No. 778,630. PATENTED DEC. 27, 1904.

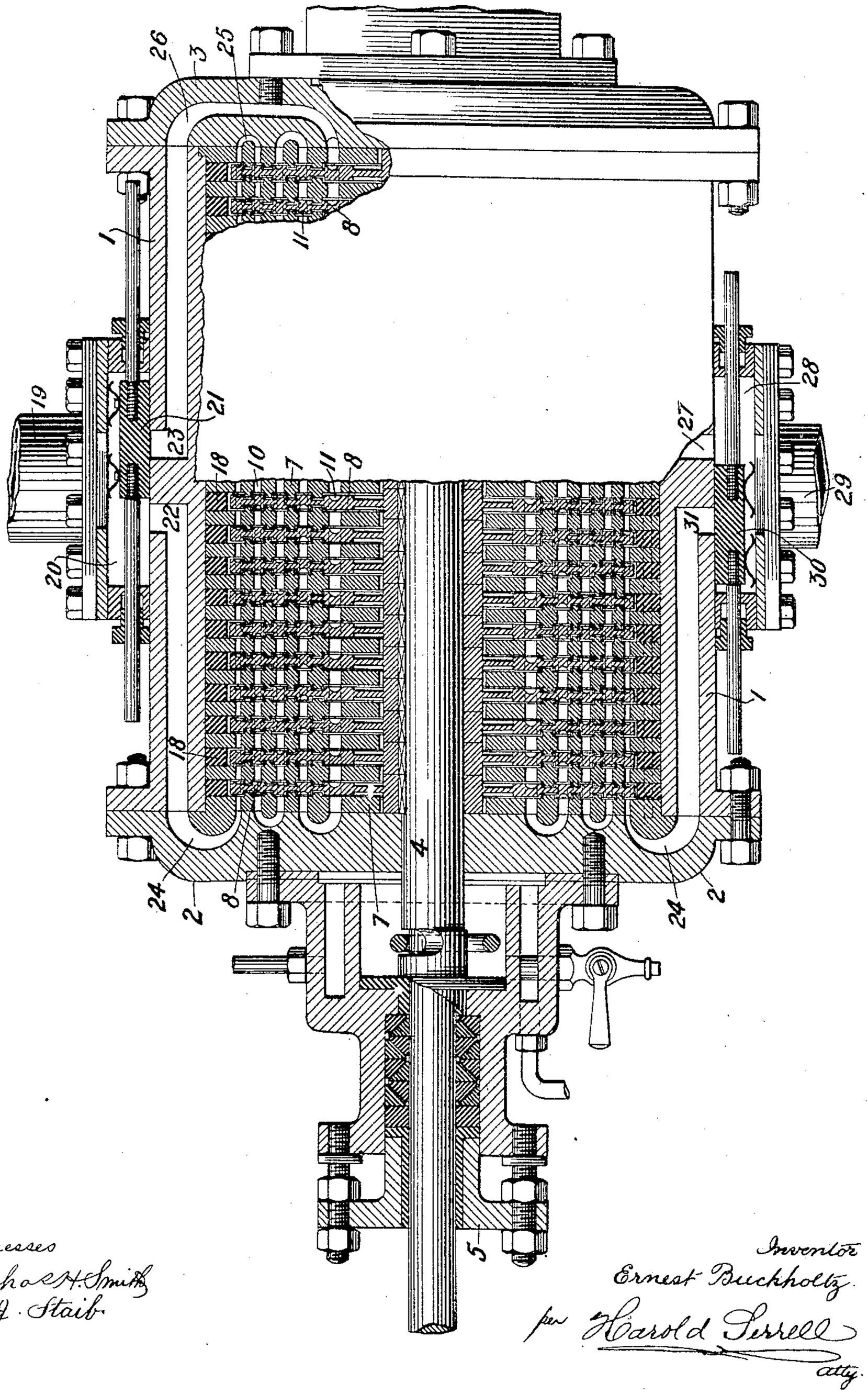
E. BUCHHOLTZ.

ROTARY ENGINE.

APPLICATION FILED DEC. 14, 1903.

3 SHEETS—SHEET 1.

FIG. 1.



Witnesses
Chas. H. Smith
J. Stair.

Inventor
Ernest Buckholtz.
per Harold Serrell
atty.

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3 SHEETS—SHEET 2.

FIG. 2.

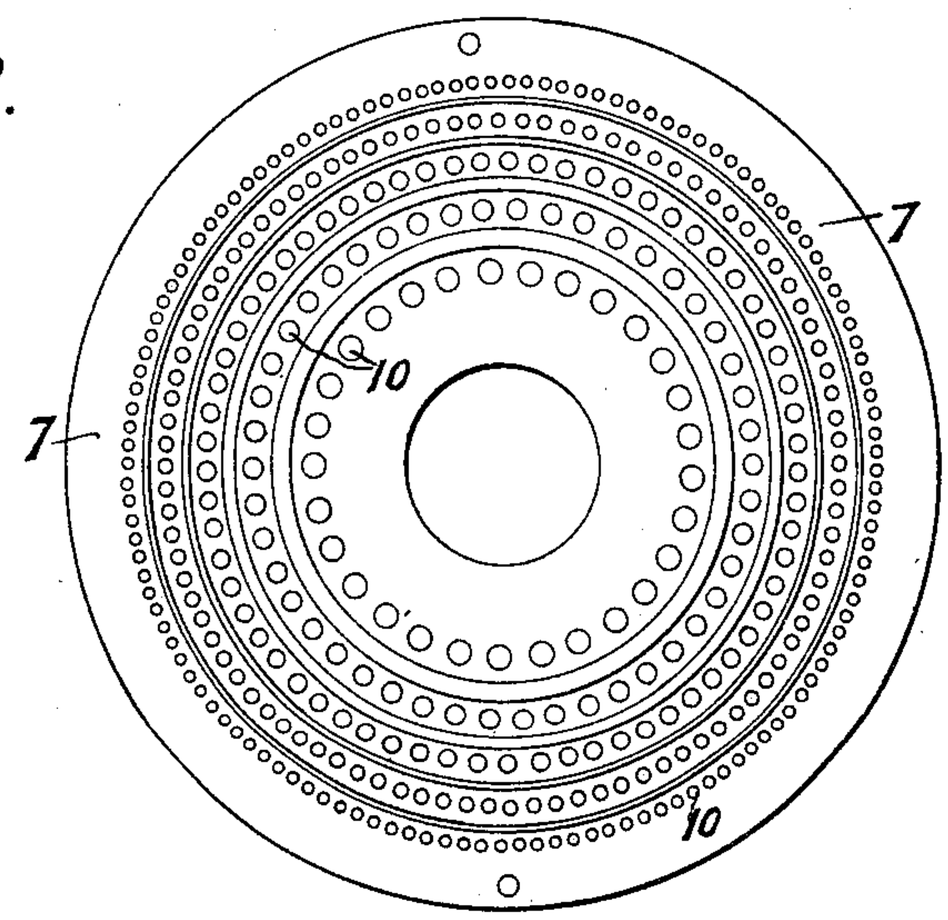
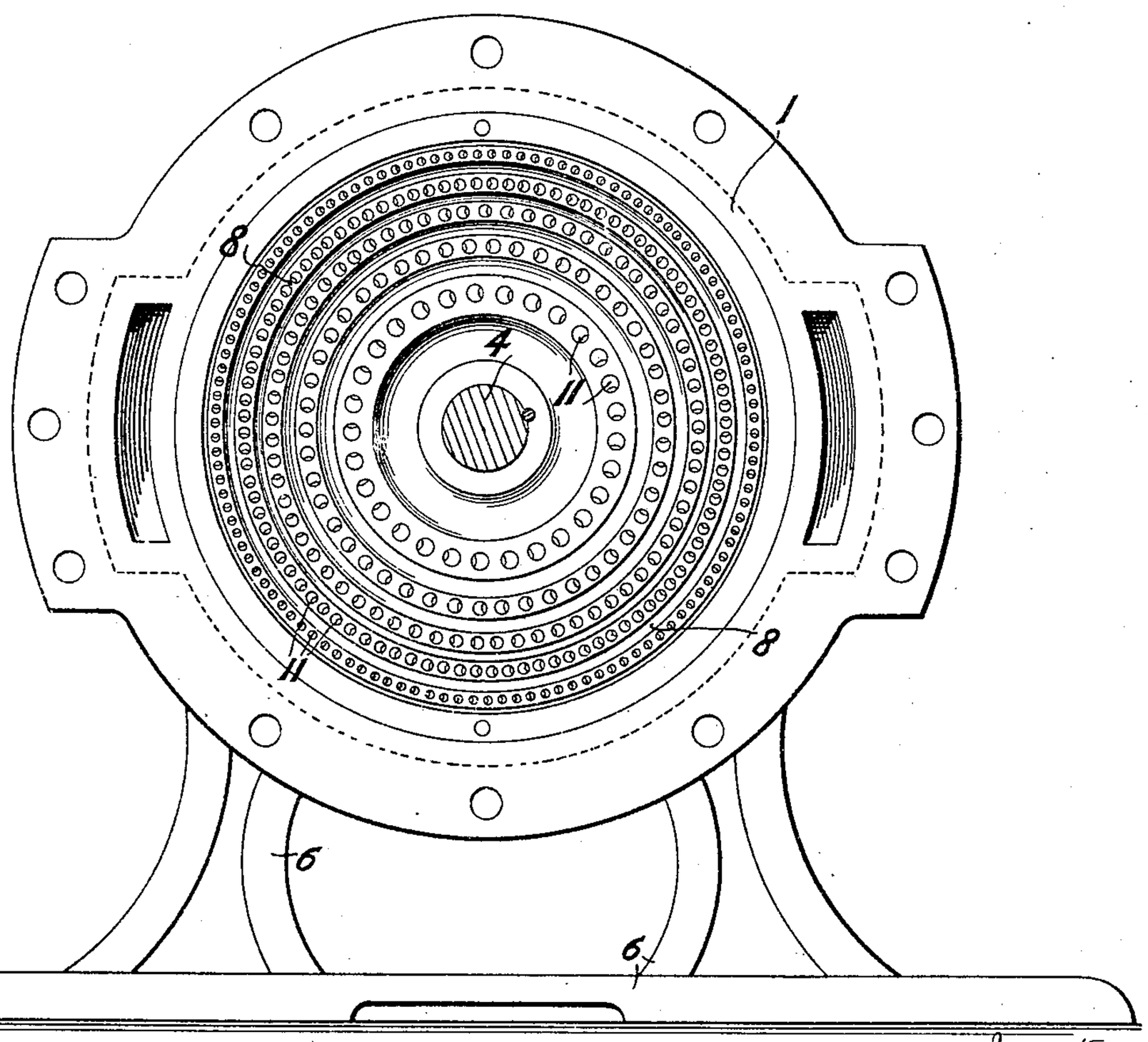


FIG. 3.



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3 SHEETS—SHEET 3.

FIG: 4.

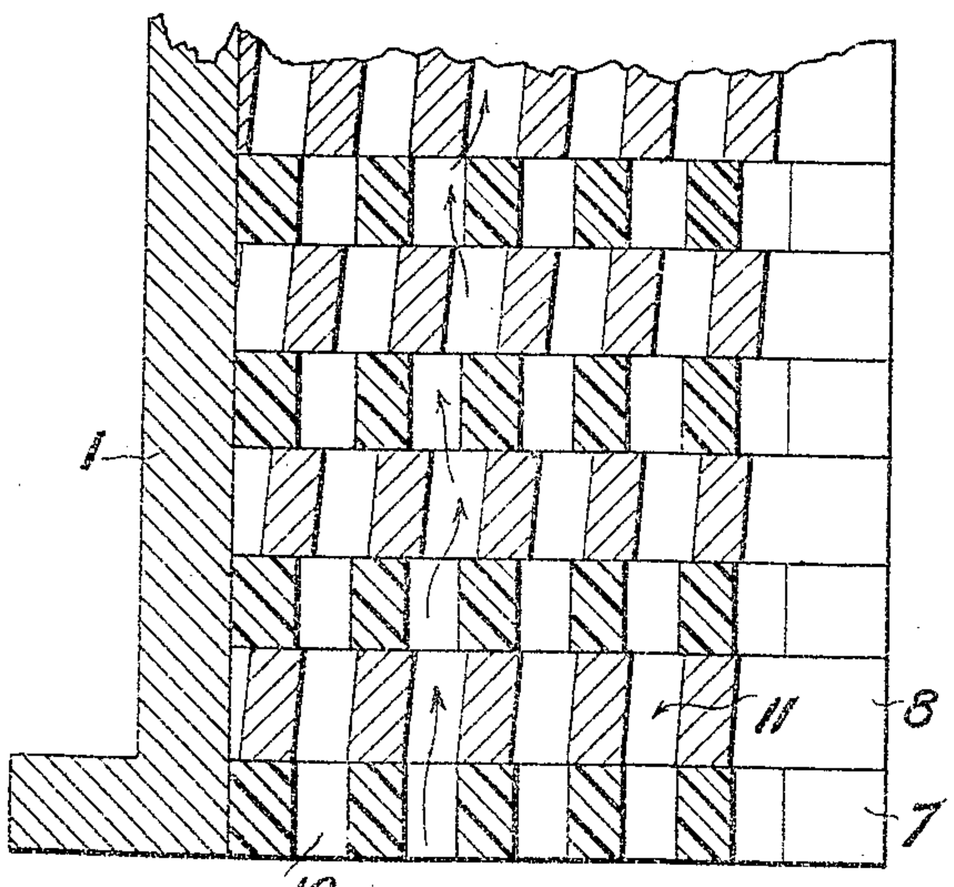
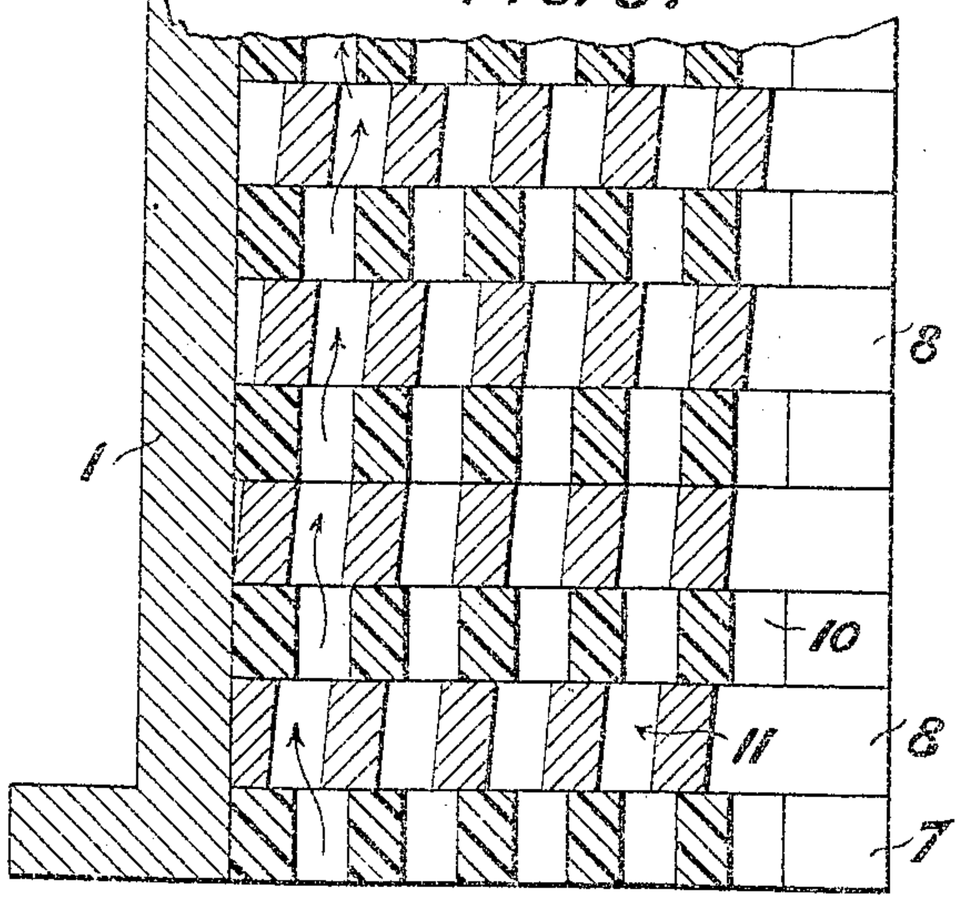


FIG: 5.



Witnesses
Chas. H. Smith
J. Stabb.

Inventor
Ernest Buchholtz
per Harold Serrell
Atty.

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UNITED STATES PATENT OFFICE.

ERNEST BUCHHOLTZ, OF LONDON, ENGLAND.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 778,630, dated December 27, 1904.

Application filed December 14, 1903. Serial No. 185,006.

To all whom it may concern:

Be it known that I, ERNEST BUCHHOLTZ, a subject of the Emperor of Germany, and a resident of London, England, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates to rotary engines operated by steam or other pressure fluid, and belongs to that class which has a stationary cylinder with a revoluble shaft passing axially therethrough and carried in bearings in the end covers of the cylinder.

According to this invention a number of stationary disks of equal thickness are fixed within the cylinder in planes at right angles to the axis thereof and at distances apart. Each of these stationary disks is bored centrally to allow of the free passage of the shaft, and the latter shaft has fixed to it a number of revoluble disks so placed that each revoluble disk is located between two stationary disks, but is not in actual frictional contact with the latter or with the cylinder, while the numbers of stationary disks compared to the numbers of revoluble disks are such that a revoluble disk becomes located at each outer end of the cylinder. It is important, according to this invention, that a stationary disk should be at each outer end of the series and that the revoluble parts of the engine should not be, and according to this invention they are not, in frictional contact with any stationary part of the engine, excepting at the shaft-bearings, and to this end the revoluble disks are formed so that an interspace exists between their surfaces and the surfaces of the stationary parts, and by annularly grooving the revoluble disks and forming intermeshing ribs on the stationary disks the interspace is made circuitous and forms a steam-packing. A single series or several series of perforations are made through each of the revoluble and through each of the fixed disks, these perforations being arranged in a circle or circles concentric with the shaft, so that the perforations of the revoluble disks coincide with the perforations of the fixed disks.

The invention provides that the fixed disks shall be of equal and sufficient thickness, so that the perforations therethrough form directive passages for the pressure fluid, the perforations extending through the revoluble disks at angles opposed in direction to the direction of the corresponding series of perforations of the fixed disks, the said perforations of the revoluble disks passing in the circular direction in which the series are arranged.

There are ports to admit pressure fluid to one end of the cylinder and to exhaust it from the other, the pressure fluid passing through all the directive perforations of the fixed disks and through the revoluble disks, producing the rotation of the revoluble parts and driving the motor-shaft. Reversal of the motion can be effected by reversing the direction of flow of the pressure fluid.

There will now be described a construction of such an engine having several and preferably an unequal number of concentric series of coincident perforations formed through both the stationary and revoluble disks, so that the pressure fluid is passed in at one end of the cylinder, is changed in its direction to pass through the next series of perforations, and so on.

Referring to the accompanying drawings, Figure 1 is a part-sectional plan view of a rotary engine according to this invention. Fig. 2 is an end elevation of the same engine having the cover-plate and the first stationary disk removed to show one of the revoluble disks. Fig. 3 is an end elevation of one of the stationary disks detached. Figs. 4 and 5 are diagrams showing a relative arrangement of the perforations through the disks.

Referring to the example of construction shown at Figs. 1 to 3, 1 is the cylinder of the engine provided with end covers 2 3, which carry the bearings of the axial revoluble shaft 4 and the glands 5 for the said shaft, and the cylinder 1 may be constructed to be carried by any suitable framework, such as 6, Fig. 2, so as to be held stationary.

Within the cylinder 1 there are arranged a number of disks 7, which are fixed to the cylinder by any suitable means, so as to be held stationary, and the disks are bored at the

center with perforations of such diameter as to be clear of the parts which pass through the central boring.

Upon the shaft are fixed a number of disks 8, which revolve therewith, and each of the said disks 8 is located between two fixed disks 7, and thus the whole contained series of disks commences at one end with a stationary disk 7 and terminates at the opposite end of the cylinder with another stationary disk 7.

In the construction shown the stationary disks 7 are separated from each other by annular rings 18, which fit the interior periphery of the cylinder 1, and the said disks 7 and rings 18 are bolted together and held stationary within the cylinder, as before explained.

The revoluble disks 8 are formed with shoulders to fit centrally upon the shaft and are keyed thereto, while their surfaces are made with annular grooves in between each circular series of perforations. Annular projecting ribs are also formed on the stationary disks 7 to enter the grooves of the disks 8, the grooves and ribs of the revoluble disks being so proportioned that no part of the surfaces of the disks 8 are in actual contact with the disks 7, and this narrow circuitous interspace forms a steam-packing between the disks.

Each stationary disk 7 is formed with several concentric series of perforations, the number of circular series being preferably unequal. In the present instance there are five concentric series of perforations through each fixed disk, the said perforations being preferably circular and extending through the disks in a direction parallel with the axis of the shaft and at right angles to the plane of the disks. These perforations are indicated at 10 in the drawings and are arranged at equal distances apart in each circle, as is clearly shown at Fig. 3 of the drawings.

Perforations 11, equal in number to the perforations 10 or one less in number, are also formed through the revoluble disks 8, as shown at Fig. 2, these perforations 11 being arranged in circles concentric with the shaft and corresponding in number with the circular series of perforations in the fixed disks 7. The perforations 11 are not, however, formed at right angles to the plane of the disks 8, but are arranged at a suitable angle thereto, less than a right angle, and inclined in a circular direction. Each perforation of the outer circle is inclined to the plane of the fixed disks oppositely to each perforation of the next innermost circle of perforations in the revoluble disks 8.

It will now be understood that several and preferably an unequal number of concentric series of coincident perforations are formed through both the stationary and revoluble disks 7 and 8, the first (inner or outer) series of perforations through the revoluble disks being made at opposed angles to the first series of perforations through the thickness of the fixed disks, the second series of perforations through the revoluble disks being at oppositely-opposed angles, and so on.

All the perforations through all the disks are circular in shape in planes at right angles to the directions of such perforations, and the diameter of the outermost series of perforations in the fixed disks corresponds with the diameter of the outermost series of perforations through the revoluble disks, and so on through all the series, while the perforations forming the outer circular series in each disk are made smaller in diameter and greater in number than the next inner series of perforations, the perforations of the innermost series being of larger diameter and few in number, and the one circular series is so proportioned with regard to the next series that the addition of the areas of the perforations in one series will be equal to the addition of the areas of the perforations in the next series, so that the total sectional area of each series of perforations through which the steam passes is equal to that of the next inner series. Moreover, in the stationary disks the solid metal between each adjacent perforation in a circular line is equal to the actual diameter of the bore composing a perforation in that series, and therefore in the revoluble disks having the perforations extending angularly, (although the said perforations are circular in planes at right angles to their direction,) yet at the face of the revoluble disk the configuration of the perforations will be elliptical, and consequently the metal separating one perforation from the next in any series in the revoluble disks will be slightly less in the direction of the series upon the face of the said disks than the major axis of the ellipse formed by the perforation on the face of the disk.

The steam-pressure is supplied by a steam-pipe 19 to a valve-chest 20 upon the outer surface of the cylinder 1, Fig. 1. In the valve-chest is located a slide-valve 21, by which one of two steam-ports 22 or 23 may be opened for the admittance of steam, while the other is closed, or both ports may be closed. In the drawings the port 22 is shown to be open for the admittance of steam. The steam passing through the port and passage 22 enters an annular segmental chamber 24, formed in the end 2 of the cylinder in conjunction with an annular projection on the first of the fixed disks 7, and by this annular chamber the steam is simultaneously supplied to all the outer circular series of perforations in the said fixed disk 7. Passing then through all that outer series of perforations in the fixed and revoluble disks within the cylinder, the steam enters annular passage 25 in the opposite cover 3 of the cylinder, by which it is conducted to supply simultaneously all the perforations composing the next inner series in that sta-

tionary disk 7 at the opposite end of the cylinder from which the steam first entered and from which it passes through all that series of perforations in the fixed and moving disks to the end cover 2 of the cylinder and by another annular passage is fed to the next inner series of perforations, and so on until it has passed in alternate directions through each series of perforations and is then delivered to an annular passage 26 in the end cover 3. From the annular passage 26 the exhaust-steam passes by the port 27 upon the other side of the cylinder, the connection between the annular passage 26 and the port 27 being similar to the connection between the port 23 and the annular passage 26. The exhaust-steam passes by the port 27 through a valve-chest 28 and away by the exhaust-pipe 29. The valve-chest 28 also contains a slide-valve 30, similar to the slide-valve 21, and both valves are capable of adjustment to either open one or other of the two passages which they respectively control or to close both the passages. The travel of the steam has been thus stated when the engine is to be driven in one direction; but when it is to be reversed in its direction of motion the valve 21 is adjusted so as to close the port 22 and open the port 23, while the valve 30 is adjusted so as to close the port 27 and open the port 31, and then the steam-supply will pass by the port 23 to the annular passage 26 and enter through the inner series of perforations of the disks, and after traversing all the series outwardly in alternately-reversed directions the exhaust-steam will pass away by the port 31 and the engine will be driven in the reverse direction.

There have been shown five concentric series of perforations in each disk; but obviously I might make a less or a greater number. For instance, there might be only one circle of perforations, or there might be two circles of perforations in each disk, when in this latter case the pressure fluid would pass twice through the cylinder.

I preferably fix the revoluble disks in such relative positions to each other in the circular direction that the steam only has at any one moment a comparatively free passage through a certain number of the fixed and revoluble disks—say through five of the revoluble disks in one of the circular series of perforations, as is illustrated on the diagrams Figs. 4 and 5. At Fig. 4 the perforations or ports of the first stationary disk 7 are full open for the admittance of steam, whereas the ports of the second stationary disk are less open than the first, and so on with the third and fourth, while at the fifth stationary disk the said ports are closed and will open when the revolving disks commence their motion. Fig. 5 shows the same arrangement in a more advanced position. Thus a volume of steam entering the open passage through the first fixed disk may pass practically unobstructed through several of the disks, its passage-way being closed behind it by the movement which will take place of the first revoluble disk through which it passes, while simultaneously the passage which was hitherto closed at the opposite end will be opened, permitting of the expansion of steam in the direction of its travel. In these views the traverse of the steam is indicated through one series of ports by arrows.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a rotary engine having a stationary cylinder with a revoluble shaft passing axially therethrough; the combination with a number of stationary disks equal in thickness fixed within and fitting the cylinder at distances apart, each having a central aperture to permit of the free passage of the revoluble shaft, and each having similar series of perforations arranged in circles concentric with the shaft to form directive passages for the pressure fluid, the sum of the areas of the perforations composing each series being equal to each other; of a number of disks of equal thickness fixed upon and revoluble with the shaft, each revoluble disk being located between two stationary disks, and each having series of perforations arranged in circles concentric with the shaft coincident in position and areas with the corresponding circular series of perforations through the stationary disks, and extending in the circular direction in which the series of perforations are arranged, and at angles opposed in direction to the direction of the corresponding perforations through the fixed disks, cover-plates one at each end of the cylinder having passages communicating with the perforations of the outer stationary disks, means for changing the direction of flow of the pressure fluid through the said passages for reversing the direction of motion of the engine, and bearings carried by the cover-plates to support the axial shaft, substantially as set forth.

2. In a rotary engine having a stationary cylinder with a revoluble shaft passing axially therethrough; the combination with a number of stationary disks of equal thickness fixed within and fitting the cylinder at distances apart, each having a central aperture to permit of the free passage of the revoluble shaft, and each having perforations extending through the said disks parallel with the axis of the shaft to form directive passages for the pressure fluid, the perforations being circularly arranged concentric with the shaft; of a number of disks of equal thickness fixed upon and revoluble with the shaft, each revoluble disk being located between two stationary disks, so that the outer end directive disks of the series are stationary, the said revoluble disks not being in frictional contact with the said stationary

disks or with the cylinder, the said revoluble disks having perforations arranged circularly concentric with the shaft and coincident with the perforations of the stationary disks, the perforations passing through the revoluble disks at angles opposed in direction to the direction of the corresponding perforations through the stationary disks and extending in the circular direction in which the perforations are arranged, cover-plates one at each end of the cylinder having passages to communicate with the perforations of the outer stationary disks, means for reversing the direction of flow of the pressure fluid for reversing the direction of motion of the engine, and bearings carried by the cover-plate to support the axial shaft, substantially as described.

3. In a rotary engine having a stationary cylinder with a revoluble shaft passing axially therethrough; the combination with a number of stationary disks equal in thickness fixed within and fitting the cylinder at distances apart, each having a central aperture to permit of the free passage of the revoluble shaft and each having similar series of perforations arranged in an uneven number of circles concentric with the shaft to form directive passages for the pressure fluid, the sum of the area of the perforations composing each series being equal to each other; of a number of disks of equal thickness fixed upon and revoluble with the shaft, each revoluble disk being located between two stationary disks, and each having series of perforations arranged in an uneven number of circles concentric with the shaft and coincident with the circular series of perforations through the stationary disks, the outer circular series of perforations through the revoluble disks being at angles opposed in direction to the direction of the corresponding perforations through the fixed disks and extending in the circular direction in which the series of perforations are arranged, the next inner series of perforations being at oppositely-opposed angles, and so on, a cover-plate 2 fixed to the cylinder at one end and having passages therein, the passages 24 therein communicating with the outer series of perforations in the adjacent stationary disk, a cover-plate 3 on the opposite end of the cylinder having an annular passage to form communication between the first and second series of perforations of the adjacent stationary disk on that side, the opposite cover-plate 2 having an annular passage to form communication between the second and third series of perforations in the stationary disk adjacent to the cover-plate 2, and so on, passages 26 in the cover-plate 3 communicating with the inner series of perforations, and valves for controlling the passages 24 of the cover-plate 2 and passages 26 of the cover-plate 3, substantially as set forth.

4. In a rotary engine; the combination with a stationary cylinder having ports 22, 31, in its opposite circular walls communicating by passages in the walls with one end of the cylinder, and having ports 23, 27 communicating by passages in the walls with the other end of the cylinder, two valves one at each side of the cylinder, one to control the ports 22, 23, and the other to control the ports 31, 27 to admit pressure by the port 22 on one side to drive the engine in one direction and exhaust by the port 27 on the other side, or to admit pressure by the port 23 on one side to drive the engine in the other direction and exhaust by the port 31 on the other side, a revoluble shaft passing axially through the cylinder, and a number of stationary disks fixed within the cylinder, each having a central aperture to permit of the free passage of the shaft and each having similar series of perforations parallel with its axis, arranged in an uneven number of circles concentric with the shaft to form directive passages for the pressure fluid, the addition of the areas of the perforations composing each series being equal to each other; of a number of disks of equal thickness fixed on the shaft, each located between two stationary disks and each having circular series of perforations corresponding and coincident with the perforations of the stationary disks, the outer circular series of perforations through the revoluble disks being at less than a right angle with the faces of the disks and inclining in the circular direction in which the series of perforations are arranged, the next inner series of perforations inclining at an opposite angle and so on, a cover-plate 2 fixed to the cylinder at one end having passages 24 communicating with the outer series of perforations of the adjacent stationary disk and with the cylinder-passages terminating in the ports 22 and 31, a cover-plate 2 on the opposite end of the cylinder having an annular passage 25 to communicate between the first and second series of perforations of the adjacent stationary disk, the opposite cover-plate 2 having an annular passage to form communication between the second and third series of perforations and so on, and passages 26 in the cover-plate 3 to form communication between the inner series of perforations and the cylinder-passages terminating in the ports 23, 27, whereby the direction of flow of the pressure fluid can be reversed for reversing the engine substantially as set forth.

ERNEST BUCHHOLTZ.

Witnesses:
GRIFFITH BREWER,
WM. A. MARSHALL.