(Model.)

4 Sheets—Sheet 1.

# G. W. MILLER.

## Rotary Engine.

No. 230,886. Patented Aug. 10, 1880.

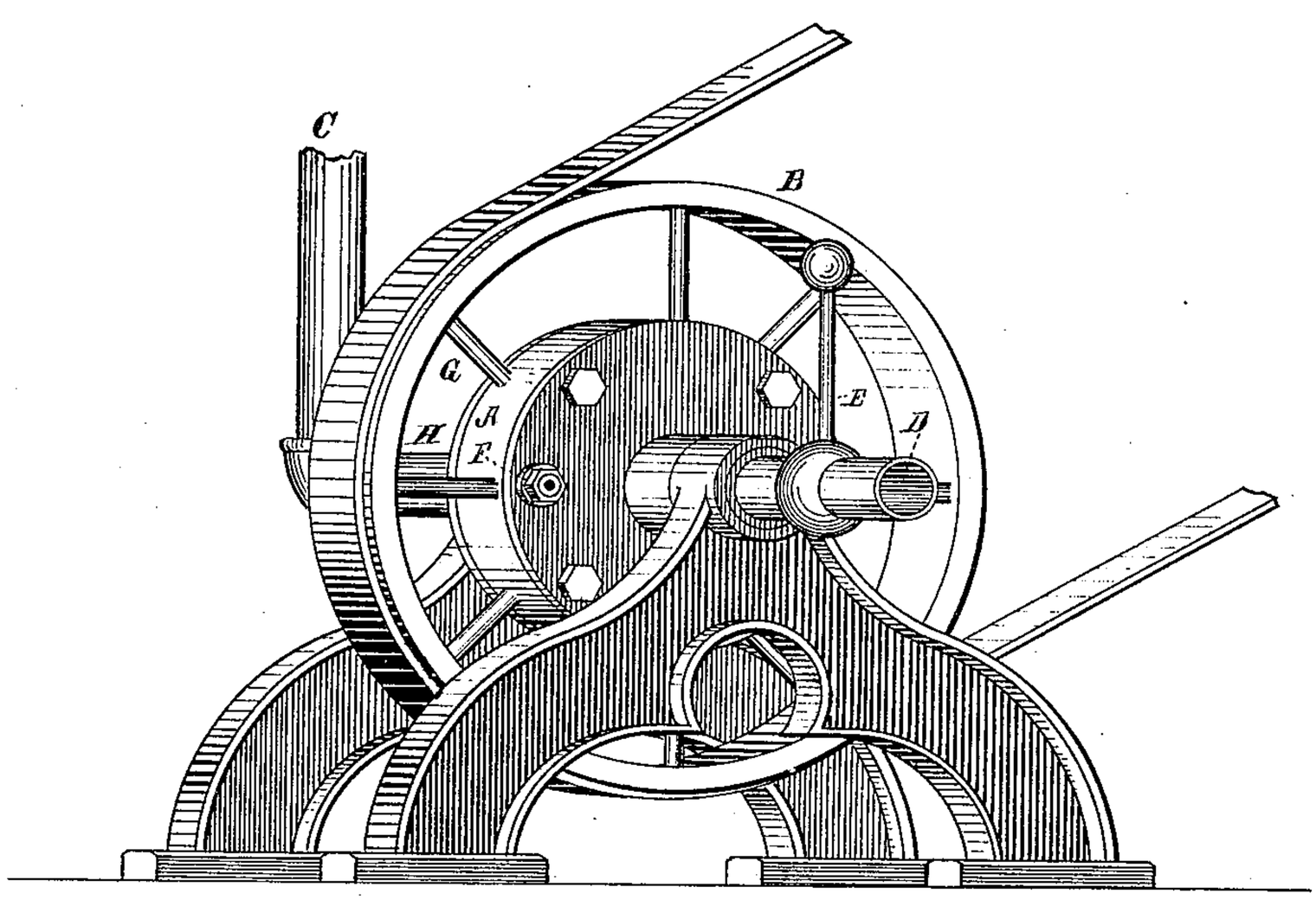


Fig 1

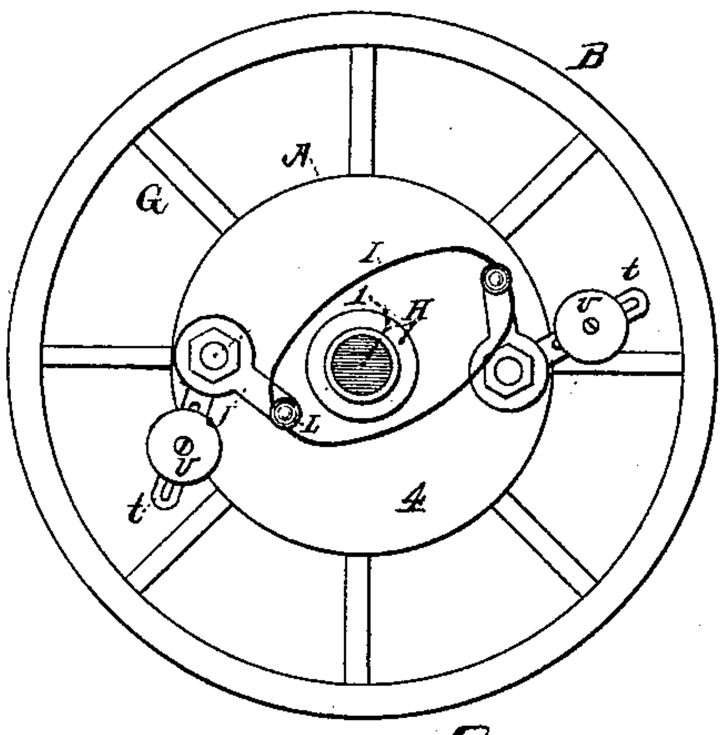


Fig 2.

WITNESSES:

Jno R. Woods.

E. P. Phillips

George W. Miller INVENTOR

by

James N. Lee. ATTORNEY

(Model.) 4 Sheets—Sheet 2.

# G. W. MILLER.

## Rotary Engine.

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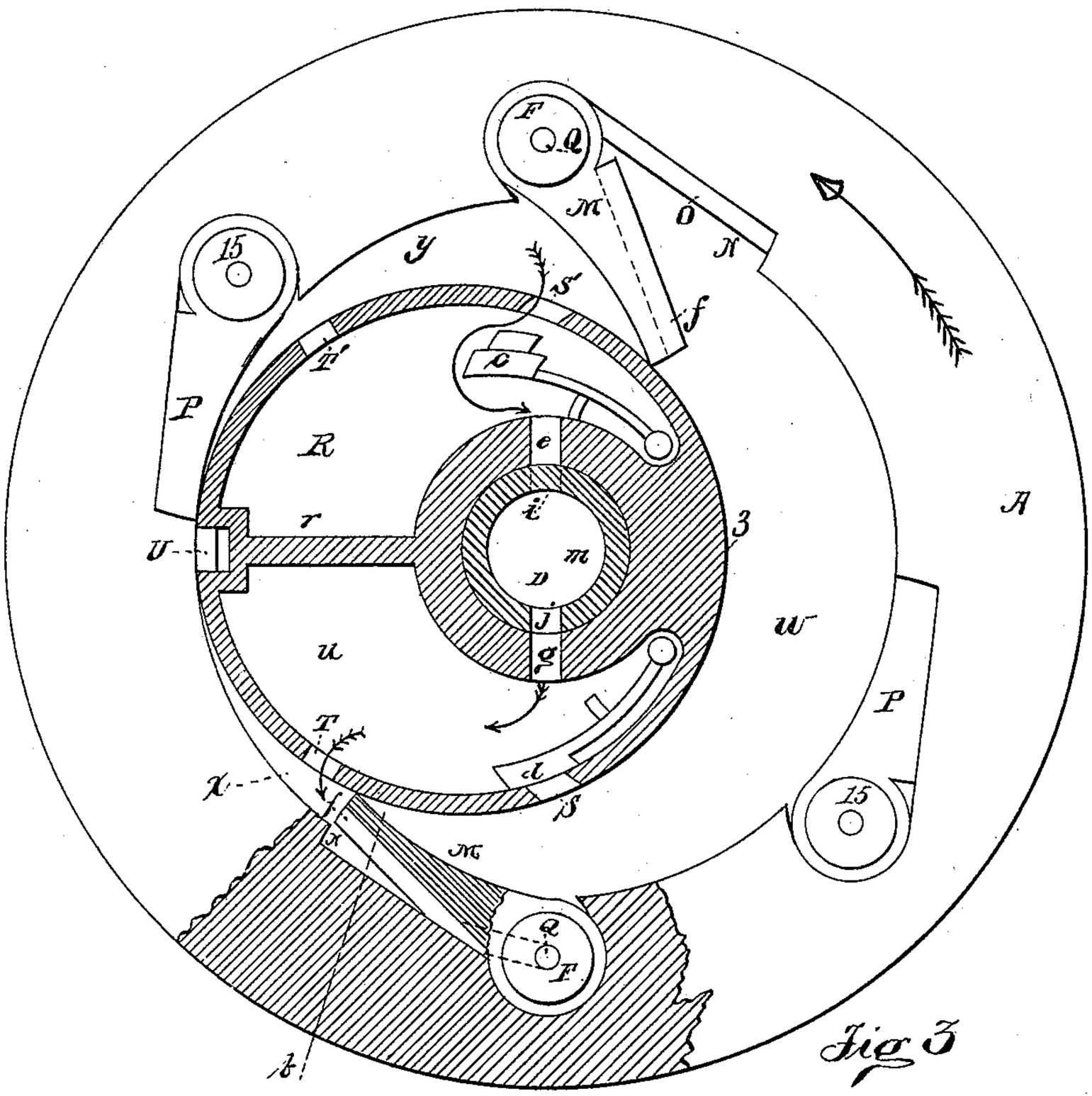


Fig 3

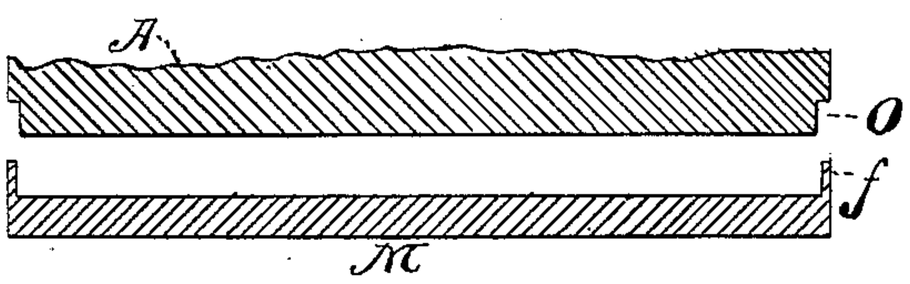


Fig 4

WITNESSES:

Jno R. Woods.

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(Model.)

4 Sheets—Sheet 3.

# G. W. MILLER.

## Rotary Engine.

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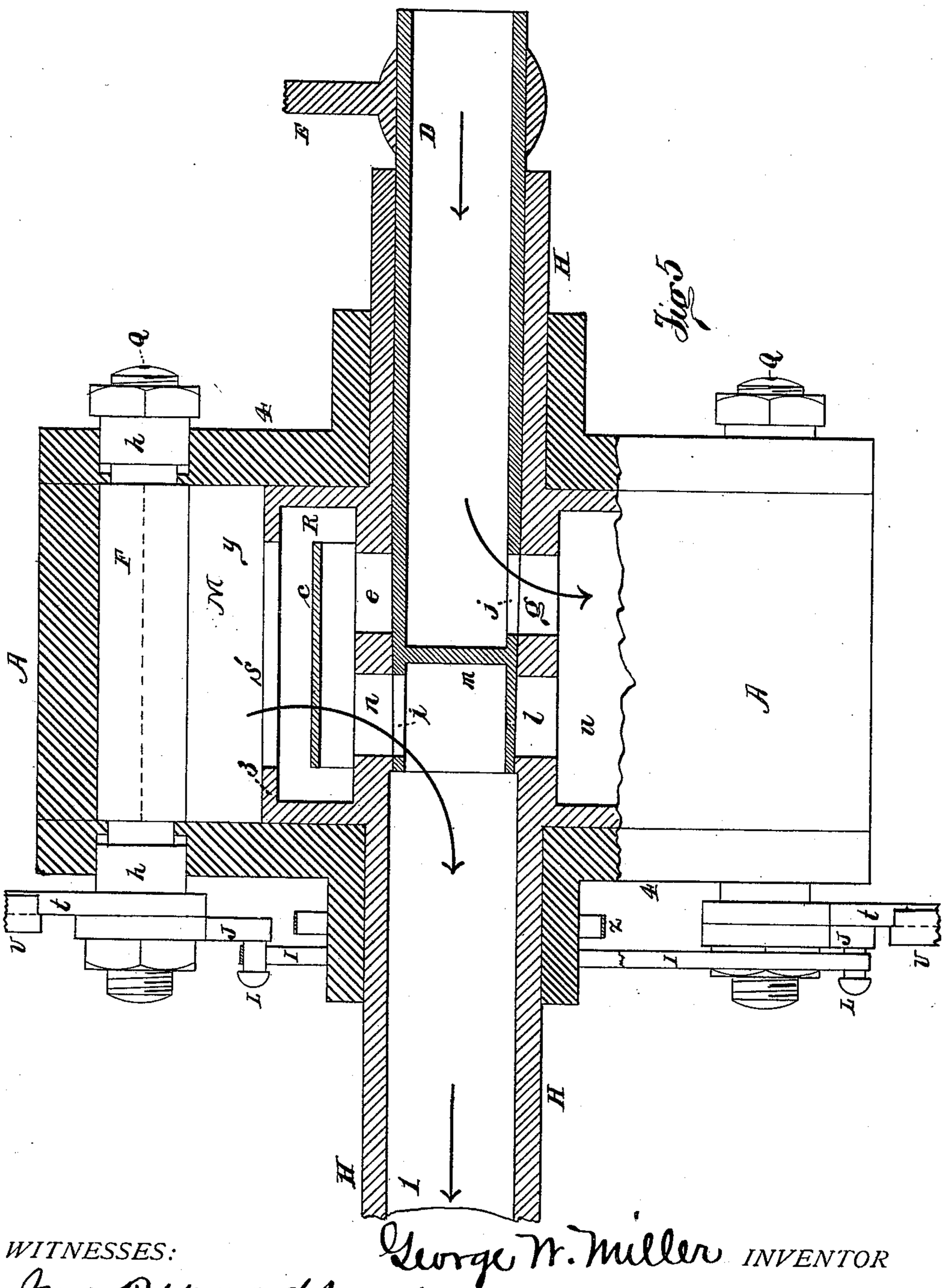


WITNESSES:

Inv. Reynolds.

C. Phillips

George W. Miller INVENTOR

by James W. See

ATTORNEY

(Model.)

4 Sheets—Sheet 4.

# G. W. MILLER.

## Rotary Engine.

No. 230,886. Patented Aug. 10, 1880.

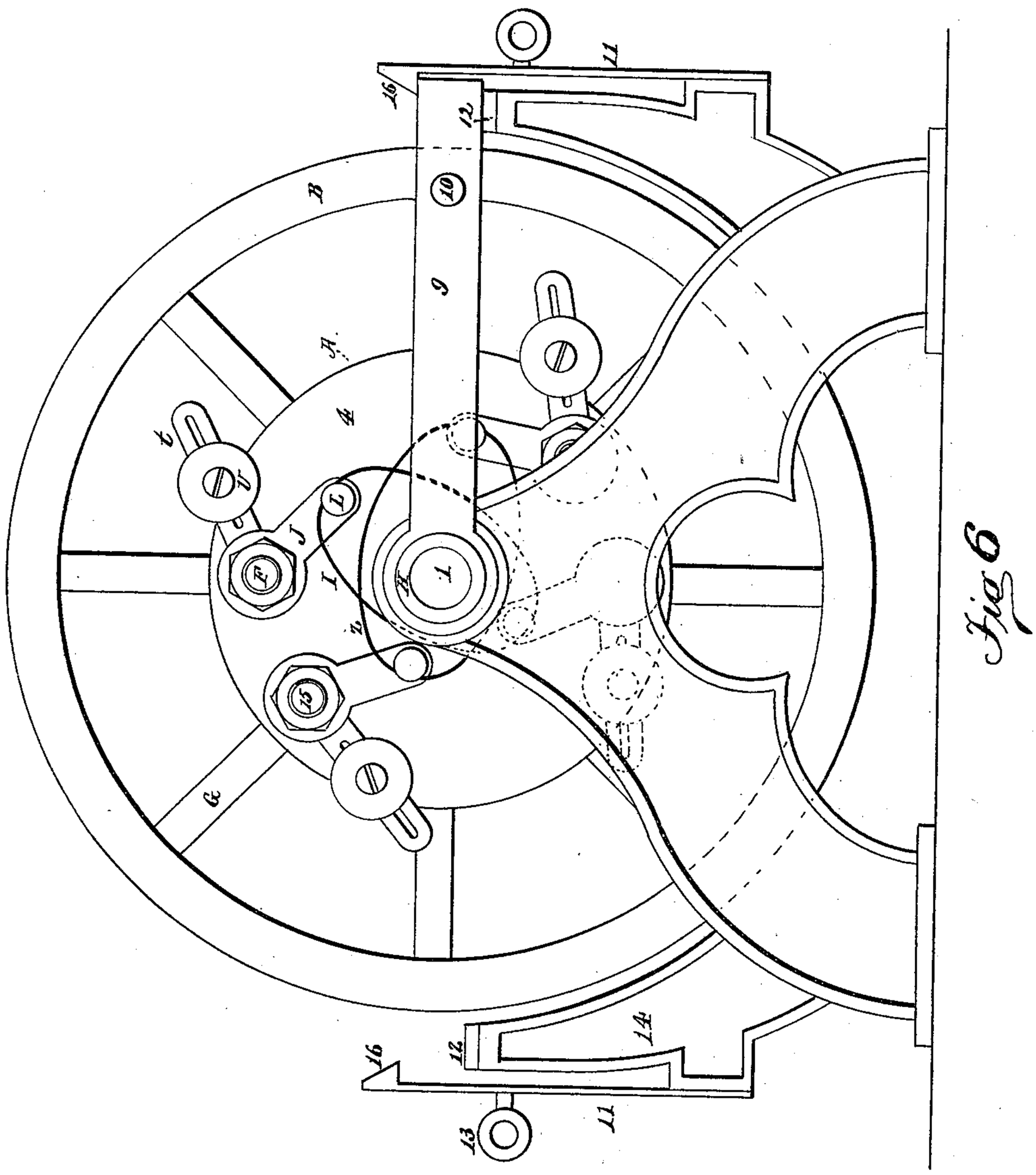


Fig 6

WITNESSES:

Inv. Reynolds.

C. B. Phillips

George W. Miller INVENTOR

by James W. See

ATTORNEY

# UNITED STATES PATENT OFFICE.

GEORGE W. MILLER, OF HAMILTON, OHIO.

## ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 230,886, dated August 10, 1880.

Application filed May 4, 1880. (Model.)

*To all whom it may concern:*

Be it known that I, GEORGE W. MILLER, of Hamilton, Butler county, Ohio, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

In the accompanying drawings, Figure 1 is a perspective view of a rotary engine embodying my improvements; Fig. 2, an end elevation of the exhaust end of the machine; Fig. 3, an end elevation, part section, of the cylinder with head removed, exposing the interior; Fig. 4, a section of part of the cylinder and part of a piston; Fig. 5, a side elevation, part section, of the cylinder, &c.; and Fig. 6, an end elevation of the discharge end of the engine with reversing mechanism attached.

In this engine the cylinder revolves around a stationary abutment; but from the description it will be obvious that the cylinder may be made the stationary part and the abutment become the revolving part.

In Fig. 1, A is the cylinder. It is fitted to revolve upon an abutment having a hollow shaft. Steam enters at D and discharges at C. Radial spokes G connect the cylinder with the non-conducting pulley-rim B, made of wood or other good non-conductor of heat. An air-space is left between the inside of the pulley-rim and the outside of the cylinder. This prevents the damaging by heat of the belt, which is run directly from the pulley B.

In Fig. 3, A is the cylinder, with the head at the steam end of the machine removed. Fig. 5, in connection with Fig. 3, will allow the interior devices to be understood.

3 is an eccentric abutment, whose swell reaches and fits against the interior or bore of the cylinder. Packing U is inserted in the swell of the eccentric at this point. In the metal of the cylinder pistons M and P are journaled. These pistons are simple wings attached to stems F and 15, fitting in seats in the cylinder close to the bore. The stems project through each head and are provided with packing-glands *h*. Holes Q, drilled part way into one end of the stems and then meeting a transverse hole reaching into the interior of the cylinder, form the cylinder-drains, and the usual cylinder-cocks may be used in these holes. The pistons fold or swing into recesses N in the bore of the cylinder and swing down or in upon the outer surface of the eccentric.

In order to insure durability to the end fit of the pistons against the cylinder-heads, light flanges *f* are fixed on the back of the pistons. Being light and somewhat flexible, they fit with a slight elastic pressure against the cylinder-heads, and when much worn may be readjusted by bending or setting. Rabbets O in the recesses N give room for the packing-flanges *f*. The arrrangement is plainly shown in Fig. 4.

If the engine is not to be reversed in motion, only two pistons are needed, and for the present I will assume that there are but two—those lettered M.

The eccentric abutment 3 has a hollow shaft, H, projecting at each end. This shaft is to be firmly clamped in the framing, so as to prevent the abutment from revolving. The eccentric is hollow, and the partition *r* divides it into two compartments, R and *u*. *u* is the steam-compartment, receiving steam through the hollow shaft at the end marked D. T is a steam-port in the shell of the eccentric. R is the exhaust-compartment of the abutment, and discharges its steam through the end of the hollow shaft marked 1. S′ is the exhaust-port in the shell of the abutment.

The pistons M M are valves as well as pistons. The pistons are held against the abutment by means of the band-spring I. (Shown in Fig. 2.) This spring engages with studs L in the ends of arms J, fixed upon the projecting ends of the piston-stems. The pistons are thus held to the abutment with a yielding and supple pressure. In addition to the force of the spring I, the pistons are held to the abutment by the pressure of the steam upon them, as in Fig. 3. Full-pressure steam is upon the right-hand side of the upper piston, while exhausting steam only is upon the left side. This preponderance of pressure presses with excessive force upon the pistons, and in order to lessen the effect of this pressure I fix upon the stems of the pistons arms *t*, adjustable upon the stem angularly, and carrying weights *v*, adjustable radially upon the arms. Centrifugal force, acting through the medium of these weights and arms, may be caused to counteract the pressure of steam upon the pistons, and thus

prevent undesirable friction between the pistons and the abutment.

The operation of the valve-pistons will now be explained in connection with Fig. 3. Assume that the steam-compartment *u* of the abutment is always in free communication with live steam, and assume that the exhaust-compartment is always in free communication with the atmosphere, when the parts are in the position shown in Fig. 3 live steam from the compartment *u* passes through the steam-port T into the space *x* inclosed by the abutment, the cylinder-walls, and the lower piston, M. The pressure of this steam will cause the cylinder to revolve in the direction indicated by the arrow. Steam will continue to pass into the space *x*, which is, of course, continually enlarging, until in the course of the revolution the upper piston shall have passed over the steam-port T. At this period a new space, *x*, will be formed by the new piston, and the original space *x* has been enlarged into the space *w*, bounded by the abutment, the cylinder walls, and both pistons M. The confined steam in this space *w* will now act by expansion till the upper piston shall have uncovered the exhaust-port S′, when the steam from the space *w* will exit into the atmosphere through the compartment R. This is the entire operation of the engine, so far as it is considered a non-reversing engine.

If, by a change in the direction of steam-flow, we cause the upper compartment, R, to become the live-steam compartment, and cause the lower compartment, *u*, to become the exhaust-compartment, the cylinder would obviously tend to revolve in a reverse direction; but the ports in the shell of the abutment would hardly be in proper position, and the steam would be found to press under the pistons, tending to lift them and destroy their function.

In order to make the engine properly reversing, means are provided, as will hereinafter be described, for transposing the duties of the two compartments of the abutment. Each compartment is furnished with a steam-port, T, in the lower compartment and T′ in the upper one. An exhaust-port, S, for the lower one and S′ for the upper is provided for each compartment. The exhaust-ports S and S′ are fitted with valves *c* and *d*, which will close by the pressure of live steam. In whichever compartment live steam happens to enter the valve will close, and thus automatically suppress the exhaust-port in the live-steam compartment.

The steam-ports are not provided with valves, as their existence in an exhaust-compartment has no effect.

For reversing, a second pair of pistons is provided. These pistons P P are similar to the others, but face in the opposite direction. In the drawings they are shown as out of action entirely for the purpose of simplifying previous description, but in reality they bear against the abutment the same as the others. The presence of a pair of idle pistons while another pair is doing the work does no harm. The second pair of pistons is provided with band-spring, arms, and weights, as shown in Fig. 6, precisely as the first pair.

It will thus be seen that the cylinder will revolve in either direction, according to which of the two compartments of the abutment the live steam is admitted.

In Fig. 5, H is the hollow shaft of the abutment 3. A pair of ports, *n e*, lead to the upper comparment, R, of the abutment, and a pair of ports, *l g*, lead to the lower compartment. Into the right-hand end of the hollow shaft is fitted the throttle-pipe D, having a hand-lever, E. This pipe is tapered or spigoted at the ports so as to be steam-tight. Opposite ports, *i* and *j*, are cut in the throttle-pipe to match the ports in the hollow shaft. There are but two ports in the throttle-pipe, and a transverse partition, *m*, in the throttle-pipe separates the ports.

In the position shown in Fig. 5, live steam entering the throttle-pipe at the right-hand end must pass into the lower compartment of the abutment, and exhaust-steam from the compartment R must exit to the left. If the throttle-pipe be slightly revolved, the ports will be somewhat closed and the speed of the engine reduced. Any form of governor may operate on this throttle-pipe to regulate speed.

Revolving the throttle-pipe till the ports are closed will stop the engine, and turning the throttle-pipe half round will admit live steam to the upper compartment instead of the lower one, and will at the same time place the lower compartment in communication with the atmosphere. This operation, as previously referred to, will reverse the motion of the engine.

In connection with the hand-lever E, as shown in Fig. 1, any form of segment and detent lock may be used to hold the lever in place at any point it may be put.

In Fig. 6 is shown the automatic reversing-gear. It will be readily understood that if the throttle-pipe be held stationary and the abutment be revolved half-way the engine will reverse.

In Fig. 6, 9 is a lever fixed upon the hollow shaft of the abutment. The end of this lever is locked between a buffer, 12, and a spring-hook, 16, and the abutment is thus prevented from turning. If the hook be pulled back, the lever will be released. The abutment, always tending to revolve in a direction contrary to that of the cylinder, will revolve half round, causing the lever to lock under the left-hand hook. There is a point in this motion of the abutment where the steam ceases to urge it, owing to the ports being both open. Momentum of the abutment and lever will complete the motion and the buffers 12 arrest the lever and prevent undue jar. The engine is thus reversed in motion by simply relieving the engaging-hook by means of a cord in the eyes 13, or otherwise.

For an engine not intended to reverse, the partition *m* (shown in the throttle-pipe) may be

fixed in the hollow shaft, and only one port leading to each compartment of the abutment will be required. The throttling or regulation may be effected by any suitable devices in the steam-pipe.

I claim as my invention—

1. The cylinder A, eccentric abutment 3, having ports S, *g*, S′, and T, hollow shaft H, partition *m*, pistons M M, arms J, and spring I, combined substantially as set forth.

2. The cylinder A, pistons M M and P P, arms J J and I I, springs I and Z, abutment 3, ports S S′ T T′, valves *c* and *d*, ports *n*, *e*, *l*, and *g*, hollow shaft H, throttle-pipe D, ports *i* and *j*, and partition *m*, combined substantially as set forth.

3. The pistons M, combined with the flexible flanges *f*, substantially as set forth.

4. The combination of the pistons M, stems F, arms J, spring I, arms *t*, and weights *v*, substantially as set forth.

5. The cylinder A, abutment 3, shaft H, lever 9, and hooks 16, combined substantially as set forth.

6. The combination, with the abutment and journaled hollow shaft fixed therein, provided with radial ports *n g* and a taper to a portion of its bore, of a throttle-pipe fitted and adapted to rotate within said hollow shaft, so as to form a steam-tight joint at the said taper in the hollow shaft, and provided with radial ports *i j*, and a transverse partition, *m*, located between the ports, the whole constructed and arranged to operate substantially as set forth.

GEORGE W. MILLER.

Witnesses:
J. W. SEE,
NELSON WILLIAMS.