No. 668,942. Patented Feb. 26, 1901.

A. T. WELCH.

ROTARY STEAM ENGINE.

(Application filed Jan. 17, 1900.)

(No Model.)

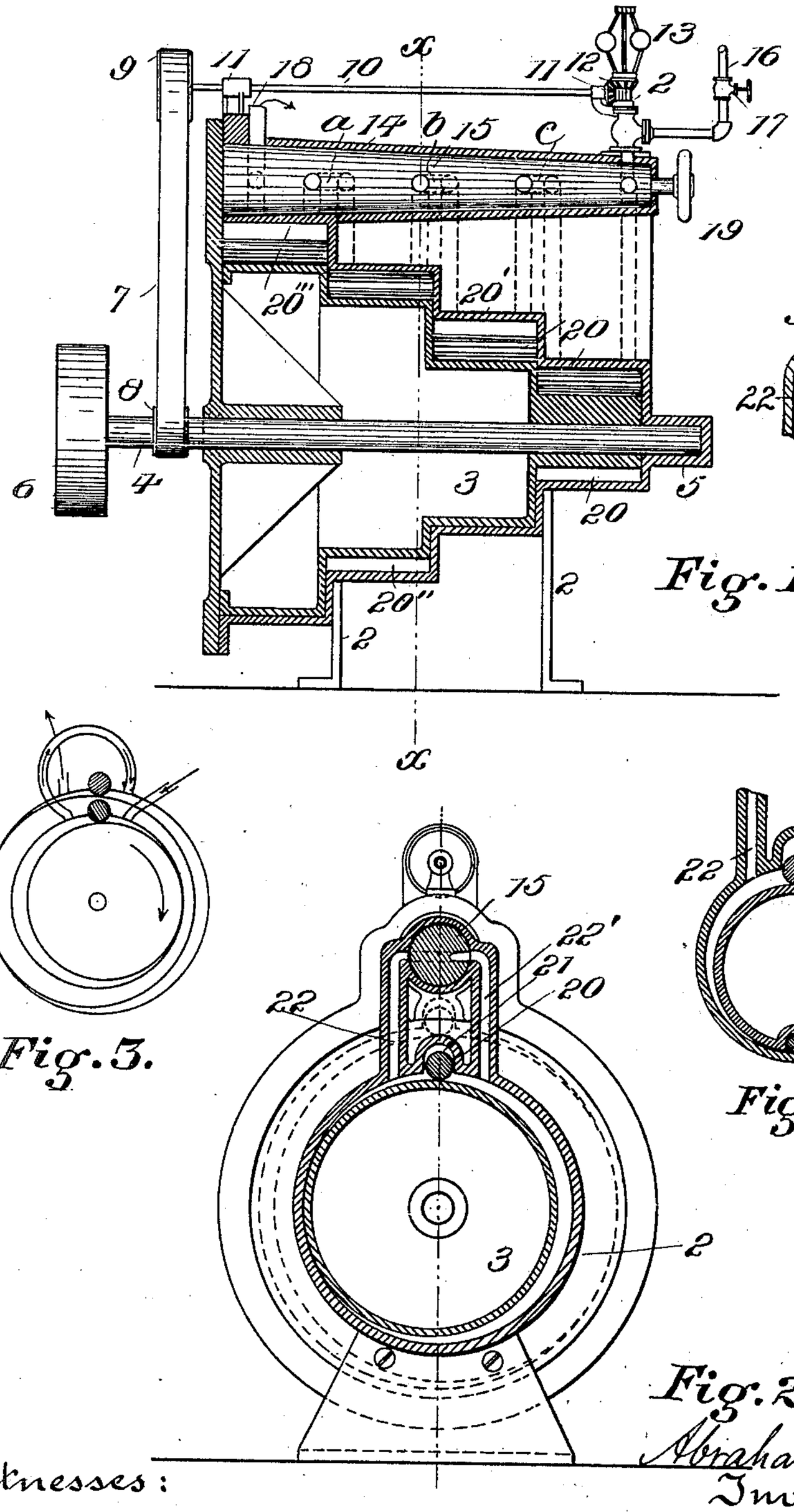

Fig. 1.

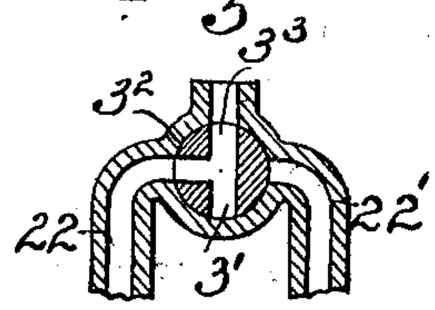

Fig. 5.

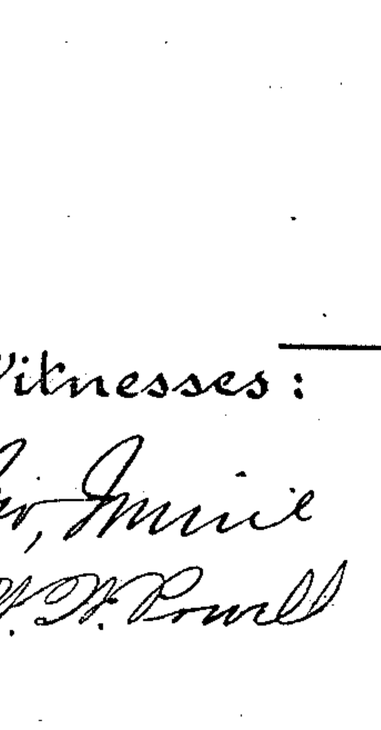

Fig. 3.

Fig. 2.

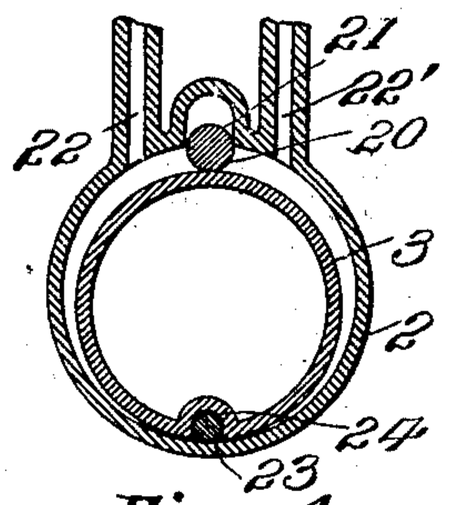

Fig. 4.

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ABRAHAM T. WELCH, OF BALTIMORE, MARYLAND.

ROTARY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 668,942, dated February 26, 1901.

Application filed January 17, 1900. Serial No. 1,811. (No model.)

To all whom it may concern:

Be it known that I, ABRAHAM T. WELCH, a citizen of the United States of America, and a resident of Baltimore, Maryland, have invented certain new and useful Improvements in Rotary Steam-Engines, of which the following is a specification.

This invention relates to improvements in rotary steam-engines.

The objects of my invention are to utilize all the power by progressive geometrical increasing of expansion of the pressure of the heat units down to as near zero as possible and as quickly as possible and to utilize the leakage incurred by the wear of parts through speed and where the leakage is always toward a lower pressure of constantly-increasing expansion.

The advantages of the invention are as follows: first, constant expansion of main power under pressure; second, constant expansion of leakage-power under pressure; third, speed of utilizing main power for economy of radiation; fourth, simplicity of manufacture and of the parts to be replaced, and, fifth, capacity of high or low speed and reversibility of the engine.

The invention consists of an improved rotary engine, as hereinafter set forth and claimed.

Referring to the accompanying drawings, Figure 1 is a vertical longitudinal section of the rotary engine proper constructed in accordance with this invention. Fig. 2 is a vertical transverse section on the line $x\,x$ of Fig. 1, showing the piston in the position of a quarter-turn to the left from that in Fig. 1. Fig. 3 is a diagram showing the relative position of the piston to the cylinder when the engine is reversed. Fig. 4 is a vertical transverse section. Fig. 5 is a vertical transverse section on the line of the governor through the reversing-cock.

Referring to Figs. 1 and 2, 1 indicates the cylinder of the engine, mounted on suitable supports 2, 3 the piston, and 4 the shaft, having its ends mounted in the bearings 5, and a fly-wheel 6 on one end. The shaft 4 is connected with a second shaft by an endless belt 7, passing over a pulley 8 on the shaft 4 and over a pulley 9 on one end of a shaft 10, mounted in bearings 11, and having its other end connected by a beveled gearing 12 with the governor 13. 14 is a casing in which is mounted the reversing-cock 15. The governor 13, as shown, is mounted on one end of the casing 14. 16 is the inlet supply-pipe, controlled by a valve 17, and 18 is the exhaust-pipe, located at the other end of the casing 14. 19 is a handle for operating the reversing-cock.

Referring now to the construction of the cylinder and piston of the engine, in order to carry out the principle of this invention they are formed from end to end as shown in Fig. 1, preferably in the shape of a stepped funnel or cone, thereby affording or presenting a series of gradually-enlarged cylinders and pistons extending from end to end, the steam-space in each cylinder or section of the whole cylinder gradually increasing in size from the smallest or first cylinder to the largest or last cylinder. Any number of these stepped parts of the cylinder and piston may be provided, according to the work required. The several steam-spaces are indicated by $20'$, 20^2, and 20^3. They are shown in Fig. 1 as alternately located on opposite sides of the piston. This is due to the fact that the piston is preferably constructed with the eccentric alternating in each section of the cylinder, for the purpose to be hereinafter explained. The piston, however, may be formed with its eccentric on the same side in the several stepped portions thereof.

Referring to Fig. 2, 20 indicates a roller steam packing or abutment located in a circular seat $20'$, between the steam-ports 22, said circular seat being larger in diameter than the diameter of roller 20, as shown, whereby the steam can act upon said roller 20 and press it down, the roller 20 being pushed up by the eccentric of the piston as it revolves. If desired, a small friction-roller may be employed in the piston similar to that shown in Fig. 4.

Referring to Fig. 1, the steam-ports of the reversing-cock 15 and their connections with the steam-spaces of the cylinder will now be described. At the steam-entrance end of the cock 15 there is a three-way steam-passage, as shown in Fig. 5, (indicated at $3'$, 3^2, and 3^3,) and at the exhaust end of the reversing-cock 15 there will be a similar three-way arrangement of ports, and intermediate between said ends of said cock there will be a number of two-way steam-ports, according to the num-

ber of steam-spaces, as shown in dotted lines, Fig. 1, (indicated at the points *a b c*,) the steam exhausting from one cylinder to the next, beginning with the smallest cylinder, the steam passage-ways extending across partitions from one steam-pipe to another. By revolving the cock 15 one-half turn toward the right the engine is reversed to ends of the three-way and opposite ends of the two-way through the cock, being brought flush with the inlet and exhaust openings or ports in the casing, so as to present a continuous opening for steam through the engine, which is intermittently intercepted by the eccentric of the piston alternately when the engine is running. The advantage of the construction of the roller 20 and its seat 21 is that it is actuated by the steam-pressure, so as to run smoothly at a high speed with an economy of space.

The operation of the engine is as follows: Steam being admitted through pipe 16, by means of valve 7, through the governor 13 and reversing-plug 15 to steam-port 22, Fig. 1, and from the latter to the left of the roller 20, Fig. 2, presses against the eccentric of piston 3 and causes it to revolve toward the left. During the time it takes to start or to make one revolution the unpacked joints allow a certain amount of steam to escape to the next larger cylinder through the exhaust-port 22′, including all that leaks past the roller 20 and its ends toward the right side and directly through the vertical joint, where there is pressure during the revolution. As the contact of piston with the cylinder in the next larger cylinder is just the opposite of that in the smaller cylinder practically all the leakage to the next larger cylinder is delivered into the steam-space between the roller and the contact of piston and cylinder in succession to do the work. After all the larger cylinders get their quota of steam the leakage is delivered against a lower steam-pressure, and thereby prevents loss by successive expansion of leakage. Should the smallest section of the pistons be on or nearly on the center, the leakage will start the engine through the next larger cylinder. In this construction the steam can be expanded, so that there will be very little pressure from the larger to the largest cylinder, the leakage toward and in the largest being practically nothing.

The speed of the engine can be regulated to run fast or slow, but the proportional size of the sections of the cylinder to that of the piston, so as to allow more or less steam-space, governs the economy and practicability of a slow or fast speed of pistons. A small steam-space in volume necessitates high speed, but more wear, a large steam-space less wear, but less economy. A medium volume of long length is preferred, so as to utilize the high speed of the steam to a desired extent.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A rotary engine, having its cylinder and piston formed of a series of parts gradually increasing in size from the steam-inlet to the exhaust of the engine, said several parts being, in effect, a series of pistons and cylinders, in combination with abutments and a regulating-valve, and steam connections between said regulating-valve and said series of cylinders, connecting each adjacent pair of cylinders, and forming a continuous connection from the steam-inlet to the exhaust, as and for the purpose set forth.

2. In a rotary steam-engine, a cylinder and piston, forming with each other a series of gradually-enlarged cylinders and pistons, said cylinders separated from each other and connected by steam-passages extending from one cylinder to another in combination with suitable abutments, as and for the purpose set forth.

3. In a rotary engine, a cylinder and piston forming a series of gradually-enlarged pistons and cylinders (each piston being eccentric in its own cylinder), each pair of cylinders being connected by steam-passages, and the eccentric of each piston being located on the alternate side from that of the adjacent piston in combination with suitable abutments, as and for the purpose set forth.

4. In a rotary engine, a cone-shaped cylinder and piston forming a series of stepped portions, each pair of cylinders being connected by steam-passages, and each cylinder being provided with an abutment and socket, said abutment being movable in said socket and impinging against the piston, as and for the purpose set forth.

5. In a rotary engine, a cylinder and piston, forming together a series of pistons and cylinders, in combination with abutments and a regulating-cock having ports and steam-passages connecting each adjacent pair of cylinders, and forming a continuous connection from the steam-inlet, the said series of pistons and cylinders gradually increasing in size from the steam-inlet to the exhaust, as and for the purpose set forth.

6. In a rotary engine, a cylinder and piston, forming together a series of cylinders and pistons of gradually-increasing size from the steam-inlet to the exhaust, a socket and an abutment movable in said socket and impinging against the piston, said abutments and socket being located in each section of said cylinder, forming a series of cylinders, in combination with a regulating and reversing cock having three-way ports, and passages between said inlet end and the exhaust, connecting pairs of adjacent cylinders, or steam spaces, as and for the purpose set forth.

Signed by me at Baltimore, Maryland, this 12th day of January, 1900.

ABRAHAM T. WELCH.

Witnesses:
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