(No Model.) 3 Sheets—Sheet 1.

P. BROTHERHOOD.

MULTIPLE CYLINDER ENGINE.

No. 284,372. Patented Sept. 4, 1883.

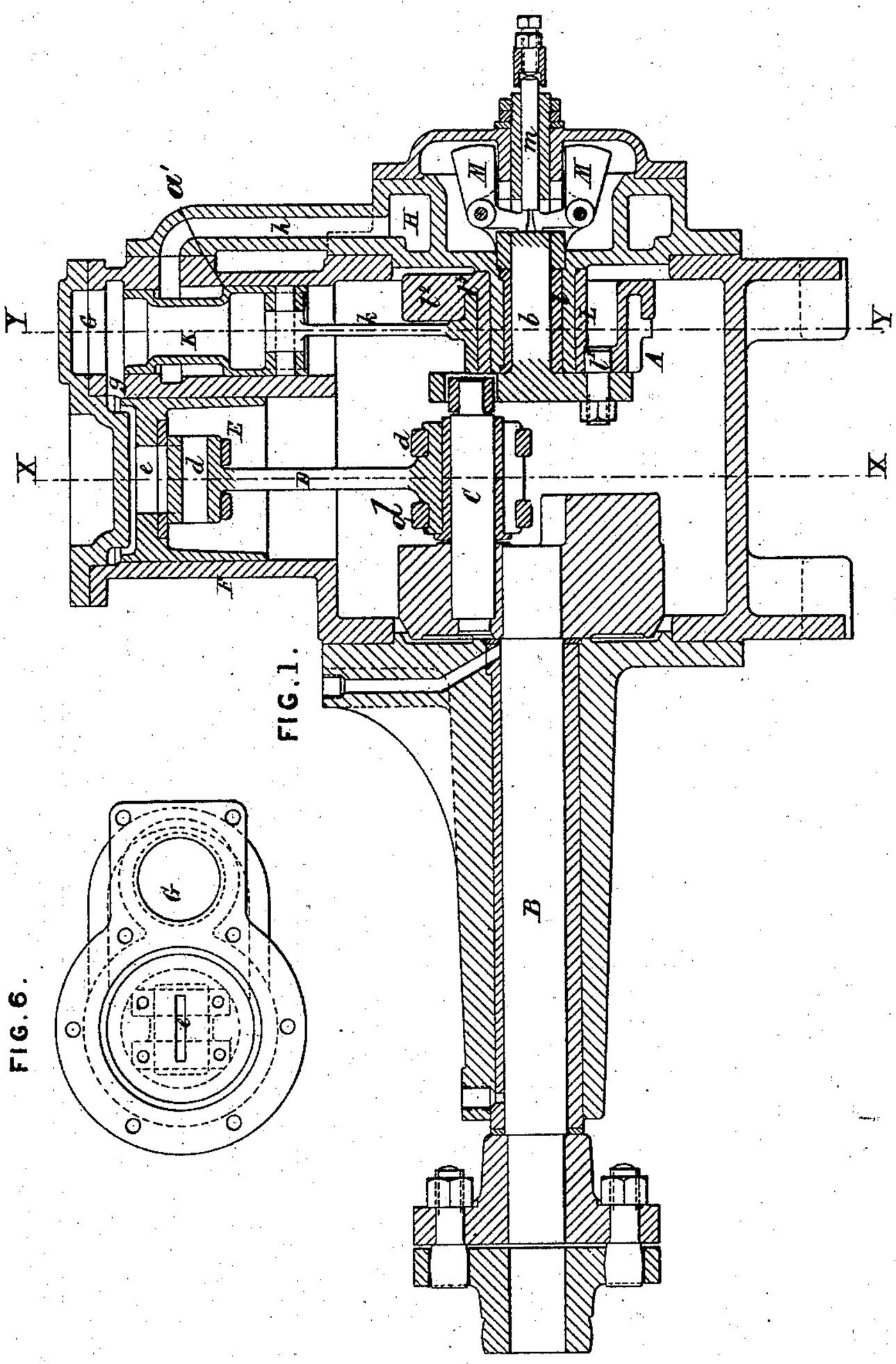

FIG. 1.

FIG. 6.

Witnesses.

J. A. Rutherford.

Robert Everett.

Inventor.

Peter Brotherhood.

By James L. Norris.

Atty.

(No Model.)

3 Sheets—Sheet 2.

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MULTIPLE CYLINDER ENGINE.

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FIG. 3.

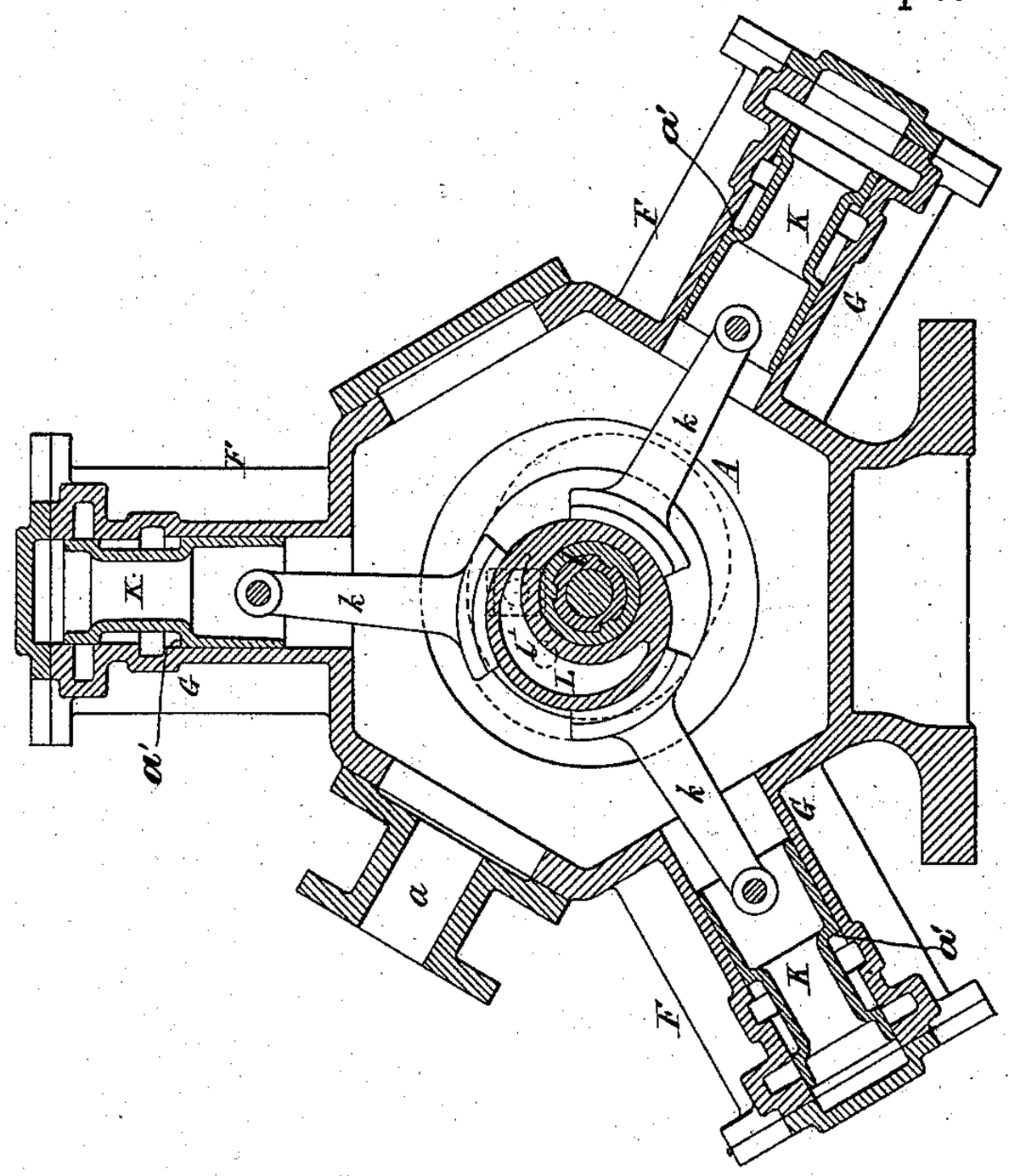

FIG. 2

Witnesses,

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Robert Everett,

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Peter Brotherhood.
By James L. Norris. Atty.

(No Model.) 3 Sheets—Sheet 3.

P. BROTHERHOOD.

MULTIPLE CYLINDER ENGINE.

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FIG. 5.

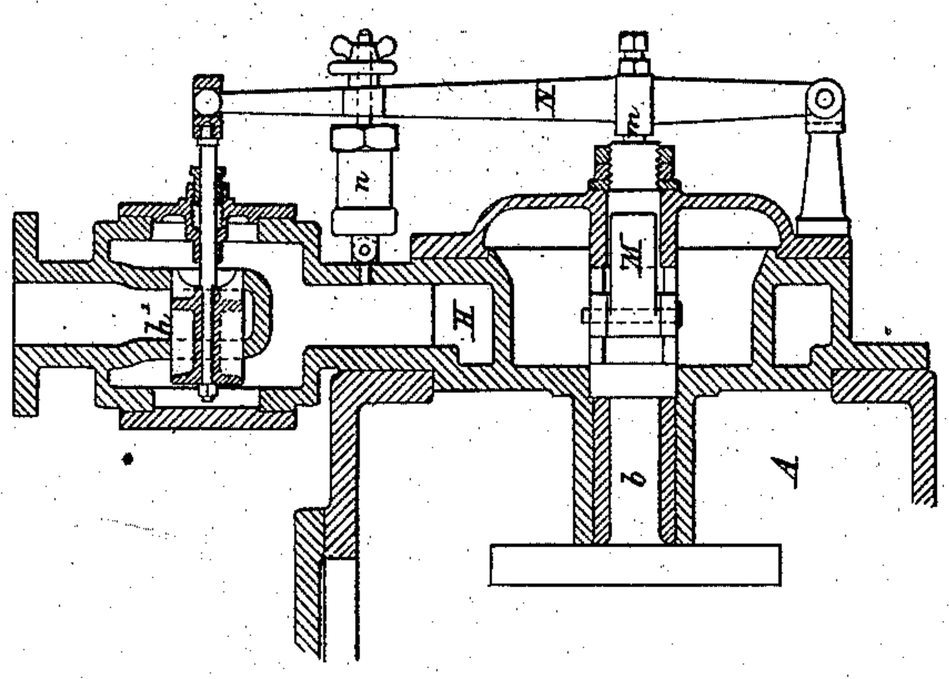
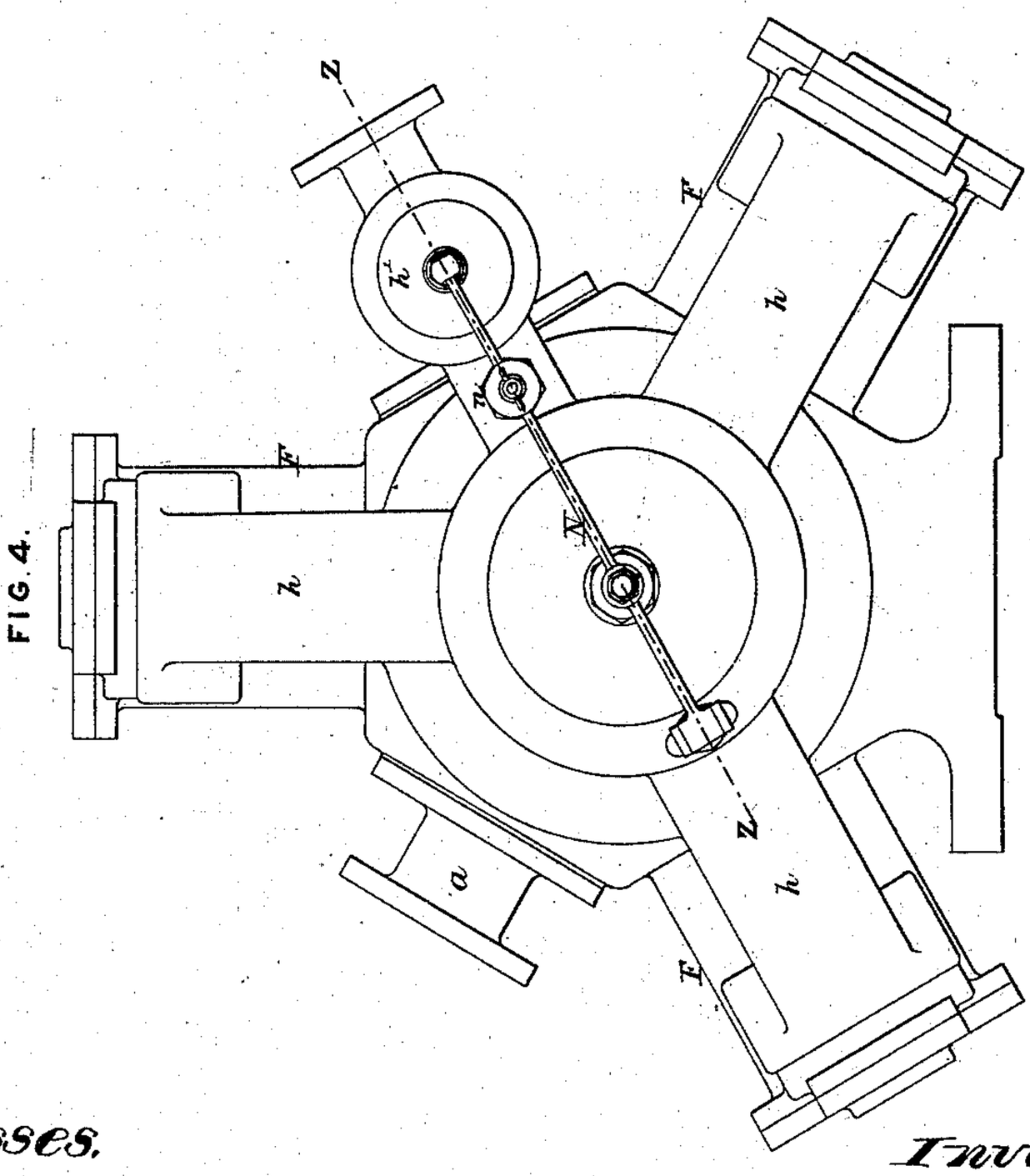


FIG. 4.



Witnesses.

J. A. Rutherford

Robert Everett.

Inventor.

Peter Brotherhood.

By James L. Norris.

Atty.

UNITED STATES PATENT OFFICE.

PETER BROTHERHOOD, OF LAMBETH, COUNTY OF SURREY, ENGLAND.

MULTIPLE-CYLINDER ENGINE.

SPECIFICATION forming part of Letters Patent No. 284,372, dated September 4, 1883.

Application filed June 16, 1883. (No model.)

To all whom it may concern:

Be it known that I, PETER BROTHERHOOD, a citizen of England, residing at Lambeth, in the county of Surrey, England, have invented a new and useful Improvement in Multiple-Cylinder Engines, of which the following is a specification.

My invention relates to engines of the kind having two or more single-acting cylinders radiating from a central cavity within which revolves a single crank linked directly by connecting-rods to the several pistons.

The chief object of my improvement is to alternate the supply and exhaust of each cylinder by means of a slide-valve, and to provide at the same time means of relieving the piston from back-pressure during its return-stroke.

Usually engines of the kind to which my invention relates are made with three cylinders, and I will therefore describe such an engine, embodying my improvement, with reference to accompanying drawings.

Figure 1 is a central vertical longitudinal section. Fig. 2 is a vertical transverse section on the line X X of Fig. 1. Fig. 3 is a similar section on the line Y Y of Fig. 1. Fig. 4 is a side elevation. Fig. 5 is a part section on the line Z Z of Fig. 4, and Fig. 6 is a plan of one of the cylinders and its slide-case.

A is the central cavity into which the cylinders successively discharge the exhaust, which passes away by the exhaust-pipe *a* on one side.

B is the engine-shaft working in a long bearing, preferably lined with soft metal, and having the balanced crank-pin C. On this crank-pin bear the segmental ends of the three connecting-rods D, which are held to it by two rings, *d*. Each connecting-rod D is linked to the deep piston E, working in the cylinder F. So far the construction and arrangement are of the usual kind.

I now proceed to describe the modifications which I adopt in carrying out my improvement.

Each cylinder F has by its side a cylindrical slide-valve case, G, communicating with the cylinder by a short port, *g*, and opening into the central cavity, A. The middle part of the slide-valve case receives supply of steam or other working-fluid by a branch, *h*, from a cavity, H, to which the working-fluid is admitted through a regulating-valve, *h'*, controlled by the governor. The slide-valve case G is bored somewhat larger in its inner than in its outer part, and it is fitted with a cylindrical tubular slide-valve, K, which is worked by a connecting-rod, *k*, having a segmental end bearing against an eccentric, L. This eccentric is free to rotate on a stationary boss, *l*, projecting inwardly from the side of the engine-casing, and having its interior lined with soft metal, so as to form a bearing for a secondary shaft, *b*, in line with the main shaft B. On the shaft *b* is a disk, receiving in a slot a bush fitted on the end of the crank-pin C, and a pin, *l'*, projecting from the back of the disk, enters a hole in the eccentric L. Thus the eccentric is caused to revolve in unison with the crank C, while there is freedom to allow for error of alignment of the shafts B and *b*. The eccentric L is balanced by a block, l^2, and it has a groove, l^3, receiving the edges of the segmental ends of the valve-rods *k*. The eccentric L being properly set relatively to the crank C, the valves K alternate the admission and emission of the working-fluid for the cylinders in succession, the exhaust in each case passing through the valve into its central cavity. The inner end of each valve is of a greater diameter than its outer end, thus forming the annular shoulder *a'*, against which the working-fluid from the branch *h* acts, thereby keeping the segmental ends of the connecting-rods *k* pressed against the eccentric, so that there is no blow resulting from attenuation of their movement, even when the speed is great. As engines of this kind are especially adapted for being worked expansively with steam, compressed air, or other fluid at very high pressure, and the eccentric is therefore set so as to cut off supply at a very early period of the piston-stroke, it is necessary to provide for relief of the pressure that would act against the back-stroke of the piston when the slide closes the cylinder-port during exhaust. For this purpose I cut through the piston a rectangular slot, *e*, and I cut a corresponding slot, *e'*, through the wall of the eye *d*, at the outer end of the connecting-rod D, which eye is made tubular. The latter slot is cut in such a position that as the piston E is making its back-stroke at the time when the valves K are

about closing the exhaust it comes into coincidence with the slot *e* of the piston, and thus there is afforded free passage for exhaust from behind the piston through the slot *e*, and the slot *e'*, and eye *d* into the cavity A, and the back-pressure in the cylinder is thus completely relieved, notwithstanding that the port *g* may be closed by the valve.

For governing the engine, I mount on a sleeve fitted on the secondary shaft *b* weights M in the form of bent levers, the inner arms of which bear against a spindle, *m*, which is free to slide in a hole bored centrally along the shaft *b*. This spindle bears against a lever, N, which is controlled by an adjustable spring, *n*, and which engages the stem of the balanced regulating-valve *h'*.

Although I have described my improvement more particularly as applied in a three-cylinder engine, it is obvious that the arrangement of slide and eccentric and the slots in the piston and eye of the connecting-rod are equally applicable when there are less or more than three cylinders, and whether the engine be worked by steam, compressed air, or other elastic fluid.

Having thus described the nature of my invention and the best means I know of carrying it into practical effect, I claim—

1. In a multiple-cylinder engine, the combination of an eccentric with segmental-ended connecting-rods and cylindrical valves, having their inner ends of larger diameter than their outer ends, substantially as and for the purpose herein set forth.

2. The combination of the connecting-rod D, having the tubular eye *d*, provided with the slot *e'*, opening into said eye, with the piston E, having the slot *e*, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 4th day of June, A. D. 1883.

PETER BROTHERHOOD.

Witnesses:

OLIVER IMRAY,

J. WATT.