No. 666,371. Patented Jan. 22, 1901.

A. F. BAATZ.

ROTARY ENGINE.

(Application filed Apr. 17, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

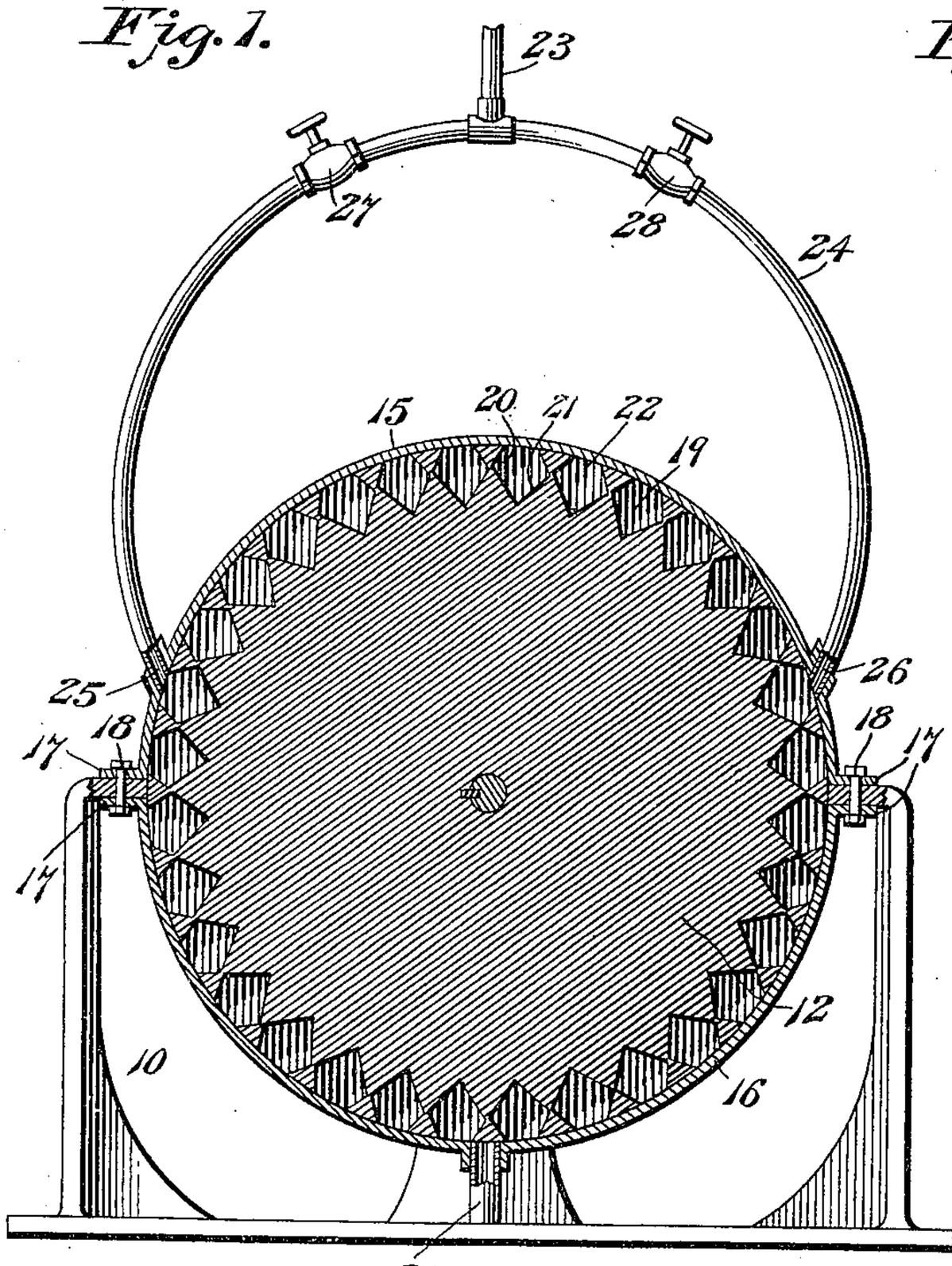

Fig. 2.

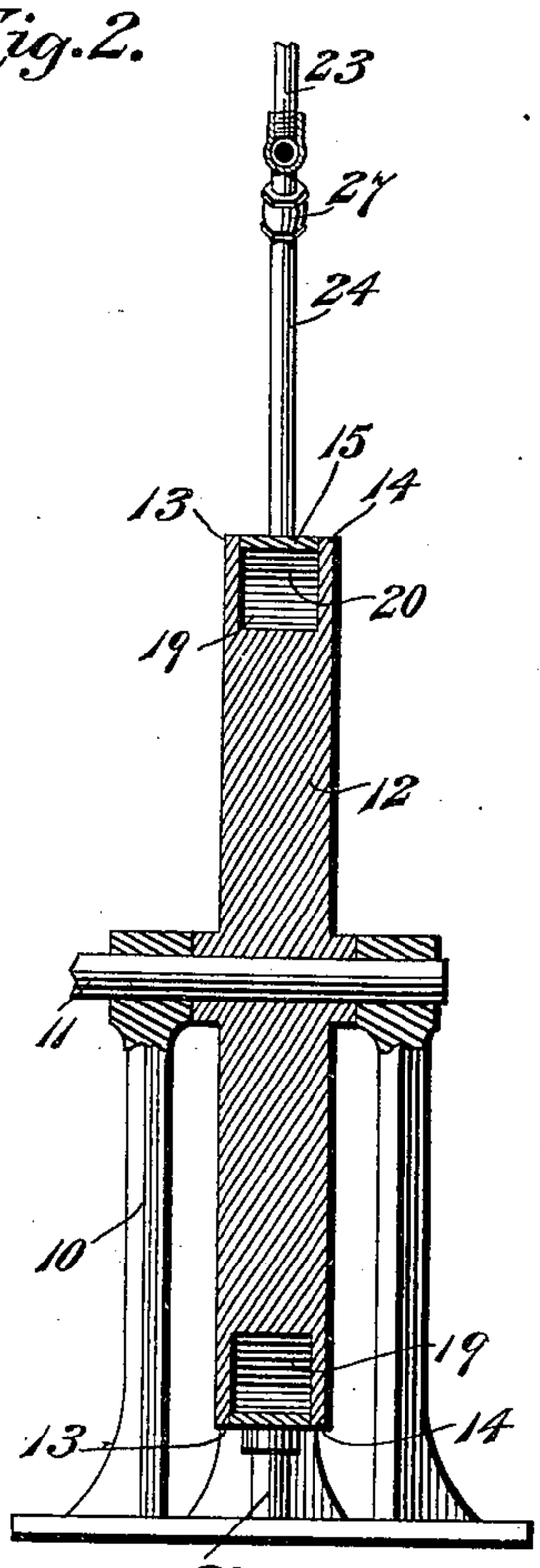

Fig. 3.

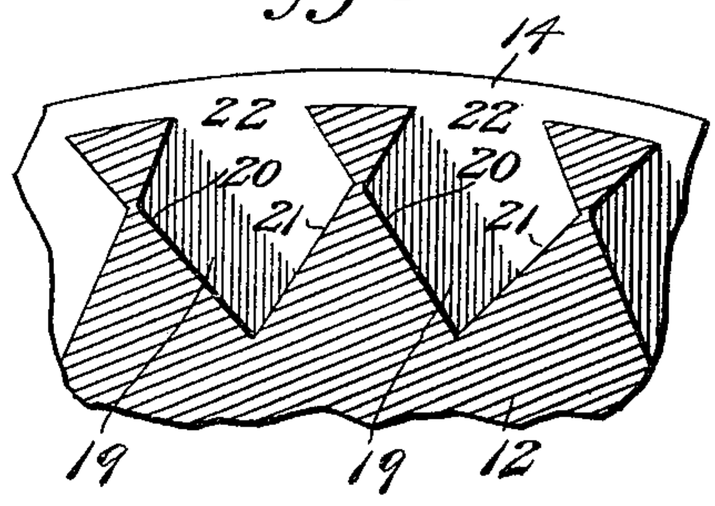

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Fig. 4.

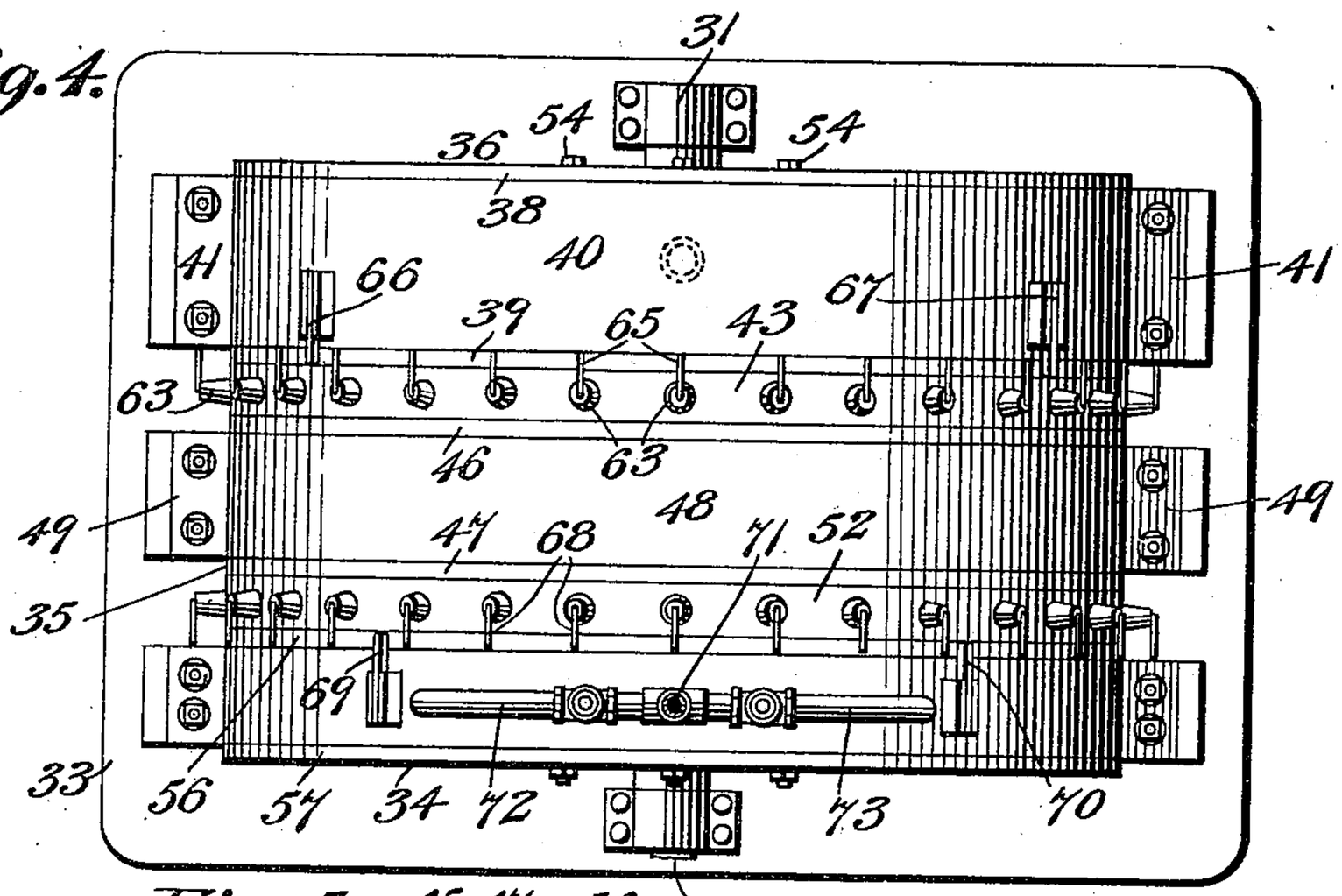


Fig. 5.

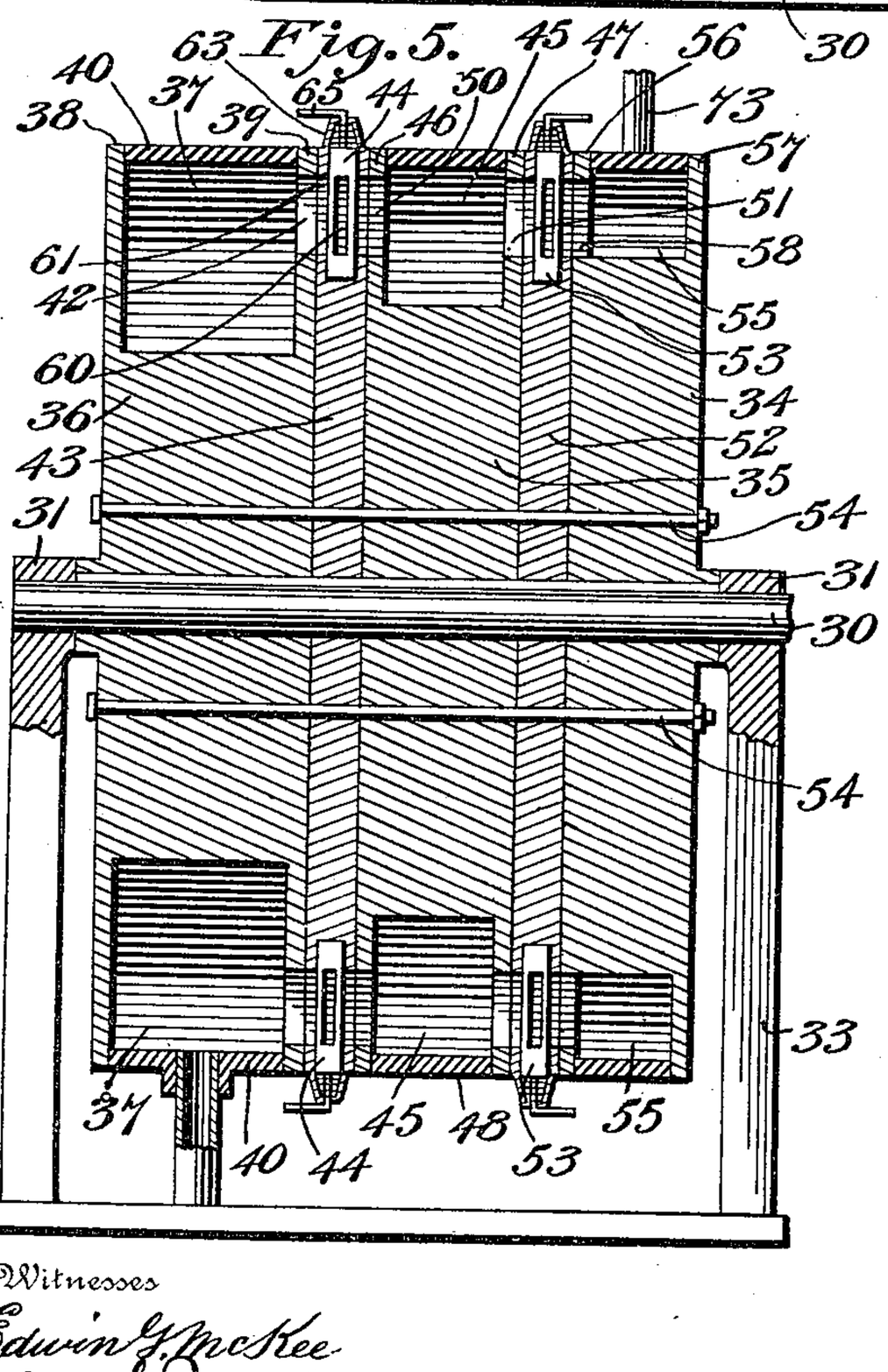
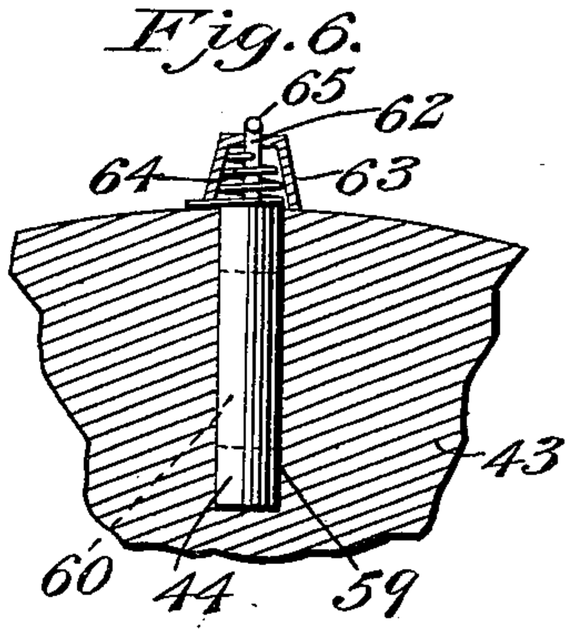


Fig. 6.



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UNITED STATES PATENT OFFICE.

AUGUST F. BAATZ, OF FAIRHAVEN, WASHINGTON.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 666,371, dated January 22, 1901.

Application filed April 17, 1900. Serial No. 13,265. (No model.)

To all whom it may concern:

Be it known that I, AUGUST F. BAATZ, a citizen of the United States, residing at Fairhaven, in the county of Whatcom and State of Washington, have invented a new and useful Rotary Engine, of which the following is a specification.

My invention relates to improvements in rotary engines of that class in which a piston-wheel is provided with a series of peripheral expansion-chambers; and one object in view is to simplify the construction in a manner to dispense with a casing and to prevent the motive fluid from "choking up" in the expansion-chambers.

A further object is to provide a novel construction by which the energy of the motive fluid is utilized to the best advantage and so as to effect economy in the consumption of the motive fluid.

A further object is to provide a rotary engine having its parts combined to utilize the steam expansively with a view to producing an economical and powerful low-speed engine, although certain parts of the engine may be availed of in the construction of a high-speed engine adapted to the use of a high-pressure motive fluid.

Further objects and advantages of the invention will appear in the course of the subjoined description, and the novelty in the combinations of parts, as well as in the construction and arrangement thereof, will be defined in the claims.

In the drawings, Figure 1 is a sectional elevation in a plane at right angles to the engine-shaft, illustrating a high-speed engine embodying the present improvements. Fig. 2 is another sectional elevation in a plane at right angles to that of Fig. 1 and in the direction of the engine-shaft. Fig. 3 is an enlarged detail view through a part of the piston-wheel, illustrating one of the improved expansion-chambers. Fig. 4 is a plan view of a compound engine for utilizing the motive fluid expansively. Fig. 5 is a transverse section thereof. Fig. 6 is a detail view of a part of the engine, illustrating one of the valves.

The same numerals of reference are used to indicate like and corresponding parts in each of the several figures of the drawings.

In carrying my invention into practice I employ suitable standards or a frame 10, which is provided with journal-bearings adapted for the reception of a horizontal shaft 11, which carries the piston-wheels 12 when the invention is embodied in a single-wheel engine. This piston-wheel is of annular form and provided with the peripheral annular flanges 13 14, which are in spaced relation to each other for the reception of an annular rim-hoop, the same being constructed of the segmental or semicircular sections 15 16. These members of the rim-hoop are fitted snugly to the periphery of the piston-wheel, between the annular flanges 13 14 thereof, so as to practically form a casing which excludes to a maximum extent the leakage of the motive fluid. The members of the rim-hoop are provided at their meeting ends with outwardly-extending flanges or elbow-joints 17, arranged to lap a part of the frame 10, and said flanged ends of the members or sections are secured firmly in place by the transverse bolts 18.

The engine of my invention does not have its piston-wheel housed or contained within a casing; but the piston-wheel and the rim-hoop therefor are constructed and fitted so snugly together as to prevent the leakage of steam and dispense with the employment of a shell or casing. This piston-wheel is provided with a series of peripheral expansion-chambers 19, and each chamber is peculiarly fashioned to utilize the energy of the motive fluid to the best advantage and to enable the piston-wheel to be driven in either direction, according to the admission of such fluid on one side or the other of the wheel. The expansion-chambers 19 are each provided with angular walls 20 21, disposed in opposing relation, and the lower inclined portions of these two walls converge in directions toward the axis of the wheel, so as to meet or intersect one another, and thereby form a tapering inner portion of the chamber. The upper inclined portions of the walls are disposed at angles to intersect with the periphery of the piston-wheel in a manner to produce a port 22, which opens through the periphery of the wheel, between the protruding flanges 13 14 thereof. This peculiar disposition of the walls forming each expansion-chamber gives to the latter a cross-sectionally diamond-shaped appearance, approxi-

mately, which provides for the proper action of the motive fluid when it is injected or admitted under pressure for the purpose of propelling the piston-wheel—that is to say, the opposite side walls of each expansion-chamber are made up of a plurality of angularly-related impact-faces. The purpose of this is to prevent the steam from being guided over a substantially continuous impact-face extending from the periphery of the wheel to the bottom of the pocket, as in usual constructions. It will be observed that by reason of the peculiar angularly-related walls of angular form the steam as it enters the chamber will impact with one of the impact-faces in advance of the openings and will have a rebounding or sharply-deflected action to produce a successive impact with an impact-face in angular relation to that receiving the initial impact, both of said faces being located in advance of the port and disposed in directions transverse to the travel of the piston-wheel at that point.

The motive fluid, which may be either steam, compressed air, or other aeriform fluid, is supplied by a feed-pipe 23, the same being attached to a curved branch pipe 24, having its ends coupled to the rim-hoop, so as to form the ports 25 26, and this branch pipe is provided with the controlling-valves 27 28, the latter being located on opposite sides of the feed-pipe and operable individually for one valve to be open when the other is closed, thus making provision for admitting steam to one side or the other of the piston-wheel, whereby the engine-shaft may be driven in one direction or reversed to rotate in an opposite direction by the simple manipulation of the controlling-valves. The exhaust-pipe 29 is coupled to the lower section of the rim-hoop at a point in the vertical plane of the engine-shaft, this exhaust-pipe lying equidistant from the ports 25 26 of the valved branch pipe.

In the operation of the engine as thus far described the motive fluid is admitted by one of the ports into one of the chambers 19 at an angle to the axis of the piston-wheel, and the impact of the fluid against the angular walls of the chamber starts the piston-wheel to rotating, thus presenting the series of peripheral chambers successively to the inlet-port. The chambers successively communicate with the exhaust on the rotation of the wheel, and the piston-wheel continues to turn in the same direction as long as the motive fluid is supplied from one port. For reversing the direction of rotation of the piston-wheel and the engine-shaft the valve to the port in use is closed and the valve to the other port is opened, thus admitting the motive fluid to the opposite side of the piston-wheel and in a direction to propel said piston-wheel in the opposite direction.

In the embodiment of my invention as a high-pressure engine adapted for high speed it is my practice to provide a single piston-wheel with a series of expansion-chambers, sixty-four in number, and the parts of this high-pressure engine are so arranged that the steam or other motive fluid will be supplied to the piston-wheel at an angle of seventy-eight and three-fourths degrees to the axis thereof.

My high-speed and high-pressure engines have powerful leverage, are economical in the consumption of the motive fluid, cannot be choked up with steam back of the piston, no matter how long they may run, and there is no cylinder-casing to wear out. The proportions of the parts, however, and the number of the expansion-chambers provided in the piston-wheel may be varied—as, for example, I may employ two piston-wheels having approximately diamond-shaped expansion-chambers, thirty-two in number, and the parts may be so disposed that the motive fluid is admitted so as to enter the chamber at an angle heretofore specified. I also contemplate the construction of a compound engine embodying any desired number of my piston-wheels coupled together and designed to utilize the steam expansively. This end I attain by mounting the compound wheel upon a shaft and by supplying the steam to one of said wheels, from which it exhausts into the next adjacent wheel, and so on until it has been liberated within each successive wheel of the series. The exhaust from the peripheral chambers of each wheel of the series is effected by means of an intermediate valve, said valves being arranged in series corresponding to the number of peripheral chambers and provided with operating means extending beyond the periphery of the engine and designed to be successively actuated by tappets or equivalent mechanism, which automatically effects the opening of the valve to permit the exhaust of the steam after it has been utilized for the purpose of contributing to the propulsion of the engine. In Figs. 4, 5, 6, and 7 I have illustrated the structure which I prefer to employ to effect the compounding of an engine of that type illustrated in the first three figures.

Proceeding now with a detailed description of my compound engine, 30 indicates a shaft carried in suitable bearings 31, supported by the frame 33. Upon this shaft are designed to be keyed or otherwise fixed a series of engines or piston-wheels connected by any suitable means and designed to constitute the multiple form of my engine. Obviously any number of these wheels or individual engines may be employed; but for the purpose of illustrating this adaptation or embodiment of the invention I have illustrated and will describe a multiple or compound engine comprising three piston-wheels, each of which is substantially identical in general construction with the piston-wheels shown in Fig. 1 of the drawings, the exception being that each of the piston-wheels in the compound engine is provided with the same number of

peripheral pockets or expansion-chambers, these pockets or chambers being of different sizes in the several wheels. The reason for this variation of size is that the tension or pressure of the steam is gradually lowered as it passes from one piston to the other, and it is therefore desirable to have the pockets or chambers of the second piston somewhat larger than the chambers of the first piston and to in like manner provide still larger pockets in the third piston into which the exhaust from the second piston passes.

34, 35, and 36 indicate the three piston-wheels or individual engines of which my compound engine is composed. In assembling the parts the piston-wheel 36, having comparatively large peripheral expansion-chambers or pockets 37, is keyed or otherwise fixed to the shaft 30. This piston-wheel 36, like the piston-wheel shown in Fig. 1 of the drawings, is provided with the parallel flanges 38 and 39, which define between them the expansion-chambers, the pockets or expansion-chambers 37 being closed by the rim-hoop 40, held stationary by the elbow-joints or bolt-flanges 41. The flange 39 of the piston-wheel 36 is provided with a series of openings or ports 42, leading into each of the pockets or chambers 37, through which ports the steam is designed to pass into the piston 36 from the piston 35, the manner in which this automatic exhaust is effected being hereinafter fully explained. After the wheel 36 is secured in place upon the shaft a circular spacing-disk or division-wall 43 is placed upon the shaft and moved against the open or ported face of the piston 36. This spacing-disk or division-wall 43 is provided for the purpose of interposing a series of valves 44 between the piston-wheel 35 and the piston-wheel 36 in order to control the exhaust from said piston-wheel 35 to the peripheral expansion-chambers or pockets 37 of the wheel 36. The specific construction and arrangement of these valves will be fully described presently. After the division-wall or spacing-disk 43 is in place against the face of the piston-wheel 36 the wheel 35 is next slipped upon the shaft and moved up against the face of the division-wall 43. This piston-wheel 35, like the piston-wheel 36, is provided with peripheral expansion chambers or pockets 45 of somewhat smaller area than the pockets 37 in the wheel 36 and defined between peripheral flanges 46 and 47 and a second rim-hoop 48, located between the flanges 46 and 47 of the wheel 35 and held stationary, as by bolt-flanges or elbow-joints 49. The flanges 46 and 47 are provided with ports 50 and 51, through which the steam is exhausted from the piston-wheel 35 to the piston-wheel 36 or received from the piston-wheel 34, as the case may be and as will be more fully pointed out hereinafter. Next a second division-wall or spacing-disk 52 is placed upon the shaft in contact with the ported face of the piston-wheel 35, and this wall, like the wall 43, is designed for the retention of the second series of valves 53, which control the exhaust from the piston-wheel 34 to the piston-wheel 35. Finally the piston-wheel 34 is passed upon the shaft in contact with the face of the division-wall 52, and when the parts have been so organized the several individual engines or piston-wheels composing the compound engine are secured in fixed relation by bolts 54, which pass entirely through the several piston-wheels and the intervening spacing-disks. The piston-wheel 34, like the piston-wheels 35 and 36, is provided with peripheral expansion chambers or pockets 55, defined by the peripheral parallel flanges 56 and 57, the flange 56 being provided with a series of ports 58, through which the steam is exhausted from the expansion-chambers 55 of the wheel 34 into the expansion-chambers 45 of the wheel 35, from whence it is further exhausted in a manner to be described into the pockets 37 of the wheel 36.

It will now be seen that each of the piston-wheels is provided with a series of expansion chambers or pockets which are preferably sixteen in number in each wheel, although of course I may prefer to employ any other number, in accordance with the requirements of the engine, and it will be also seen that the expansion-chambers 45 of the piston-wheel 35 are somewhat larger than the chambers 55 of the piston-wheel 34 and that the expansion-chambers 37 of the piston-wheel 36 are still larger than the chambers 45 of the wheel 35. I will therefore proceed with the description of the manner of mounting the sixteen valves in each of the division-walls or spacing-disks 43 for the purpose of automatically effecting the exhaust from each expansion-chamber to the expansion-chamber of the next succeeding piston-wheel.

In Figs. 5 and 6 the specific construction and arrangement of valves are clearly shown, and in Fig. 4 I have illustrated their general arrangement and the manner in which they are designed to be actuated. Each of the valves 44 in the division-wall or spacing-disk 43 is located within a valve-chamber 59, extending inwardly from the periphery of the disk or wall, and is provided with a port 60, which as the valve is turned opens an exhaust-passage 61, piercing the division-wall and located opposite the ports 42 and 50 in the flanges 39 and 46 of the wheels 36 and 35, respectively. It will therefore appear that when the sixteen valves 44 are closed communication between the expansion chambers or pockets in the wheels 35 and 36 will be cut off, but that as soon as the valves are opened the steam from the chambers 45 of the wheel 35 will be permitted to exhaust through the passage 61 of the division-wall 43 and expand within the expansion-chambers 37 of the wheel 36. Many ways of constructing these valves may be devised without departing from my invention; but I prefer to provide each valve with a stem 62, passed beyond the periphery of the wall and extended through a spring-

casing 63, within which is located a spring 64, which serves to hold the valves in their closed positions. Upon the extremity of each of the stems 62 I provide a head 65, all of these heads, as shown in Fig. 4 of the drawings, being extended in the same direction—that is to say, toward the piston-wheel 36—and moving in a path obstructed by tappets 66 and 67, carried on the rim-hoop 40 of the wheel 36 at about fifty-one degrees to each side of the vertical center.

The sixteen valves 53 in the division-wall 52 are constructed exactly like the valves 44 just described; but the exposed heads 68 of the valves 53 are turned in a direction opposite to the direction of the heads 65 and engage tappets 69 and 70, carried by the rim-hoop of the piston-wheel 34 at about forty-eight degrees to each side of the vertical center thereof. When the engine is run in one direction, the tappets 66 and 69 are thrown back out of operative relation with the valve-heads, and when it is run in the opposite direction these valves are thrown back to their original positions and the tappets 67 and 70 are thrown out of operative relation to the valves. As in the single form of engine shown in the first three figures of the drawings the steam is fed to the multiple engine from a steam-pipe 71, having valved branches 72 and 73 piercing the hoop-rim of the piston-wheel 34 at forty-five degrees beyond each side of the vertical center. It will now be apparent that as the piston-wheels rotate the tappets will effect a successive actuation of the valves between the piston-wheels to effect the successive exhaust of the steam first from the piston-wheel 34 to the wheel 35 and then from the wheel 35 to the wheel 36, the body of steam originally injected into each expansion-chamber of the wheel 34 exerting effective expansive pressure in each of the engines or piston-wheels successively, and thereby preventing any vibration or jar which would serve to effect the wear or derangement of the operated parts. The tappets controlling the valves are arranged as stated, in order to secure the admission of the motive fluid to the expansion-chambers 55 of the wheel 34 at forty-five degrees from the vertical center, to the chambers of the wheel 35 at forty-eight degrees, and to the last piston-wheel 36 at fifty-one degrees from the vertical center, thus providing for the practically constant flow of steam or other motive fluid to the chambers of the several engines or piston-wheels. It is obvious that the same general theory of construction and relative arrangement may be carried out in various adaptations of my invention, it being obvious that I may secure a double, triple, quadruple, or any further expansion by the coupling of two, three, four, or a greater number of engines or piston-wheels for synchronous rotation with the power-shaft.

If desired, a high-speed compound engine may be constructed in accordance with the general theory underlying my invention by combining a number of engine-wheels of that particular type illustrated in Fig. 1, the several wheels being progressively provided with fewer peripheral pockets and the pockets of each successive wheel being proportionately larger than the pockets of the wheel from which it receives its steam-supply. I therefore desire to be distinctly understood as reserving to myself the right to change, modify, and vary both the construction and arrangement of my single engine and to effect such combinations thereof as may be necessary to produce compound engines of any desired multiple or of either the high or low speed type so long as such changes, modifications, and variations are embraced within the scope of the protection prayed.

What I claim is—

1. In a rotary engine, the combination with a piston-wheel provided with a circular series of expansion-chambers opening through its periphery and with parallel annular flanges projecting beyond the periphery of the wheel at the opposite sides thereof, of a stationary rim-shell located wholly within the peripheral plane of the flanges and in steam-tight contact with the inner faces of said flanges and with the periphery of the wheel at points intermediate of the chambers, and means for supplying and exhausting a motive agent to and from the chambers.

2. In a rotary engine, the combination with a piston-wheel provided with a circular series of expansion-chambers opening through its periphery and with parallel annular flanges projecting beyond the periphery of the wheel at opposite sides thereof, of a stationary rim-shell located wholly within the peripheral plane of the flanges, and in steam-tight contact with the inner faces of the flanges and with the periphery of the wheel at points intermediate of the chambers, said rim-shell being composed of semicircular sections provided with terminal outwardly-extending flanges, a pair of standards located beyond the outer sides of the wheel and having their upper ends extended between the adjacent terminal flanges of the shell-section and into contact with the wheel, a bolt passed through each pair of terminal flanges and through the intermediate end of the standard to couple the shell-sections to each other and to the standard, and means for supplying and exhausting a motive agent to and from the chambers.

3. A rotary engine comprising a shaft, a series of piston-wheels provided with peripheral expansion-chambers, exhaust-passages from the expansion-chambers of one piston-wheel to those of an adjacent piston-wheel, valves controlling the exhaust-passages, and automatic tappets for periodically opening and closing the valves, as set forth.

4. A rotary engine comprising a shaft, a series of piston-wheels provided with peripheral expansion-chambers, exhaust-passages

from the expansion-chambers of one piston-wheel to those of an adjacent piston-wheel, valves controlling the exhaust-passages, heads connected to the valves and extending beyond the periphery of the engine, and means for successively tripping the heads for the purpose of actuating the valves as the engine is rotated.

5. A rotary engine comprising a shaft, a series of piston-wheels provided with a series of expansion-chambers, exhaust-passages from the expansion-chambers of one piston-wheel to those of an adjacent piston-wheel, valves controlling the exhaust-passages, and tappets removably mounted in position to effect the successive actuation of the valves as the engine is rotated.

6. In a rotary engine, the combination with a shaft, a series of piston-wheels provided with peripheral expansion-chambers and stationary rim-hoops closing said chambers, of spacing-disks mounted between the piston-wheels and provided with ports coincident with ports leading into adjacent expansion-chambers, valves carried by said disks and controlling the ports, and tappets located upon the exterior of the engine and operatively related to the valve.

7. In a rotary engine, the combination with a shaft, a series of piston-wheels provided with a series of expansion-chambers and stationary rim-hoops closing the expansion-chambers of each wheel, spacing-disks intermediate of the wheels and movable therewith, said spacing-disks being provided with ports in communication with adjacent expansion-chambers of the opposed wheels, spring-retained valves controlling said ports and provided with heads extending beyond the periphery of the engine, and tappets mounted upon the rim-hoops and arranged to trip the valves by contact with the heads thereof.

8. In a rotary engine, the combination with a shaft, a series of piston-wheels provided with peripheral expansion-chambers, the expansion-chambers of the several wheels being of different dimensions, spacing-disks intermediate of the wheels, means for connecting the several wheels and disks for simultaneous movement, separate stationary rim-hoops encircling the several wheels and inclosing the expansion-chambers thereof, exhaust-ports piercing the disks transversely and in communication with the adjacent expansion-chambers of the opposed disks, spring-retained valves controlling the ports in the disks and provided with angular heads, tappets located in the paths of the valve-heads and mounted to be removed out of operative relation therewith, and means for leading a motive agent to one of the piston-wheels.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

AUGUST F. BAATZ.

Witnesses:
B. W. BENSON,
W. A. MARSH.