5 Sheets—Sheet 1.

R. VAILE.

ROTARY-ENGINE.

No. 192,547. Patented June 26, 1877.

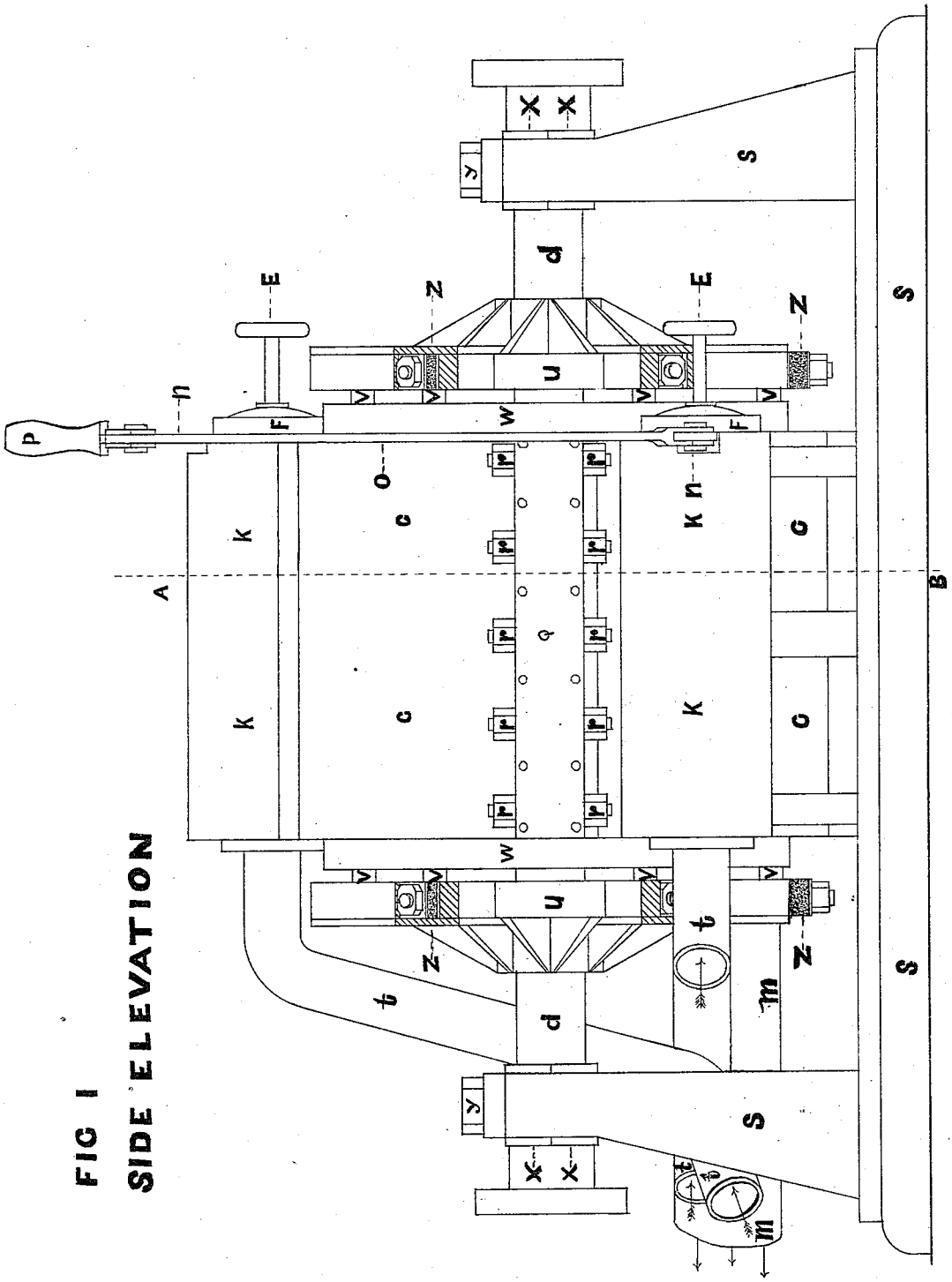

FIG 1 SIDE ELEVATION

Witnesses:
Walter Long

Robert Vaile

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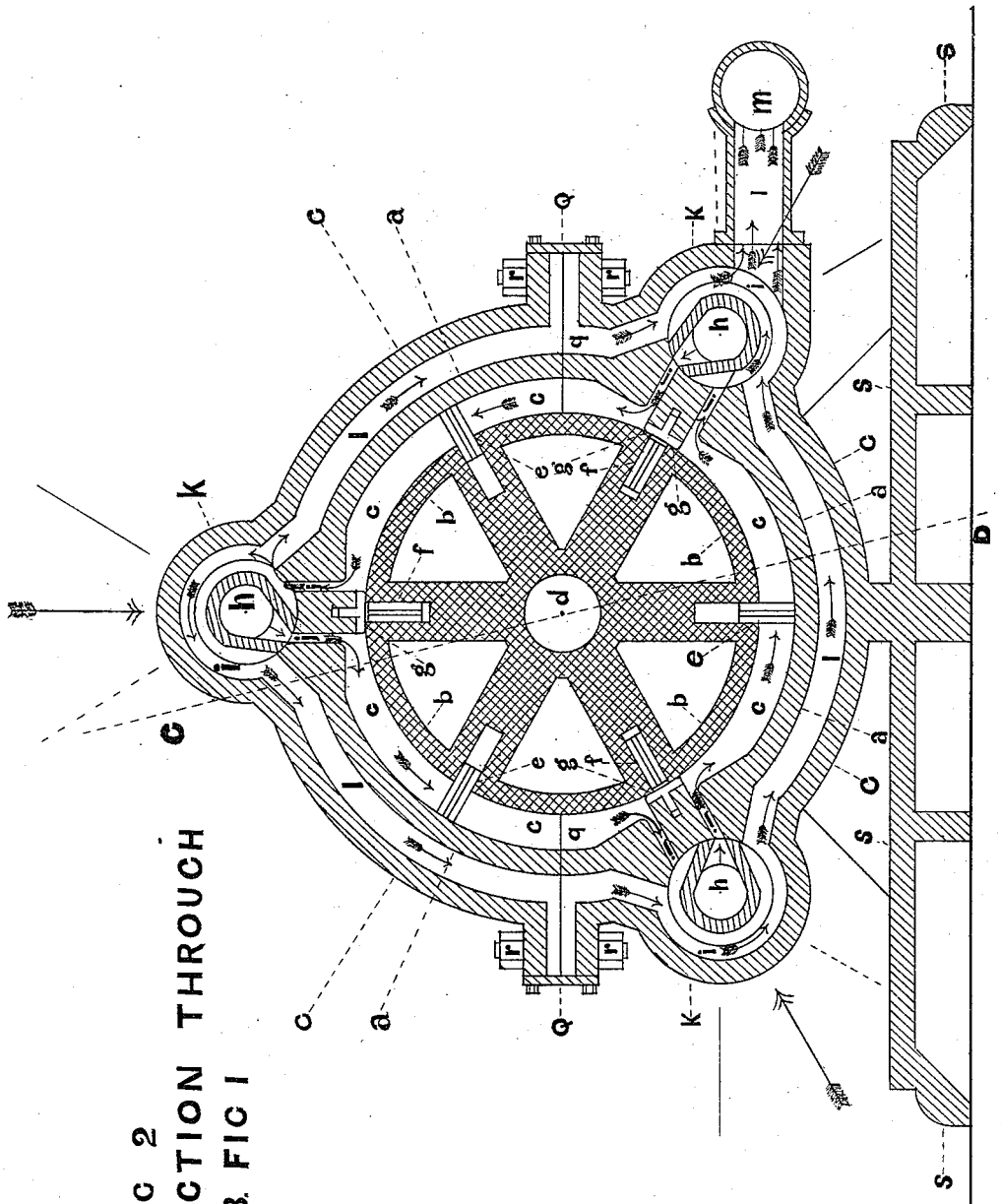

FIG 2 SECTION THROUGH A.B. FIG 1

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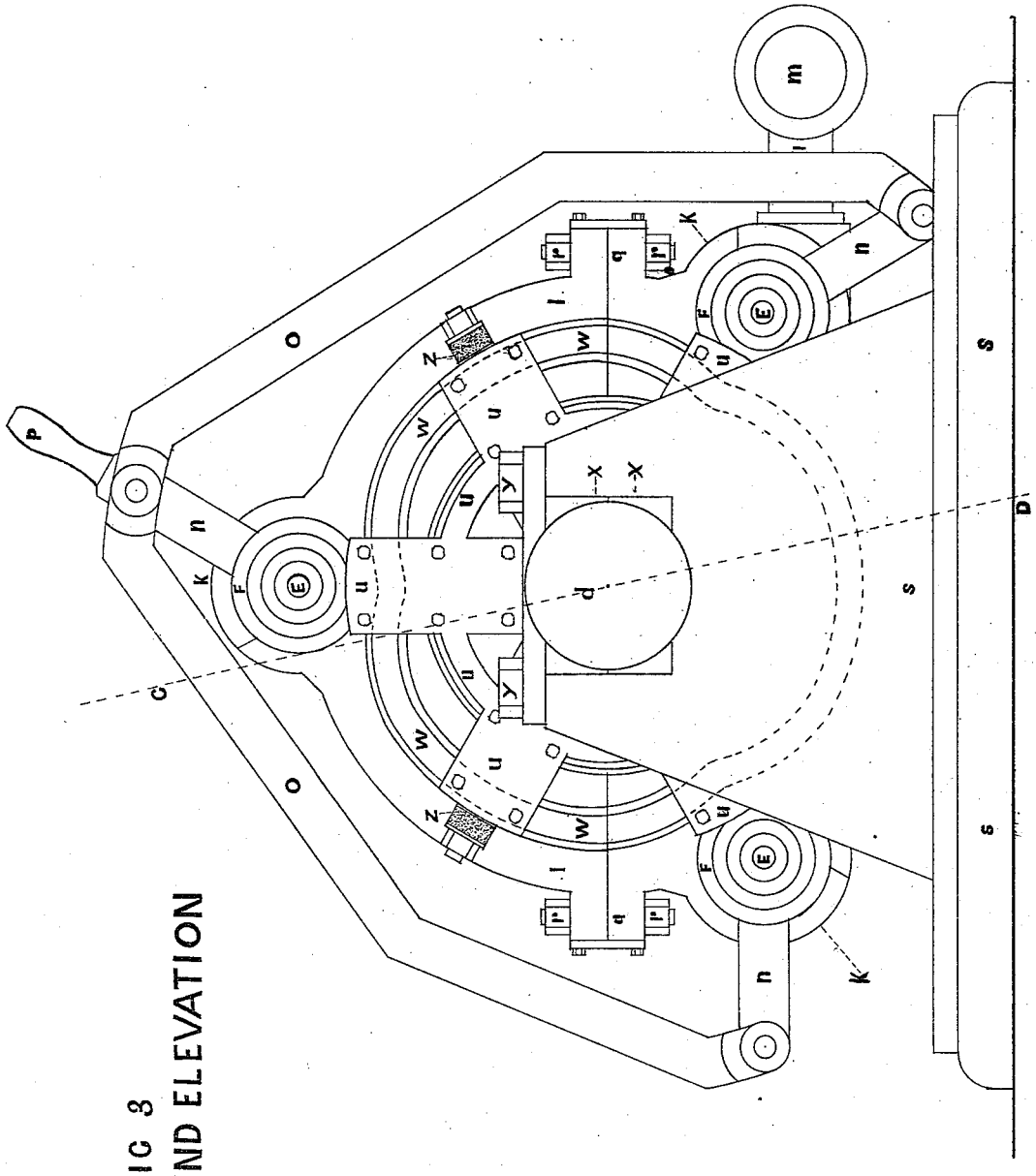

FIG 3
END ELEVATION

Witnesses:
Walter Young

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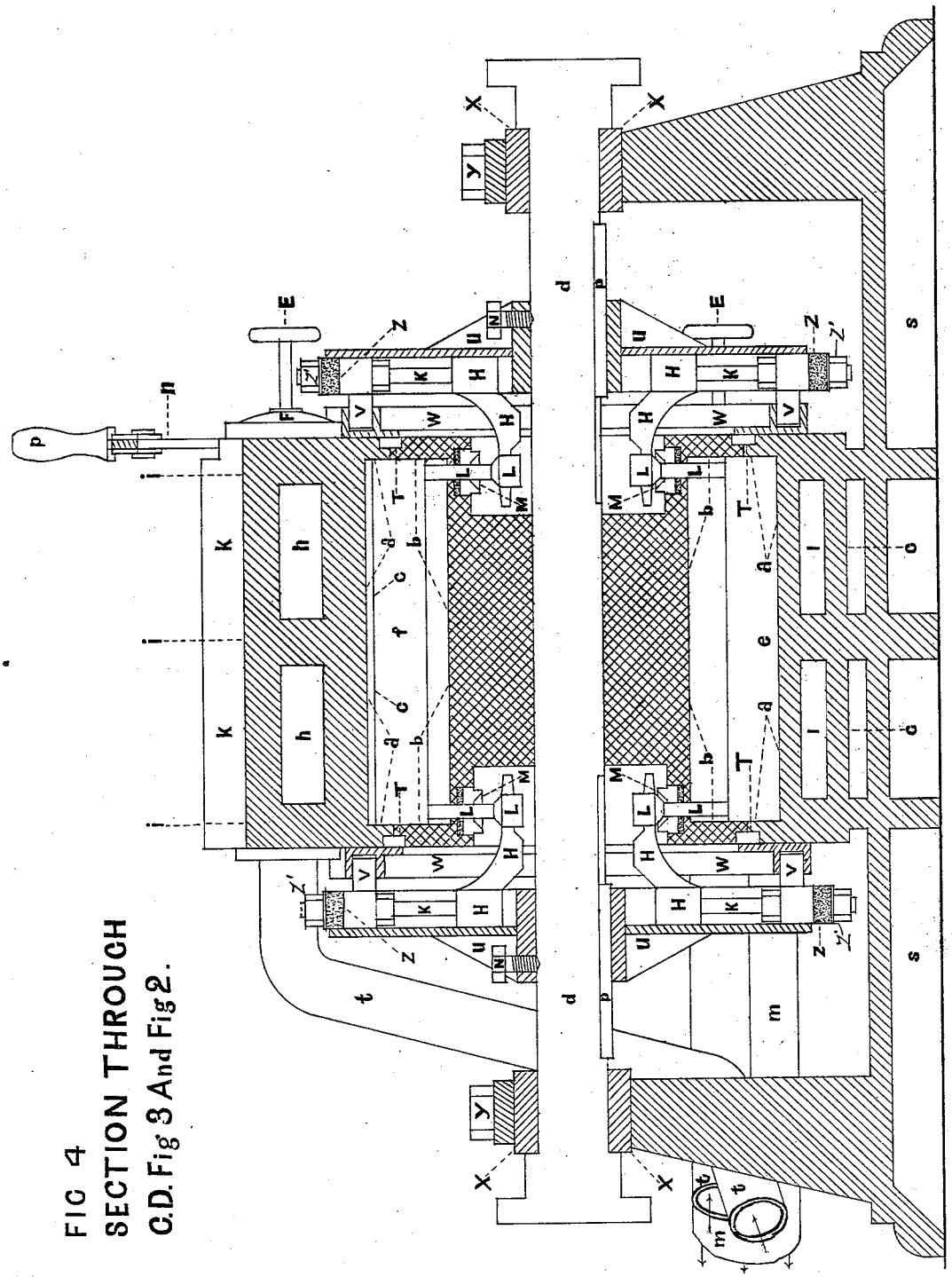

FIG 4
SECTION THROUGH
C.D. Fig 3 And Fig 2.

Witnesses:
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Robert Vaile

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FIG 6

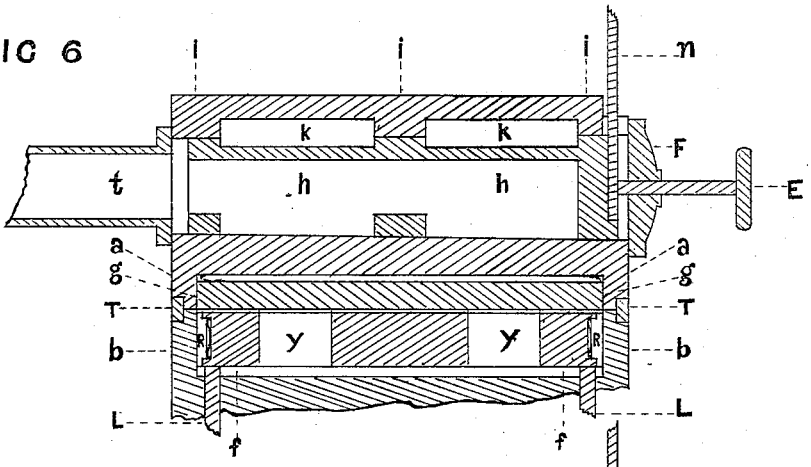


FIG 7

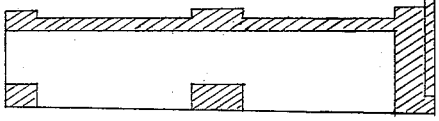
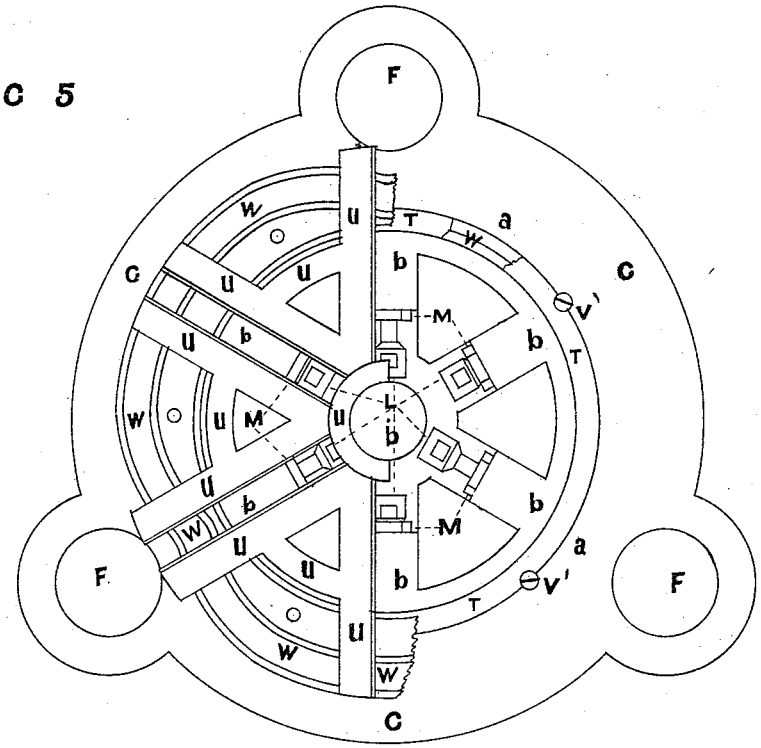


FIG 5



Henry Shaw
Walter Long

Robert Vaile

N. PETERS, PHOTO LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

ROBERT VAILE, OF AUCKLAND, NEW ZEALAND.

IMPROVEMENT IN ROTARY ENGINES.

Specification forming part of Letters Patent No. **192,547**, dated June 26, 1877; application filed July 21, 1875.

To all whom it may concern:

Be it known that I, ROBERT VAILE, of the city of Auckland, in the Province of Auckland, in the British colony of New Zealand, engineer, have invented an Improved Rotary Engine, for applying the motive power of steam, water, atmospheric air, and similarly-acting motive powers, which invention is fully set forth in the following specification, reference being had to the accompanying drawings.

My invention relates to rotary engines for applying motive power; and consists of an arrangement of mechanism for applying the motive power of steam, water, atmospheric air, and similarly-acting motive powers, so as to obtain a rotary motion direct from the power without the use of the crank and its necessary parts, which are now used to produce a rotary motion from the reciprocating engines at present in general use.

I obtain this result by causing a drum or cylinder, attached to a shaft, to revolve within an external cylinder, the steam or other motive power being confined between these two cylinders, and, acting on slides or pistons caused to alternately project and recede from the surface of the internal cylinder, compels the internal cylinder and its shaft to revolve, thus giving the rotary motion desired.

Figure 1 is a side view; Fig. 2, a section through A B of Fig. 1. Fig. 3 is an end view. Fig. 4 is a section through C D of Figs. 2 and 3. Fig. 5 is a partial end view, showing packing-ring, governing-wheel, and the cam-groove. Fig. 6 is a detail in section of the steam-valve, the abutment, and steam-piston. Fig. 7 is a longitudinal section of the steam-valve.

Like letters refer to the same parts in all the figures of the drawing.

In Fig. 2, *a a a a* is the external cylinder; *b b b b*, the internal cylinder; C C C C, jacket covering external cylinder; *c c c c c c*, the steam or other motive-power space between these two cylinders; *d*, shaft of internal cylinder; *e e e*, slides or pistons on which the motive power is acting; *f f f*, similar slides or pistons, which are passing the abutments in the external cylinder. *g g g g* are metal tongues for keeping a steam-tight joint between the abutments in the external cylinder and surface of the internal cylinder. They may be kept in place by springs from above or by steam-pressure. *h h h* are inlet-valves, revolving in sockets *i i i*, which sockets are cast in one piece with the external cylinder; *j j j j j j*, inlet and outlet ports to the engine. When the valves *h h h* are in the direction of the full line, Fig. 2, the engine is working forward; when in direction of the double-headed arrows the motive power is shut off, and all the ports *j j j j j j* are open to the exhaust; when in the direction of the dotted line the engine is reversed, and working backward. It will be observed by following the indications of these lines that the port which is the inlet when working forward becomes the exhaust when working backward, and that port which is the inlet when working backward becomes the exhaust when working forward. When in the direction of the double-headed arrows the valve rests in its seat, and the motive power is shut off, leaving all ports open to the exhaust. *k k k* are exhaust-chambers over valves. I I I I are exhaust-passages connecting exhaust-chambers over valves with main exhaust-pipe *m*. *t t t t*, Fig. 1, are inlet-pipes conveying steam or other motive power to the engine. *n n*, Fig. 3, are levers for turning the valves *h h h*. *o o* are rods for connecting these levers together; *p*, a handle for operating the levers to control the valves *h* to admit steam to the ports *j*, to run the engine either forward or backward, or to stop it. *u u*, Figs. 3 and 5, are wheels which are keyed to the shaft, and revolving with it to govern the movements of the slides or pistons *e e e f f f*, by compelling the studs V to follow the eccentricities of the guides W W. The governing-wheels *u*, as shown in Figs. 2, 3, and 5, rotate with the shaft, and are provided with grooved radial arms, in which the studs V, rods K, and cross-heads H slide. The cross-heads are connected by rods L, which pass through stuffing-boxes M in the internal cylinder, with the steam-pistons *e f*. A cam-groove, W, is fixed to some stationary part of the engine. The depressions in this cam correspond with the fixed abutments *g* in the external cylinder.

As the shaft *d d* is caused to rotate it carries around with it the governing-wheel *u*. The studs V, sliding in the cam-groove W, are moved up and down, which throws the pistons *e* into

the space *c* to be operated by the fluid pressure, and withdraws them into the internal cylinder to allow them to pass the abutments *g*. An elastic material, Z, is fixed on the stems K, between the studs V and the adjusting-nuts Z′. This material keeps the pistons *e* working up steam-tight on the external cylinder, and takes off the jar and strain of these parts. The engine is divided horizontally into two parts, *q q*, the two parts being held together by bolts *v*. Q Q are plates that may be removed to view the joint *q*. The upper half of the external cylinder can be removed and the interior of the engine examined, and, should it be desired to further examine the whole of the internal cylinder, its shaft can be lifted out by releasing the brasses X X X X, in which the shaft *d d* revolves. Y Y are screw-bolts for keeping the brasses X X X X in place. E E E are hand-screws working in covers F to keep valves *h h h*, Figs. 3 and 6, up to their seats. When it is desired to disconnect the engine for examination, the set-screws N N are taken out, and the governing-wheels *u u u u* are drawn along the shaft *d d* in a line with their keys P P, close to the brasses X X X X, thus completely disconnecting the studs V from the eccentric guides W W W W, and the cross-heads H from the connecting-rods L. T T T, Fig. 5, is a spring-packing, closing on the internal cylinder, broken through at W to show joint between internal and external cylinders. V′ V′ are screws to prevent spring-packing revolving with internal cylinder. *y y* are slots through the slide or piston to allow free circulation of steam round it while in the act of projecting from and receding into the internal cylinder. R R, Fig. 6, are metal tongues for making the ends of the slides or pistons steam-tight and compensating for wear. They are kept up by springs at their back.

If desired, instead of using india-rubber for the cushions Z, metal springs can be substituted.

Though in the accompanying drawings three inlet-valves are shown and six slides or pistons, I by no means confine myself to these numbers, but work with these, or more or less, according as I want steam-surface, or wish to adapt the engine for working expansively.

When working expansively, I either place expansion-valves in the inlet-pipes *t*, or cause the valves *h* to rock, so as to admit and cut off the steam or similar motive power at any period of the revolution desired, in either case working such valve by a movement from the main shaft.

If desired, two of these engines of different capacity can be used on the compound principle, as in the present reciprocating engine, by taking steam at a high pressure direct from the boiler into the smaller engine, and from it expanding into the larger.

In some cases, instead of jacketing the external cylinder with exhaust steam, I connect the exhaust-chambers *k* by pipes, so as to complete the circuit, and convey the exhaust steam to the main exhaust-pipe *m*.

When the jacket G is used, and the length of cylinder will permit, I prefer, instead of using the inlet-pipes *t*, as shown in the drawings, to take a portion of the jacket G for the supply steam, and the other portion for the exhaust steam, connecting the main steam-pipe with any convenient part of the jacket, at the same time shortening the valves *h* with their sockets, and the ports of the engine to the breadth of that portion of the jacket reserved for the exhaust steam, the end sockets of the valves *h* being formed in the wall dividing the chambers containing the supply and exhaust steam, thus taking in steam at their ends in the same manner as shown in the drawings by the inlet-pipes *t*.

I am aware that the principle of a rotary engine is not new, and I therefore make no claim thereto; but

I claim—

1. The combination, in a rotary engine, of a governing-wheel, *u*, the cross-heads H, the rods L attached to the steam-pistons, the rods K, the studs V, and the cam W, substantially as described, whereby sufficient space is provided to give long and free curves to the cam-guide.

2. The combination of the steam-piston, the connections L H K, the stud V, the cam W, and the cushioning device Z, substantially as described, whereby the pistons are kept steam-tight and are readily adjusted.

3. The combination, with the governing-wheel, of the steam-piston, the cross-head, the stud V, the cushioning device Z, and the adjusting-nuts on the stem K, substantially as described.

4. The combination of the horizontally-divided cylinders *a*, *b*, and *c*, the plates Q, the pistons and abutments, the steam-ports *j j*, and exhaust-passages I, substantially as described.

5. The combination of the hollow steam-valves *h*, the steam-passages *j j*, the exhaust-passages I, the lever O for connecting the valves, by which they are operated to start, stop, and reverse the engines, substantially as described.

ROBERT VAILE.

Witnesses:
HENRY SHAW,
WALTER LONG.