No. 664,509. Patented Dec. 25, 1900.

F. G. TEES.

ROTARY ENGINE.

(Application filed Sept. 13, 1899. Renewed May 8, 1900.)

(No Model.) 2 Sheets—Sheet 1.

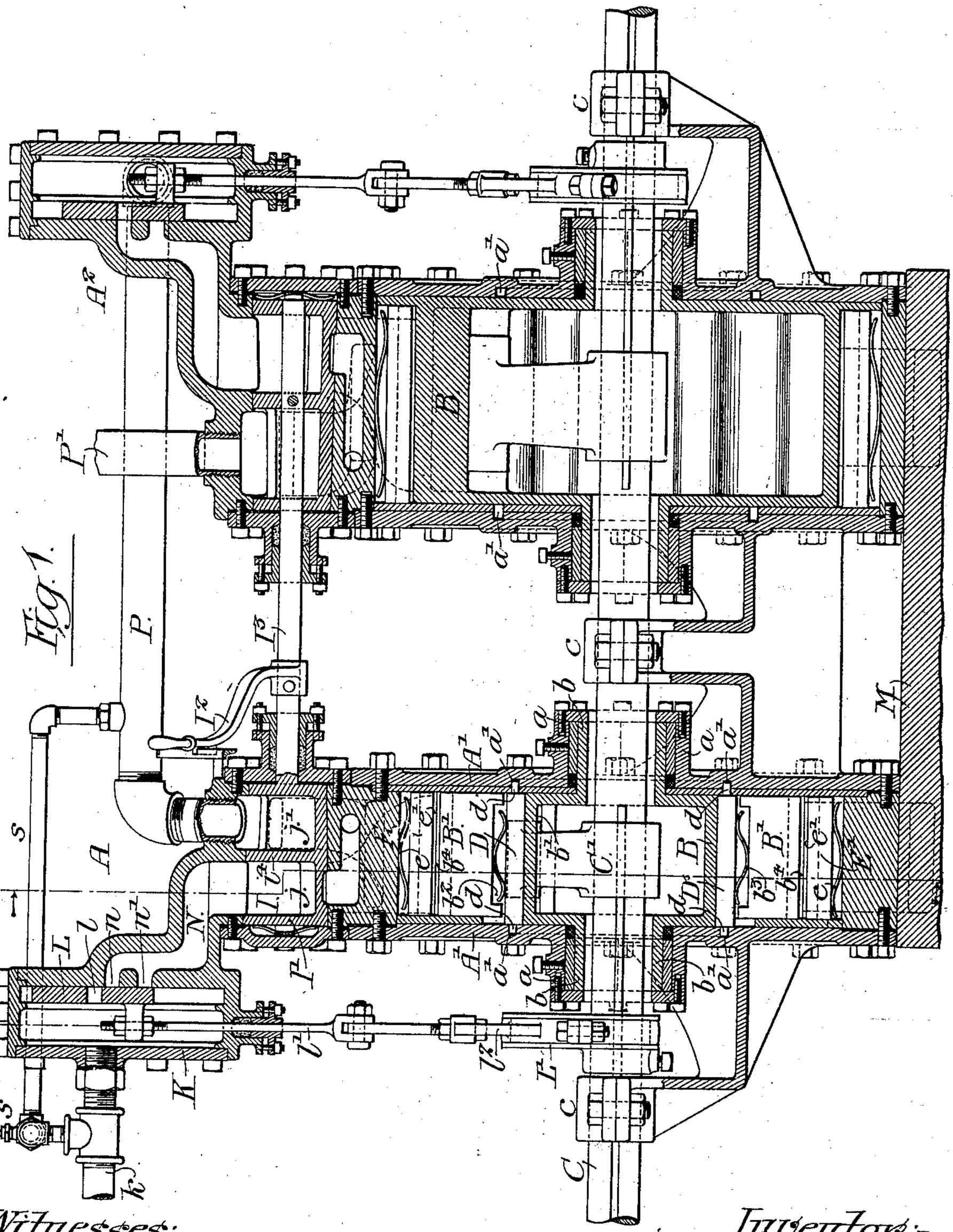

Fig. 1.

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Fig. 3.

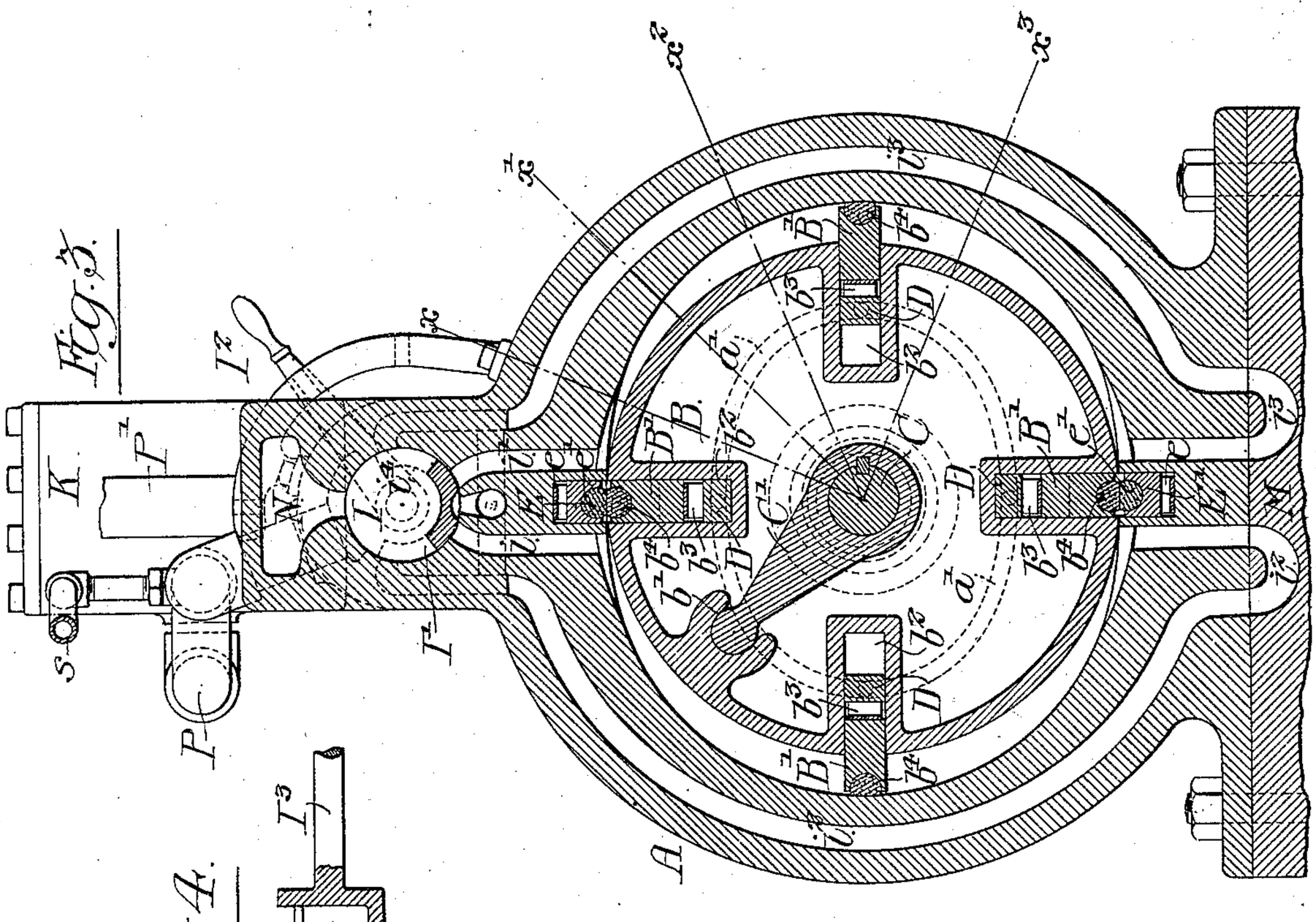
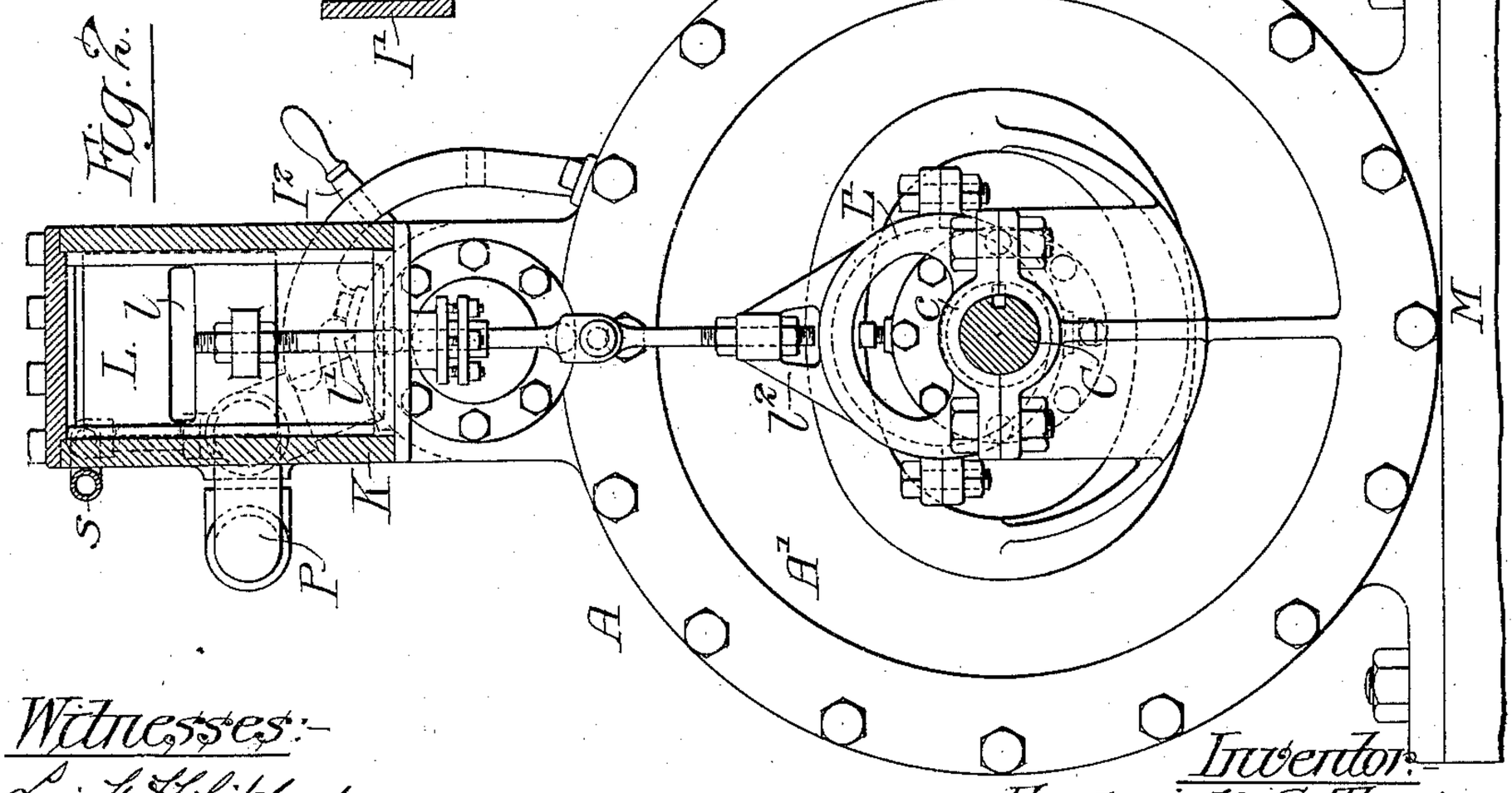


Fig. 4.

Fig. 5.



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UNITED STATES PATENT OFFICE.

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ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 664,509, dated December 25, 1900.

Application filed September 13, 1899. Renewed May 8, 1900. Serial No. 15,978. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK G. TEES, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Rotary Engines, of which the following is a specification.

The object of my invention is to so construct a simple and compact rotary engine which can be readily used either as a single or a compounding engine without materially altering the valve mechanism and by simply duplicating the parts and making sundry connections, as fully described hereinafter.

In the accompanying drawings, Figure 1 is a longitudinal sectional view of my improved engine, showing two cylinders coupled to form a compounding engine. Fig. 2 is a front view with the valve-chest in section. Fig. 3 is a section on the line 3 3, Fig. 1; and Fig. 4 is a section of the controlling-valve.

In setting forth my invention I will describe the high-pressure engine in detail as follows, it being understood that the engine may be used as a single high-pressure engine or coupled to another and used as a compounding engine, as shown in the drawings.

A is the cylinder of the engine, and within the cylinder is mounted the hub B, in which slide the piston-blades B′—four in the present instance. The interior of the cylinder is shaped as clearly shown in Fig. 3, and two abutments are formed, one diametrically opposite the other. The hub is hollow and has two trunnions *b*, adapted to bearings *a a*, projecting from each cylinder-head A′. A stuffing-box is formed in each bearing, so as to make them steam-tight. Mounted within the hub is the shaft C. This shaft is adapted to independent bearings *c c*, as clearly shown in Fig. 1, and the shaft is somewhat less in diameter than the hub, so that the hub does not touch the shaft, as it is free to rotate without touching the hub. Splined on the shaft is an arm C′, the end of which is adapted to a socket *b′* in the hub, so that while the shaft does not touch the trunnions of the hub it is driven by the hub through the arm C′. In each cap are grooves *a′*, to which are adapted pins *d* of bars D, which are guided in slots b^2 in the hub B and which force out the blades B′. Springs b^3 are mounted between these bars D and the blades B′. Thus there is a yielding pressure of the blades against the inner walls of the cylinder. At the extreme end of each blade is a swiveled block b^4, which conforms to the shape of the cylinder and makes a tight joint at all times.

E E′ are the upper and lower abutments, respectively, having springs *e e* back of them and having swiveled blocks *e′*, similar to the blocks b^4 of the pistons, so that the abutments will snugly fit the hub.

I is a valve-chamber communicating with one portion of the interior of the cylinder through short inlet-passages *i i′* and with long outlet-passages i^2 i^3, communicating with the opposite end of the cylinder, as clearly shown in Fig. 3.

The valve-chamber I is preferably tapered, and adapted to this chamber is a controlling-valve I′. This valve has a partition i^4, which divides it into two sections. One chamber, *j*, of the valve is the inlet-chamber, and the other chamber, *j′*, is the exhaust-chamber. The valve is so formed that by turning it in one direction one of the passages, *i*, is opened to the inlet for live steam and the other passage, *i′*, is closed, while the passage i^2, leading from the opposite end to the cylinder, is open to the exhaust and the other passages closed. When the valve is turned in the opposite direction, the other passages are opened and the passages *i* i^2 closed. The valve is controlled by a hand-lever I^2.

K is the steam-chest for the live steam. A steam-pipe *k* communicates with the chest, and in the chest is a slide-valve L, having a single passage *l*. The valve covers the ports *n n′*, which communicate with the live-steam passage N, which in turn communicates with the valve-chamber I, containing the controlling-valve I′. The slide-valve L is connected by a rod *l′* to an eccentric-strap l^2, adapted to an eccentric L′ on the shaft C, so that as the shaft C is turned the valve L will reciprocate, first opening one port *n* and then the other, allowing the steam to pass into the passage N through the chest I and into the cylinder by the ports as dictated by the controlling-valve I′. By this means I am enabled to make a very simple, compact, and easily-running engine which will be economical in the use of

steam and which can be readily constructed and mounted in any suitable manner.

I have described my invention as a single high-pressure rotary engine. It will be understood that while I have shown it mounted upon a base M it may be arranged on its side and mounted on a long base, the base supporting the valve-chest as well as the cylinder; but the position of the engine is immaterial.

In Fig. 1 I have shown the engine coupled as compounding, providing a duplicate engine A^2, similar in all respects to the engine just described, with the exception that the cylinder and its passages, as well as the hub and its blades, are larger in proportion, figured according to the expansion desired.

The exhaust-chamber of the engine A communicates through a pipe P to the steam-chest of the engine A^2, and the exhaust-passage of the low-pressure cylinder connects with the discharge-pipe P'.

The valve-rod I^3, carrying the valve I', is not only connected to this valve I' of the high-pressure cylinder, but is also connected to the reversing-valve of the low-pressure cylinder, so that the one lever will shift both valves.

A by-pass is formed by a pipe *s* from the live-steam pipe *k* to the exhaust-pipe P, and this by-pass has a suitable valve *s'*, by which it can be closed, so that in starting the engine the valve can be opened and both engines will take steam at high pressure.

The operation of the compound engine is readily understood. Steam is admitted through the pipe *k* into the chest K, through it into the passage N, and directed by the controlling-valve I into the proper ports. To drive the engine in one direction, steam will act upon the blades and turn the hub, and the hub being connected to the shaft through the arm C' will turn the shaft. The steam as it is exhausted from the high-pressure cylinder will pass through the pipe P to the steam-chest of the low-pressure cylinder, and it will pass through the low-pressure-controlling valve into the low-pressure cylinder and will turn the hub in the manner described above and will exhaust through the pipe P'. The eccentrics controlling the valve are operated so that the valves will open the ports at the proper time.

It will be noticed that there are four blades on the hub and one inlet-passage, so that there must be four admissions of steam on each revolution. There are two ports *n n'* in the steam-chest, and the valve L has a single passage *l*. On the downward stroke this port *l* communicates first with the port *n*, then closes, and then communicates with the port *n'*, then closes, and as the valve returns it communicates with the port *n'* again, then closes, and then communicates with the port *n* and closes, so that there are four distinct passages of steam to the cylinder during one revolution of the shaft. The valve mechanism can be so set that the valves will have the proper lap and the proper cut off. As shown in the drawings, there is a certain amount of lap—for instance, in referring to Fig. 3 the engine does not take steam until the blade is on the line *x*. Then the valve L opens up the upper port *n* and takes steam, the valve being full-open when the blade reaches the point on the line *x'*, and steam is gradually cut off and the valve is closed when the blade reaches the line x^2. The steam is allowed to expand during the balance of the stroke. When the blade reaches the point x^3, the valve L commences to uncover the port *n'*, the second blade being on the line *x*, and the engine will take steam again until the point x^2 is reached by the second blade, when the valve will close the port *n'*, and during the remainder of the stroke of the valve and the return stroke a third blade is moving into position, so that when the valve on its return opens the lower port *n'* the engine will take steam back of the third blade, and when this third blade reaches the point x^3 the valve will close the port *n'*, and during the time the valve is passing from the port *n'* to the port *n* the fourth blade will be moved to the position *x*. Steam will then be admitted back of this blade at this point, and when the blade reaches the point x^2 the valve will cut off the steam from the port *n* and will complete its upward movement, so that by this mechanism a very simple valve motion is obtained and the valve can be set to cut off at any point to give more or less expansion and to operate the engine economically.

It will be seen that the controlling-valve not only acts in its capacity as a reversing-valve, but also controls the flow of steam to the cylinders. If the valve is shifted wide open, so that it will give a clear passage to the ports, then the engine will run at full speed. If the valve is turned so as to partly open the inlet-port, then the steam is cut down and the engine is turned slowly, and by simply turning the valve to the position shown in the drawings the ports will be closed and the engine will stop.

In order to prevent back pressure and trapping of the steam when the engine is quickly reversed, I form a small outlet-passage *t* between the two inlet-ports *i i'* and recess the valve, as shown, so that when the valve is shifted the steam entrapped within the cylinder can freely escape through the small outlet-passage. The passage *t* may connect with the exhaust-passage or may exhaust into the open air.

I claim as my invention—

1. The combination of a cylinder of a rotary engine, a hub adapted to the cylinder having four blades, a steam-inlet passage communicating with the interior of the cylinder, two ports communicating with the steam-inlet passage, a valve having a single passage, means for operating said valve so that there will be four independent passages of steam to

the cylinder during one revolution of the hub, substantially as described.

2. The combination of a cylinder of a rotary engine, a hub adapted to the cylinder having four blades, a steam-inlet passage communicating with the interior of the cylinder, two ports communicating with the steam-inlet passage, a slide-valve having a single passage, means for reciprocating said slide-valve so that there will be four independent passages of steam to the cylinder during one revolution of the hub, substantially as described.

3. The combination in a rotary engine, of a cylinder, a hub mounted therein having four blades, a single steam-inlet port, a valve-chest having two ports n n' communicating with the single steam-port, a slide-valve having a single passage and adapted to uncover the ports four times during the revolution of the hub, a controlling-valve in the steam-passage between the slide-valve chest and the cylinder, so as to control the admission of steam to the cylinder, substantially as described.

4. The combination in a compound rotary engine, of the two cylinders, one larger in diameter than the other, a hub in each cylinder, blades on the hub, a valve-chest, slide-valves in each chest, eccentrics on the shaft controlling the movement of the slide-valves, a pipe leading from the exhaust-passage of the high-pressure cylinder to the inlet-passage of the low-pressure cylinder, the shaft on which the hub is mounted being adapted to independent bearings, substantially as described.

5. The combination in a rotary engine, of a cylinder, a hub mounted in the cylinder, bearings for said hub, blades carried by the hub, a shaft free of the hub, independent bearings for said shaft, an arm on the shaft engaging said hub, ports in the cylinder, and valve mechanism controlling the admission and exhaust of steam to and from the cylinder, substantially as described.

6. The combination in a cylinder having heads, cam-grooves in said heads, a hub adapted to bearings in the heads, radial slots in the hub, blades in these heads, bars back of the blades and having pins extending into the camways, ports in the casing, valves controlling the admission of steam to the cylinder, a shaft adapted to independent bearings and connected to the hub, substantially as described.

7. The combination in a rotary engine, of a casing, a hub, blades on the hub adapted to travel within the casing, a valve-chamber having a steam-inlet to the valve-chamber, a slide-valve having a single port, two ports in the valve-casing covered by the said valve, and means for reciprocating said slide-valve, substantially as described.

8. The combination in a rotary engine, of the cylinder, a hub within the cylinder having blades, passages leading to the cylinder, a valve-chest, ports n n' in said valve-chest communicating with the passage N, a controlling-valve chest I, a controlling-valve therein, a slide-valve having a single passage and adapted to cover the ports n n', means for reciprocating said valve, a steam-inlet passage communicating with the valve-chest, substantially as described.

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

FREDERICK G. TEES.

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