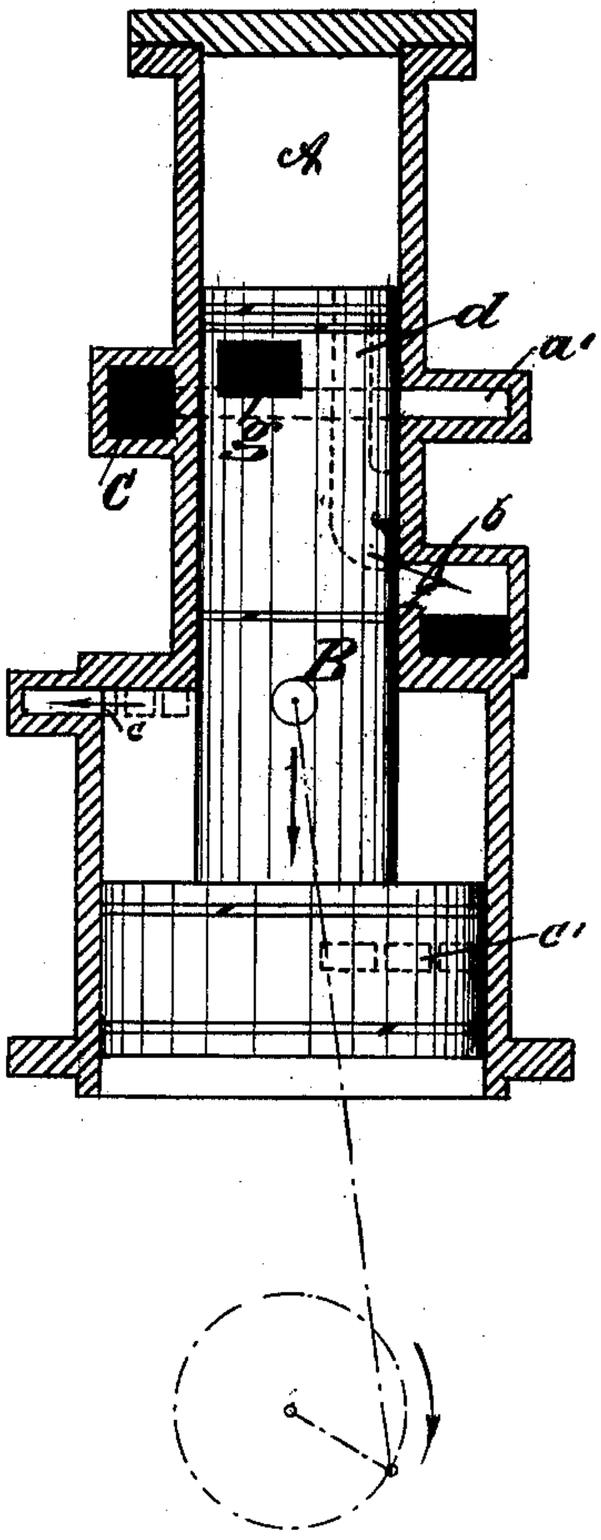


Fig. VII



WITNESSES,

James Newton Ramsey

August T. Herbaleb.

John H. Eickershoff INVENTOR.

By Frank O. Loveland

ATTORNEY.

UNITED STATES PATENT OFFICE.

JOHN H. EICKERSHOFF, OF CINCINNATI, OHIO, ASSIGNOR TO THE TRIUMPH COMPOUND ENGINE COMPANY, OF SAME PLACE.

SINGLE-ACTING COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 407,184, dated July 16, 1889.

Application filed September 24, 1888. Serial No. 286,258. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. EICKERSHOFF, a citizen of the United States, residing at Cincinnati, in the county of Hamilton, State of Ohio, have invented new and useful Improvements in Single-Acting Compound Engines, of which the following is a specification.

My invention relates to single-acting compound engines in which the steam in compounding is passed directly from one cylinder to another.

The object of my invention is to produce an engine of the kind referred to in which the pistons serve to open and close the inlets and outlets of steam to the cylinders without using induction or eduction valves.

Referring now to the drawings, Figure I is a side view of three cylinders of a steam-engine embodying my invention. Fig. II is a vertical section of the same and crank-case. Fig. III is a horizontal section on line 3 3, Fig. I. Fig. IV is a horizontal section on line 4 4, Fig. I. Fig. V is a horizontal section on line 5 5, Fig. I. Fig. VI is a vertical section of the middle cylinder and crank-case. Fig. VII is a vertical section of the right-hand cylinder shown in Fig. I.

A A′ A^2 are cylinders arranged in a common plane above the crank-shaft S, with whose cranks, set at equal angles apart, the pistons B B′ B^2 of the cylinders engage by pitman P in the usual manner. Each cylinder is constructed with two different diameters and provided with a correspondingly-shaped piston working therein. The upper or smaller portion of the cylinder forms what may be termed the "high-pressure cylinder," and is adapted to receive live steam, while the lower or enlarged portion may be termed the "low-pressure cylinder," and is adapted to receive expansion-steam from a high-pressure cylinder preceding it. Both parts of the pistons are suitably fitted with packing-rings.

C is a steam-chamber, to which the live steam from the boiler is admitted through the opening *q*.

a′ a² a³ are passages through which the live steam flows. From these passages the live steam is admitted to the high-pressure cylinders A A′ A^2, respectively, through passages *d d′ d²* in the pistons.

b b′ b² are passages for the expansion-steam, connecting the high-pressure cylinders with the low-pressure cylinders.

c c′ c² are exhaust-pipes.

e e′ e² are the openings in the sides of the pistons at the lower extremity of the passages *d d′ d²*.

f f′ f² are openings in the side of the cylinders at the extremity of the expansion-passages *b b′ b²*.

g g′ g² are passages, which, when brought over the passages *a′ a² a³*, make continuous passages for the live steam through the cylinder-piston.

The operation of the engine is as follows: The middle piston in Fig. II being at the top, the piston B will have made a partial downward stroke and passage *g* will uncover the passage *a′* and form a continuous passage *a′ g a′*. Live steam is admitted from the steam-chamber C through this passage *a′*, the opening *e′*, and piston-passage *d′* into the high-pressure cylinder A′, and the piston B′ is driven downward. The flow of live steam into cylinder A′ is cut off when the opening *e′* passes below passage *a′*, the passage being covered by the side of the piston, or when piston B passes upward or downward, so that the passage *g* will not lie in the same plane with the passage *a′*. Which of these methods will be used depends upon the relative sizes and locations of the passages. When the opening *e′* uncovers the opening *f′*, the expansion-steam flows downward through passage *b* into the low-pressure portion of cylinder A^2 and acts upon the enlarged portion of the piston B^2, which piston at that instant is ready to begin its downward stroke. The only exhaust of this steam takes place from the low-pressure end of the cylinder A^2 by an independent exhaust-passage c^2. The residuum of steam in high-pressure cylinder A′ is retained as a cushion at the conclusion of the backward stroke of the piston B′. The piston B having completed its downward stroke and passed the lower end of the exhaust-passage *c′*, when the piston B′ is ready to begin its upward stroke, piston B′ will force the exhaust-steam above it through exhaust *c′* underneath piston B; thence it will be forced downward upon the shaft S and be utilized to lubricate the bearings in the crank-case.

When the piston B′ acts in its downward

course, so that the passage g' through the piston B′ uncovers the passage a^2, live steam passes through the piston and enters, through opening e^2 and piston-passage d^2, the high-pressure end of cylinder A^2. The expansion-steam in the high-pressure end of cylinder A^2 flows through the opening e^2 and passage b^2 into the low-pressure end of cylinder A. The exhaust is discharged through passage c^2 into the crank-case, as before. In the same manner live steam is admitted by passage a^3; passage g^2 in piston B^2, opening e, and piston-passage d to the high-pressure end of cylinder A. The expansion-steam in the high-pressure end of cylinder A^2 is conducted through passage b^2 and discharged upon the enlarged portion of piston B. The exhaust is discharged through the exhaust c into the crank-case, where it is utilized to lubricate the bearings. The steam escapes from the crank-case through opening s.

While I have described my invention as embodied in an engine having three cylinders, I do not wish to be understood as confining myself to that number, as two cylinders, or more, can be employed with equal success. Nor do I wish to confine my invention to steam alone, as it is equally applicable to the use of liquids or gases under pressure.

I claim—

1. In a single-acting compound steam-engine, the combination of a series of cylinders, each of two diameters, having pistons working therein, and passages through said pistons and connecting said cylinders, said passages being opened and closed by said pistons, in the manner and for the purpose described.

2. The combination, in a single-acting compound steam-engine, of a series of cylinders, each of two diameters, having pistons working therein, and passages in which steam flows through one cylinder-piston into a second cylinder and actuates the piston working in said second cylinder, substantially as and for the purpose specified.

3. The combination, in a single-acting compound steam-engine, of a series of cylinders, each of two diameters, having pistons working therein, passages in which steam flows through one cylinder-piston into a second cylinder and actuates the piston working therein, and a piston governing the flow of steam, in the manner and for the purpose specified.

4. In a multiple-cylinder single-acting compound steam-engine, the combination of a series of cylinders, each of two diameters, pistons working therein, and a valveless exhaust connecting one cylinder with the free end of a second cylinder, the flow of steam in said exhaust being controlled by the piston of said second cylinder, substantially as described.

5. In a compound single-acting engine, cylinders A A′ A^2, each of two diameters, pistons B B′ B^2, working therein, live-steam passages a' a^2 a^3, and exhaust-passages c c' c^2, combined in the manner and for the purpose specified.

6. In a compound single-acting engine, cylinders A A′ A^2, each of two diameters, pistons B B′ B^2, working therein, live-steam passages a' a^2 a^3, expansion-steam passages b b' b^2, and exhaust-passages c c' c^2, combined in the manner and for the purpose specified.

7. In a compound single-acting engine, cylinders A A′ A^2, each of two diameters, pistons B B′ B^2, expansion-steam passages b b' b^2, working therein, and exhaust-passages c c' c^2, combined in the manner and for the purpose specified.

JOHN H. EICKERSHOFF.

Witnesses:
JAMES N. RAMSEY,
FRANK O. LOVELAND.