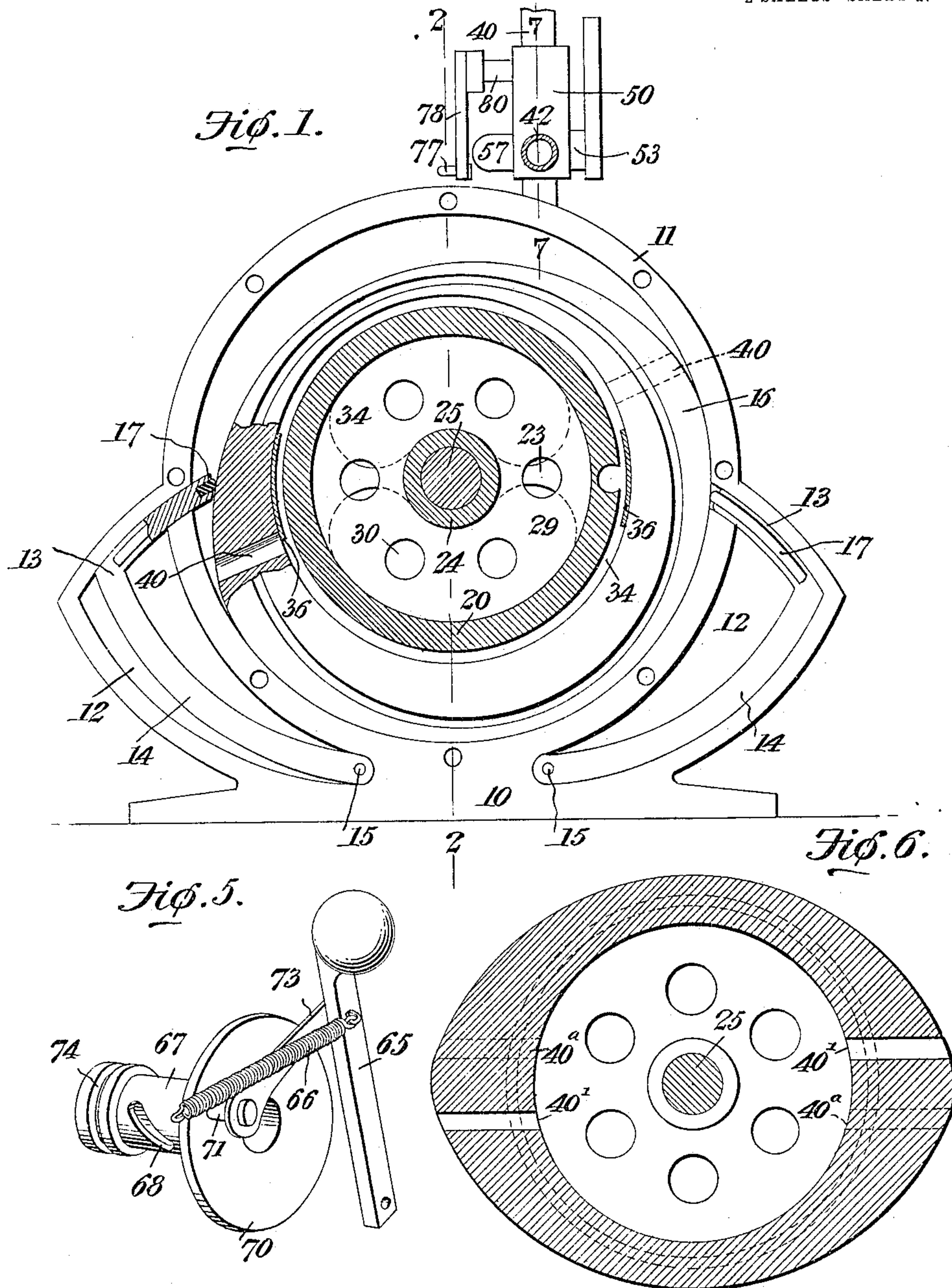


No. 819,747.

PATENTED MAY 8, 1906.

A. F. FORD.  
ROTARY ENGINE.  
APPLICATION FILED AUG. 28, 1905.

2 SHEETS—SHEET 1.



Witnesses  
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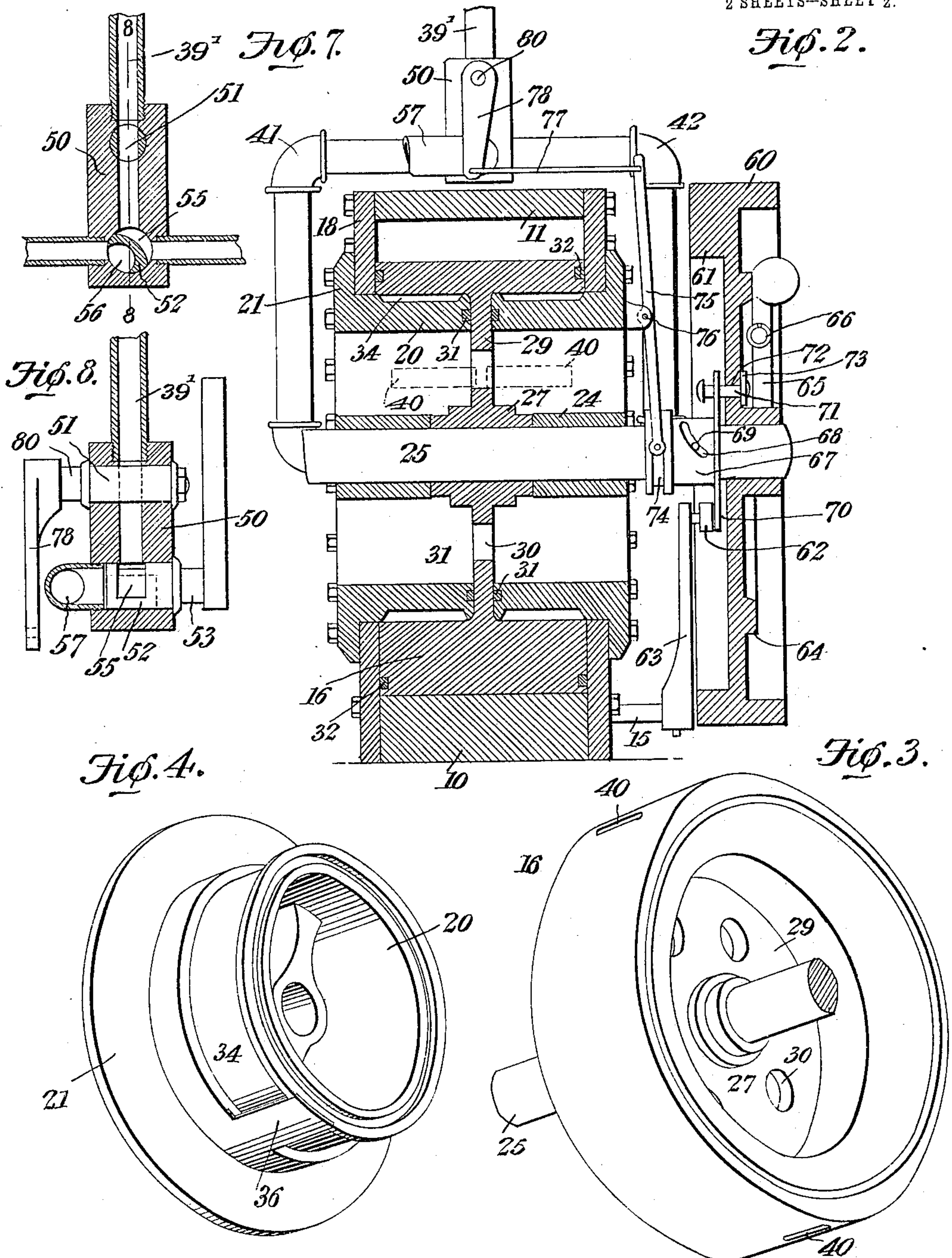
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Witnesses

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# UNITED STATES PATENT OFFICE.

ANDREW F. FORD, OF COLFAX, WASHINGTON.

## ROTARY ENGINE.

No. 819,747.

Specification of Letters Patent.

Patented May 8, 1906.

Application filed August 28, 1905. Serial No. 276,136.

*To all whom it may concern:*

Be it known that I, ANDREW F. FORD, a citizen of the United States, residing at Colfax, in the county of Whitman and State of Washington, have invented a new and useful Rotary Engine, of which the following is a specification.

This invention relates to rotary engines, and has for its principal object to provide an engine of simple construction and to employ a plurality of movable abutments which are operated in one direction by engagement with the periphery of the pistons and in the opposite direction by means of a cam carried by the main shaft and of a contour corresponding to that of the piston.

A further object of the invention is to construct a rotary engine in which the central portion of the piston adjacent to the bearings is open to permit the free circulation of air in order to prevent overheating.

A still further object of the invention is to provide an engine having a novel form of steam-chest and to provide means for controlling the flow of steam from the chest to the cylinder.

Further objects of the invention are to improve and cheapen the construction of the engine to provide improved packing for the abutments and pistons, and to insure proper movement of the abutments and the retention of the same in engagement with the periphery of the piston.

With these and other objects in view, as will more fully hereinafter appear, the invention consists in certain novel features of construction and arrangement of parts hereinafter fully described, illustrated in the accompanying drawings, and particularly pointed out in the appended claims, it being understood that various changes in the form, proportions, size, and minor details of the structure may be made without departing from the spirit or sacrificing any of the advantages of the invention.

In the accompanying drawings, Figure 1 is a sectional elevation of a rotary engine constructed in accordance with the invention. Fig. 2 is a transverse section of the same on the line 2 2 of Fig. 1. Fig. 3 is a detail perspective view of the preferred form of piston. Fig. 4 is a similar view of a portion of the one of the removable steam-chest members which is also utilized as a shaft-support. Fig. 5 is a detail perspective view of the governing mechanism. Fig. 6 is a detail view of the

modified form of piston. Fig. 7 is a detail sectional view of the reversing and throttle valves on the line 7 7 of Fig. 1. Fig. 8 is a vertical section of the valves on the line 8 8 of Fig. 7.

Similar numerals of reference are employed to indicate corresponding parts throughout the several figures of the drawings.

The engine is provided with a suitable base or bed 10, that is formed integral with a cylinder 11. The cylinder 11 is circular in form and at the opposite sides thereof are arranged abutment-receiving chambers 12 for the reception of curved abutments 13, that are carried by arms 14, the latter being secured to rock-shafts 15, extending through the walls of the abutment-chambers. These abutments are designed to bear against the periphery of the piston 16, and both their inner and side edges are provided with grooves for the reception of suitable packing-strips 17 in order to prevent leakage of the actuating fluid.

The cylinder-heads 18 inclose the steam-space at the opposite sides of the cylinder and are so shaped as to form one wall of the abutment-chambers 12. These heads are bolted in position and are provided with circular openings for the reception of the inwardly-extending annular flanges 20 of auxiliary removable heads 21, the outer portions of which are bolted to the cylinder-heads 18.

The auxiliary heads 20 are provided with webs 23, which serve as supports for centrally-disposed shaft-bearings 24, and extending through said bearings is a main shaft 25, that is connected in any suitable manner to the mechanism to be driven.

Secured rigidly to the shaft is the central hub 27 of a piston 16, and said piston is provided with a thin centrally-disposed web 29, having openings 30 to permit the free flow of air through the flanges 20 and the web in order to cool the bearings. The inner adjacent ends of the flanges 20 are provided with annular grooves for the reception of packing-rings 31, that bear against the opposite sides of the web 29, and the opposite faces of the piston-drum 16 are provided with annular grooves for the reception of packing-rings 32, that fit snugly against the inner faces of the main cylinder-heads 18 in order to prevent the leakage of steam.

In the periphery of each of the flanges 20 is formed an annular groove 34, that constitutes a steam-space, the outer wall of the steam-space being formed by the inner circu-



lar wall of the piston, and these steam-spaces may be placed in communication with a main steam-inlet pipe 39' through a pair of branch pipes 41 and 42, and steam may be directed from the main pipe through either of the branch pipes, while the second branch pipe forms an exhaust.

The groove 34, which constitutes the steam-chest, is partly closed at approximately diametrical points by means of arcuate plates 36, constituting valves for controlling the flow of steam to the steam-space in the cylinder.

The piston 16 is of irregular form, approximately one-half of its circumferential line being struck on an arcuate line from the axis of the shaft 25, and fits snugly against the inner circular wall of the cylinder. The opposite half of the circumferential line of the piston is eccentric to the center of the shaft, forming a crescentic steam-space to which steam is admitted from one or other of the steam-chests 34 through ports 40. In the construction of piston shown in Figs. 1, 2, and 3 two ports 40 are employed, one port extending from one of the steam-chests 34 and the other from the second steam-chest; but both ports open at the periphery of the cylinder at a point beyond the termination of the concentric peripheral line of the piston. In the opposite sides of the piston are formed circular recesses for the reception of flanges 20, as previously described.

In the operation of the engine as thus far described steam passing from the chest 34 through port 40 of Fig. 1 to the steam-space will there act between the abutments and the periphery of the piston to effect rotative movement of the latter in the direction indicated by the arrow. The exhaust-steam is passing from the seats on the opposite side of the abutment through the second port 40 to the second steam-space, and thence out through the exhaust-pipe. The valves 36, which partly cover the grooves 34, serve to prevent the passage of steam at the time the piston-ports are passing the abutments, and these valves may be made of sufficient length to prevent the passage of steam to the steam-space for any portion of a revolution, and thus govern the quantity of steam in accordance with the character of the engine and the work to be performed.

The steam-pipe 39' and the branch pipes 41 and 42 are connected by a valve-casing 50, containing a throttle-valve 51, which may be turned to adjust the quantity of steam passing to the engine or to entirely cut off the supply, and said casing also contains a reversing-valve 52, having a projecting stem 53. The reversing-valve 52 is provided with a port 55, which may be turned to place either of the branch pipes in communication with the supply, and at the same time a second port 56 communicates with the second of the

branch pipes and places the same in communication with an exhaust-pipe 57, so that when one of the branch pipes forms a steam-supply the other constitutes an exhaust.

Secured to one end of the shaft 25 is a balance-wheel 60, having one face recessed to form a cam 61 for engagement with the pins or antifriction-rollers 62, carried by arms 63, that are secured to the outer ends of the rock-shaft 15, on which the abutments are mounted, the cam being of such shape as to maintain the inner ends of the abutments in close contact with the periphery of the piston.

The outer face of the balance-wheel is recessed and is provided with a rib 64, to which is pivoted a weighted governor-arm 65, the weighted end of the arm having a tendency to move outward under the influence of centrifugal force and this movement being resisted by a tension-spring 66. On the shaft 25, between the balance-wheel and the engine, is arranged a collar 67, having a cam-groove 68 extending in a helical line, and through said groove passes a pin 69, secured rigidly to the shaft. At one end of the collar is a disk 70, having a crank-pin 71, that extends through a slot 72 in the balance-wheel and is connected by a link 73 to the governor-arm, so that movement of the latter will rotate the collar in one direction or the other, and the latter will be moved longitudinally of the shaft by reason of the helical groove 68 and pin 69. At the inner end of the collar 67 is an annular groove 74, which receives the lower end of a lever 75, pivoted on a lug 76, projecting from the engine, and the upper end of the lever 75 is connected by a link 77 to an arm 78, that is secured to the stem 80 of the throttle-valve 51. By means of this mechanism the increase or decrease of speed will effect movement of the collar 67 in one direction or the other, and this movement will be communicated through the throttle-valve and control the quantity of steam or other fluid passing to the engine.

In some cases a piston of the character shown in Fig. 6 may be employed. In this case the opposite sides of the piston are of the same shape, and between the smaller diameter of the piston and the inner wall of the cylinder two steam-spaces are formed. This permits of the employment of a larger number of steam-ports, two ports 40' leading from the recess at one side of the piston to the periphery thereof and two ports 40<sup>a</sup> leading from the opposite recess to the periphery of the piston.

It is obvious that the number of abutments may be increased, three abutments being found desirable in some cases in order to avoid the possibility of the piston stopping in such position as to prevent the entrance of steam to the steam-space, such as might occur when only two diametrically-opposed abutments are employed.



It is obvious that the annular flanges 20 may be formed integral with the main heads 18 instead of forming a part of the auxiliary heads 21, and as these flanges are stationary 5 they are to be considered as forming a part of the stationary cylinder.

Having thus described the invention, what is claimed is—

1. The combination in a rotary engine, of 10 a cylinder having opposite heads provided with inwardly-extending annular flanges, a piston, the opposite sides of which are recessed to form a thin central web that extends between the flanges and is provided 15 with openings for the passage of air, a shaft to which a web is secured, the body portion of the piston on opposite sides of said web being disposed in the steam-space between the flanges and the outer wall of the cylinder, 20 packing-rings between the ends of the piston and the cylinder-heads, a plurality of abutments arranged within the cylinder, means for operating the abutments, and ports for the admission and exhaust of an operating 25 fluid.

2. The combination in a rotary engine, of 30 a cylinder having an inwardly-extending flange provided with a peripheral groove forming a steam-chest, a piston having a recess for the reception of the flange and provided with ports extending from the groove to the periphery of the piston, and means for admitting steam to said groove.

3. The combination in a rotary engine, of

a cylinder having an inwardly-extending an- 35 nular flange, the periphery of which is grooved to form a steam-chest, plates partly covering the groove and forming valves, a piston having a recess for the reception of the flange and provided with ports extending between the 40 groove and the periphery of the piston, the plates serving to cut off the flow of steam while the ports are passing over said plates, and means for admitting steam or other fluid to the groove. 45

4. In a rotary engine, the combination with 46 a cylinder, of a pair of auxiliary heads, each provided with an annular flange, the periph- 47 eries of the flanges being grooved to form steam-chests, a revoluble piston having a cen- 50 tral web extending between the adjacent faces of the two flanges, packing-rings carried by said flanges and bearing on the web, a shaft to which the web is secured, shaft-bear- 55 ings for the flanges, ports leading through the piston for placing the grooves in communication with the steam-space of the cylinder, and means for controlling the admission of fluid to one of the grooves and the exhaust of fluid from the other groove. 60

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

ANDREW F. FORD.

Witnesses:

S. D. O'NEAL,  
G. W. LARUE.