

No. 643,505.

Patented Feb. 13, 1900.

L. IGELHORST.
ROTARY ENGINE.

(Application filed Sept. 22, 1898. Renewed July 25, 1899.)

(No Model.)

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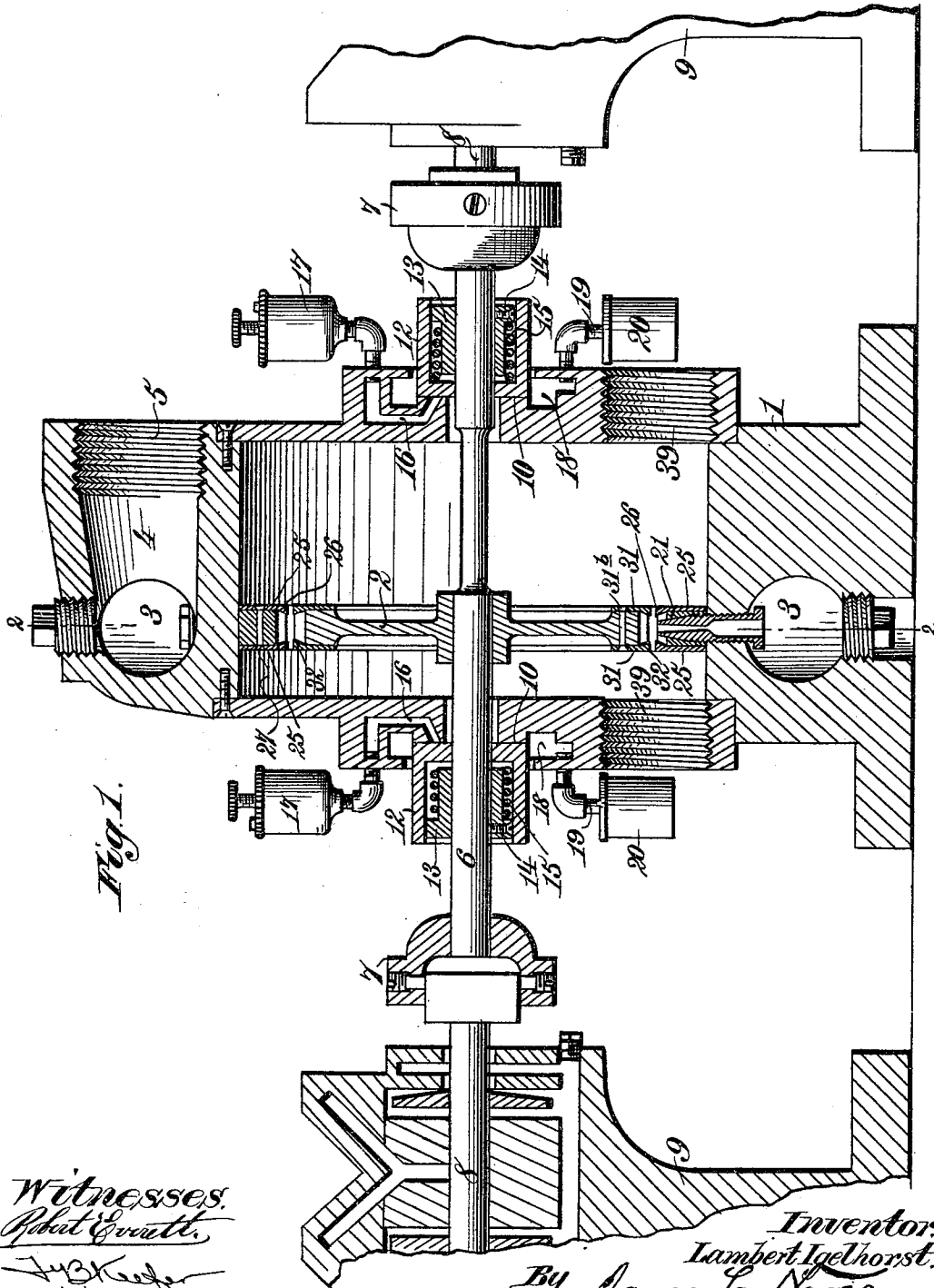


Fig. 1.

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By *James L. Norris* Atty.

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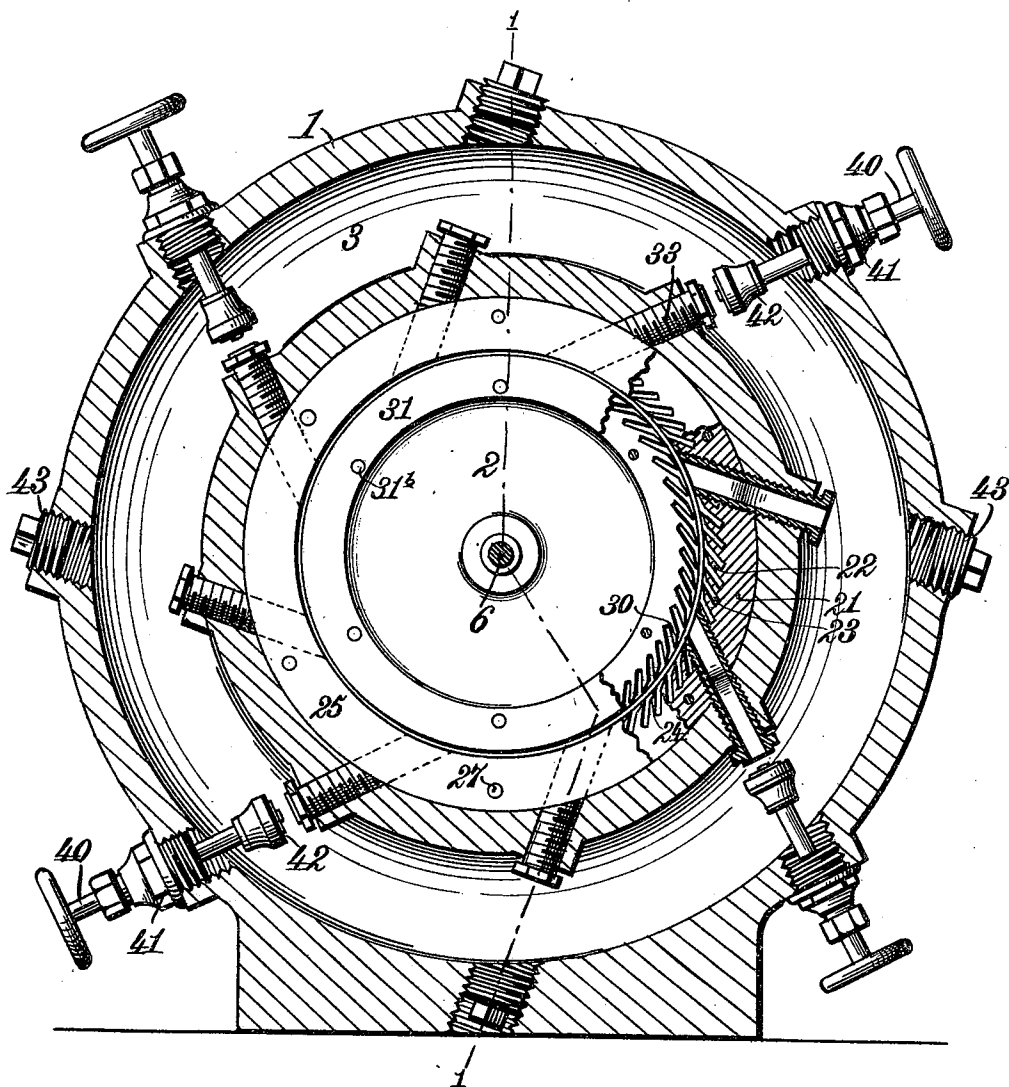
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Fig. 2.



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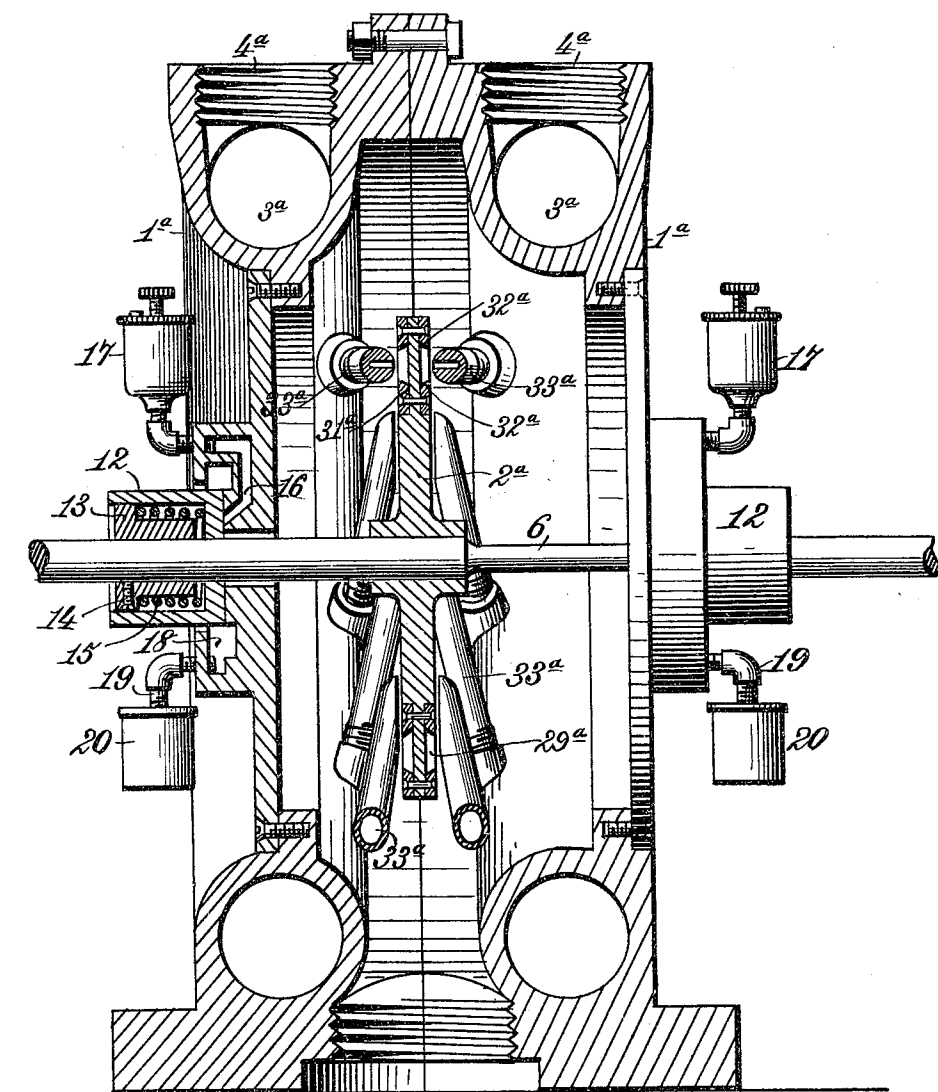
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Fig. 3.



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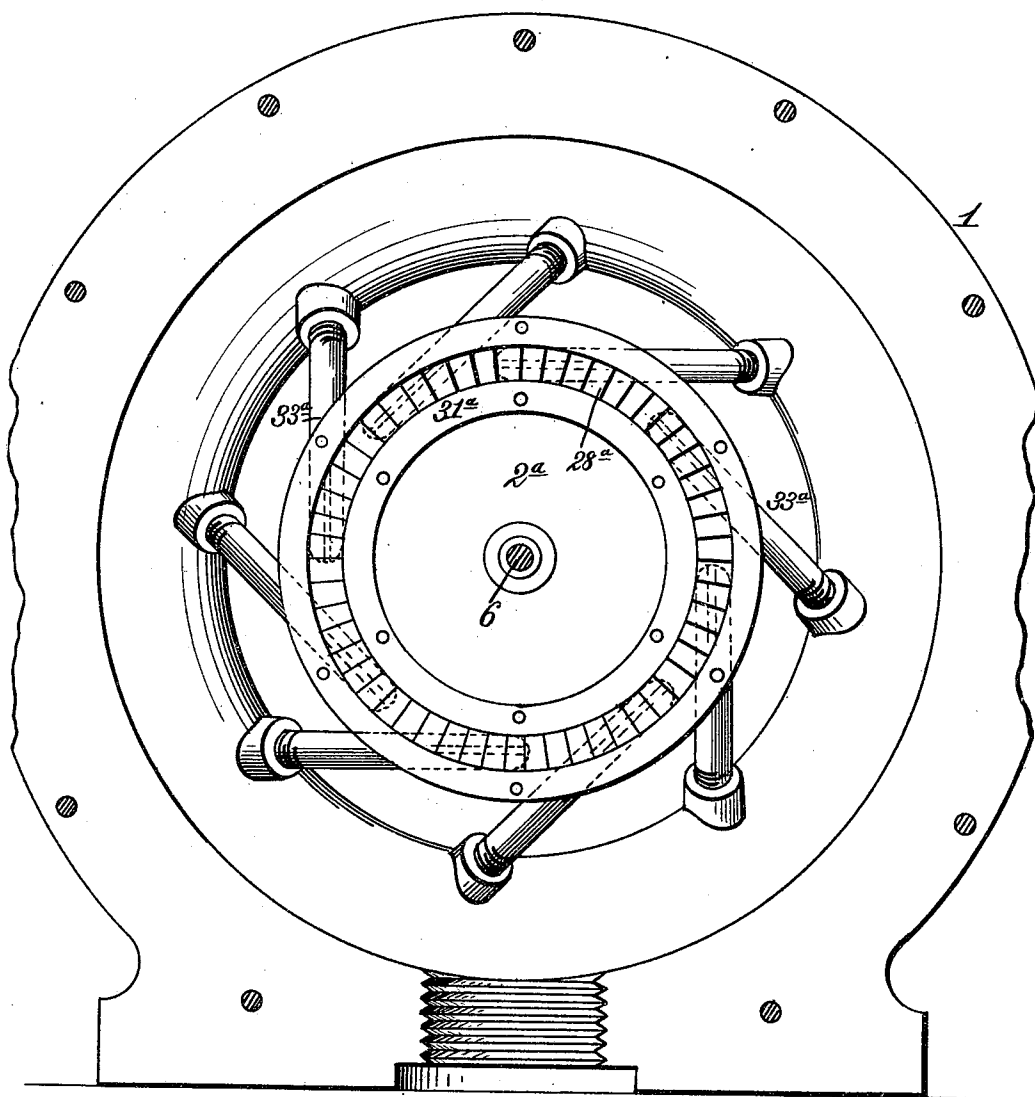
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Fig. 4.



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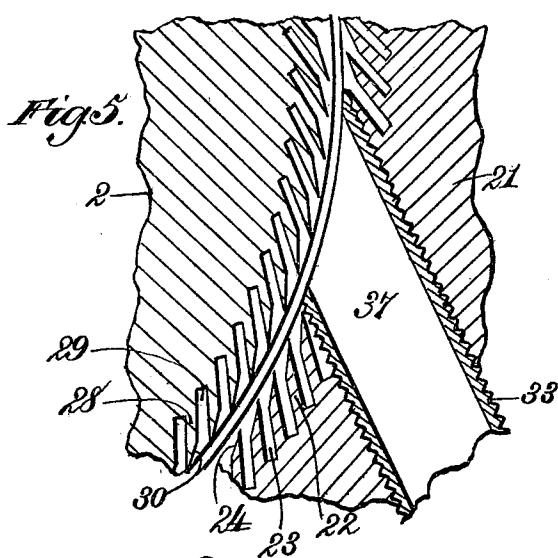
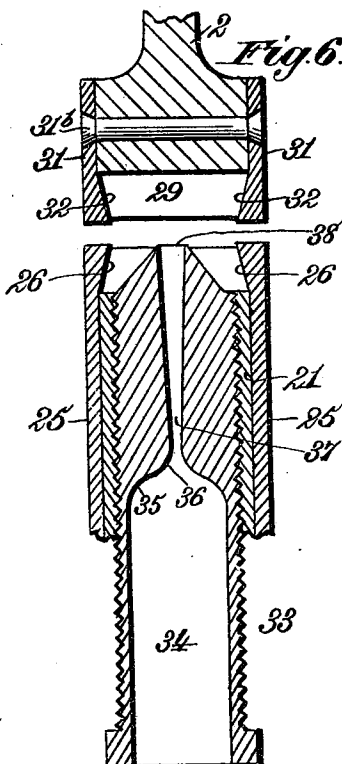
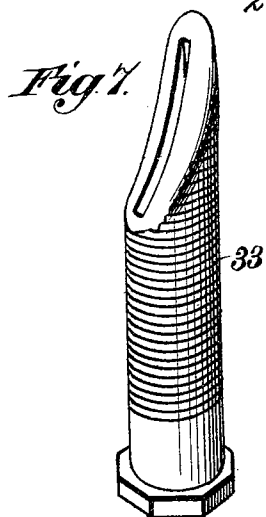
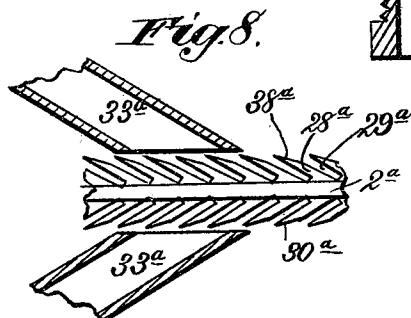
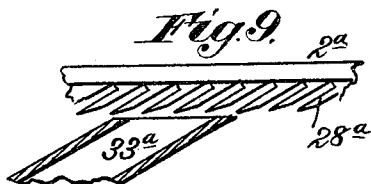
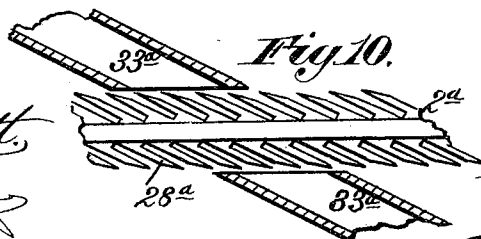
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5 Sheets—Sheet 5.



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UNITED STATES PATENT OFFICE.

LAMBERT IGELHORST, OF QUINCY, ILLINOIS.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 643,505, dated February 13, 1900.

Application filed September 22, 1898. Renewed July 25, 1899. Serial No. 725,094. (No model.)

To all whom it may concern:

Be it known that I, LAMBERT IGELHORST, brother, St. Francis College, a citizen of the United States, residing at Quincy, in the county of Adams and State of Illinois, have invented new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates to that class or type of rotary engines wherein the peripheral portion of a rotary piston is constructed with pockets or recesses in which a working fluid is directed by nozzles for swiftly revolving the piston, and thereby imparting rotary motion to the engine-shaft.

The chief objects of the present invention are to promote the efficiency of rotary engines of the character referred to, to increase their power without a proportionate increase in the quantity of working fluid used in driving the rotary piston, to improve the construction of the peripheral portions of the rotary piston, and to secure greater efficiency and power in the working of the engine.

To accomplish these objects, my invention involves the features of construction, the principles of operation, and mode of operation hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a vertical central sectional view taken on the line 1 1, Fig. 2, showing an engine embodying my invention. Fig. 2 is a vertical cross-section on the line 2 2 of Fig. 1, the piston and its surrounding ring being shown partly in elevation. Fig. 3 is a vertical sectional view taken on a line at right angles to the view in Fig. 4, showing a modified form of engine. Fig. 4 is a sectional side elevation of the parts represented in Fig. 3. Fig. 5 is an enlarged detail sectional view of a part of the engine represented in Figs. 1 and 2 to more clearly show the finger-like projections and the nozzles for delivering the working fluid. Fig. 6 is a sectional view taken at right angles to the view in Fig. 5. Fig. 7 is a detail view of the nozzle represented in Figs. 1, 2, 5, and 6. Fig. 8 is a sectional plan view showing the nozzles at opposite sides of the rotary piston, as in Figs. 3 and 4, wherein the piston is provided with finger-like projections at opposite sides near its periphery. Fig. 9

is a detail sectional view of a rotary piston having the finger-like projections at one side only, and Fig. 10 is a detail sectional view showing a rotary piston with finger-like projections at opposite sides which extend in reverse directions for the purpose of rotating this piston in either direction.

In order to enable those skilled in the art to make and use my invention, I will now describe the same in detail, referring first to Figs. 1, 2, 5, 6, and 7, wherein the numeral 1 indicates a circular casing, in which is centrally mounted the rotary piston 2. The casing is formed with an annular passage 3, communicating at the top of the casing with a lateral inlet 4, having screw-threads 5, by which to connect it with a pipe for supplying the working fluid, such as steam or air or gas under pressure. The piston is rigidly mounted on a horizontal shaft 6, which extends through enlarged orifices in the opposite side walls of the circular casing. The extremities of the shaft 6 are connected by universal couplings 7 with the shaft, as at 8, mounted in any suitable construction of bearings located within pillar-blocks 9. The shaft 6 is thus supported, but slight variations in its central position are permitted through the medium of the universal couplings. The exterior faces of the side walls of the annular casing are constructed with ground faces, as at 10, around the central openings, through which the shaft 6 passes. A stuffing-box bears against each of the ground faces 10 and is susceptible of rotating against the same. The stuffing-boxes are each composed of a cup-shaped case 12, containing a sleeve 13, which is secured fixedly to the shaft 6 by means of a screw 14, which has its inner end seated in a recess in the shaft. The sleeves 13 are each surrounded by a spiral or other suitable shaped spring 15, which at one end bears against the inner end of the cup-shaped casing 12 and at its outer end bears against the flanged head of the sleeve, whereby each cup-shaped case 12 is firmly but yieldingly pressed against one of the ground faces 10. The opposite side walls of the annular casing are also constructed with oil-delivery passages 16, communicating at their upper ends with oil-cups 17 and at their lower ends with the ground faces 10 and the inner surfaces of the cup-shaped case 12,

whereby lubricant is delivered to the ground faces to insure a smooth and easy rotary motion of the cup-shaped cases upon the ground faces. At points below the cup-shaped cases the opposite side walls of the annular casing are also formed with oil-drip channels or recesses 18, connected by pipes or tubes 19 with oil or lubricant receptacles 20 in such manner that oil or lubricant dripping from the contacting surfaces of the cup-shaped cases and the sides of the annular casing will fall into the channels or recesses 18 and thence pass to the receptacles 20. By this means the surplus oil is saved and can be reused. The cup-shaped cases 12, pressed against the ground faces 10, serve to prevent the escape of the exhausting working fluid through the openings in the sides of the annular casing through which the shaft 6 passes, such openings being somewhat enlarged relatively to the shaft, so that it is possible for the latter to slightly move either vertically or horizontally in a plane at right angles to the shaft.

The interior of the annular casing is provided with a ring 21, constructed on its inner circle with spaced-apart fingers 22 to create or form rectangular steam or air or gas pockets 23. The fingers are each constructed with a bevel outer extremity, as at 24, for the purpose hereinafter explained. The ring 21 has applied to its opposite sides the side plates or flanges 25, which have the inner sides of their outer portions beveled inwardly, as at 26. These inwardly-beveled surfaces 26 close the ends of the rectangular steam, air, or gas pockets 23, as will be best understood by reference to Figs. 1 and 6. The side plates or flanges 25 are secured to opposite sides of the ring 21 through the medium of rivets or bolts, as at 27, Fig. 2. The periphery of the piston 2 is also constructed with spaced-apart fingers 28, having bevels 30 and arranged to create or form rectangular steam, air, or gas pockets 29. The sides of the piston 2 at its peripheral portion are provided with side plates or flanges 31, which have the inner surfaces of their outer portions inwardly-beveled, as at 32. These inwardly beveled surfaces 32 close the ends of the pockets 29, all precisely the same as described with reference to the pockets of the ring 21. The side plates or flanges 31 are attached by means of rivets or bolts 31^b like the plates or flanges 25 of the ring.

The working fluid, such as steam or air or gas under pressure, is supplied to the inlet 4 and passes therefrom into the annular passage 3, from which the working fluid flows through nozzles 33, possessing a peculiar internal construction, form, or shape, which I will now explain, referring more particularly to Fig. 6. There are a plurality of nozzles disposed in a circle around the piston, and each nozzle is screwed into position through the ring 21. The nozzles are each formed with a circular bore, as at 34, at the inner end of which each nozzle is uniformly curved at

the two points 35 and 36. The delivery-slot 37 of the nozzle is substantially rectangular, so that it will deliver a somewhat broad thin sheet of working fluid, and it is uniformly tapered or widens out from the curved part 36 to the delivery end 38 of the nozzle. This uniformly-tapered broad flat slot 37 causes the steam to flow in a straight direction out of the nozzle and to gradually widen out from the uniformly-curved parts 36 to the delivery-mouth 38, thereby offering far less resistance to the outflow of steam than would be the case were the sides or walls of the slot made parallel or were the delivery-bore of the nozzle of circular form throughout. The peculiar rounded surfaces 35 and 36 of each nozzle are designed for the special purpose of enabling the steam to easily and freely flow into the small or contracted end of the delivery-slot 37. This easy and free movement of the working fluid over the uniformly-curved surfaces 35 and 36 is secured without material resistance on the part of the walls of the nozzle, and experiments made by me demonstrate that by this form of nozzle greatly-increased power is obtained, equal to thirty-seven and a half per cent. The delivery-mouth 38 of each nozzle lies lengthwise relatively to the periphery of the piston, and consequently each delivery-nozzle delivers working fluid simultaneously to a comparatively large number of the fingers and the pockets in the periphery of the piston. Working fluid directed under great velocity by the nozzles into the pockets 29 of the piston turns the latter, and the fluid rebounds into the pockets 23 of the ring 21 and thence again rebounds into the pockets 29 of the piston until the power of the working fluid is completely exhausted. It then passes out at the sides into the enlarged exhaust-chamber and through the exhaust-passages 39, Fig. 1.

It would be practicable to use a condenser on this engine, by means of which its power would be materially increased. The steam, if steam is used in this engine, is not mixed with oil, as is usually the case, and therefore the condensed water can be pumped back direct into the boiler, which is an advantage due to the fact that if only water from the condensed steam is used the boiler will remain free from scale and the like.

In my engine a heavy fly-wheel is unnecessary, and where the same is to be used for driving a dynamo all belting can be dispensed with.

Referring back to the nozzles which deliver the working fluid to the pockets in the periphery of the piston, I have found that by their peculiar construction I obtain twice the pressure on the periphery of the piston than can be obtained with nozzles having circular or round holes of the same area throughout. A nozzle having a one-quarter inch round hole gives a pressure of four pounds on the periphery of the piston with eighty pounds of boiler-pressure per square inch, while noz-

zles constructed in accordance with my invention and as hereinbefore explained and having the same area as a one-quarter inch round-hole nozzle will give a pressure of eight and three-quarter pounds on the periphery of the piston with the same boiler-pressure.

The delivery-mouths 38 of the piston are curved, as best seen in Figs. 5 and 7, to follow generally the curved outline of the periphery of the piston, as will be obvious without further explanation.

The beveled extremities or surfaces 24 of the fingers 22 and the beveled surfaces 30 of the fingers 28 are particularly designed to direct the working fluid in an easy and a better manner than heretofore into the pockets of the ring 21 and of the piston.

The side plates or flanges 25 at opposite sides of the ring 21 and the side plates or flanges 31 at opposite sides of the peripheral portion of the piston, in connection with the inwardly-beveled surfaces 26 and 32, are particularly designed to confine the working fluid more closely in the pockets of the ring and the piston, and since the inwardly-beveled surfaces 26 and 32 close the opposite ends of the pockets in the ring and the piston the working fluid cannot easily escape laterally, and consequently it follows that increased power is given to the engine.

As best seen in Fig. 2, the annular casing is provided with a plurality of valve-stems 40, passing through stuffing-boxes 41, screwed into the annular casing. The inner ends of the valve-stems 40 are provided with suitable valves 42, lying directly opposite and in correct relation to the outer receiving extremities of the nozzles 33, all in such manner that a nozzle, one or more, may be closed by a valve or valves, so that the working fluid in the annular passage 3 cannot enter such closed nozzle or nozzles for the purpose of adapting the engine to variations of load. In Fig. 2 I have represented four valve-stems 40, having valves 42 at their inner ends to cut off four of the nozzles. Other valves may be added by removing the screw-plugs 43 and applying the valves and stuffing-boxes, as will be obvious, or one of the valves may be removed and a screw-plug, like screw-plug 43, inserted into the screw-threaded hole in which the stuffing-box of the valve is screwed.

In Figs. 3, 4, and 8 I represent an engine embodying modifications of my invention. In the modified construction the ring 21, with its fingers and pockets, as described with reference to Figs. 1, 2, 5, and 6, is dispensed with, and the piston 2^a is constructed at opposite sides, near its periphery, with fingers 28^a and pockets 29^a. (Best seen in Fig. 8.) The outer extremities of the fingers are beveled, as at 38^a. The sides of the piston are also provided with side plates, as at 31^a, having upper and lower inwardly-beveled surfaces 32^a, which close the upper and lower ends of the pockets 29^a in a manner substantially the same as the ends of the pockets 29 are closed in the

piston represented in Figs. 1 and 2. The annular casing 1^a is constructed with two opposite parallel annular passages 3^a, to which the working fluid is supplied through inlets 4^a, Fig. 3. The nozzles 33^a are arranged in two sets, one set at each side of the piston. The sets of nozzles lead, respectively, from the annular passages 3^a, from which they receive the working fluid and direct it into the pockets 29^a at opposite sides of the piston. The fingers 28^a, pockets 29^a, beveled extremities 30^a of the fingers, and the nozzles 33^a are all constructed the same as hereinbefore described with reference to Figs. 1, 2, 5, 6, and 7, for which reason a more detailed explanation at this point is considered unnecessary. Reference-numerals in Fig. 3, corresponding with like reference-numerals in Figs. 1 and 2, indicate corresponding or like parts, and for this reason I do not consider it essential to further explain the same.

In Figs. 3, 4, and 8 the piston is provided with pockets at opposite sides near its periphery; but it may be provided with pockets at one side only, as will be understood by reference to Fig. 9. In the engine represented by Figs. 1, 2, 3, and 4 the piston is designed to run in one direction only; but by arranging the pockets in reverse directions at opposite sides of the piston, near its periphery, as will be clear by reference to Fig. 10, and properly arranging the nozzles, as shown in this figure, it is possible to run the piston in either direction by supplying the working fluid through the nozzles at either side of the piston. If the working fluid be supplied through the nozzles at one side, the piston will be rotated in one direction, while by supplying the working fluid through the nozzles at the opposite side the piston will be caused to rotate in the reverse direction, as will be obvious.

I may apply valves and stems similar to the valves 42 and stems 40 shown in Fig. 2 relatively to the outer ends of the nozzles 33^a, Figs. 3 and 4, in much the same manner and for the same purpose as hereinbefore described with particular reference to Fig. 2.

The piston in my improved engine is intended to be constructed of a fine grade of steel, so that it will successfully withstand all strain incident to centrifugal force.

The piston-shaft is made flexible through the medium of the universal couplings, so that if the piston is not exactly balanced, which might cause it to vibrate some, the vibration will not be transmitted to the bearings, as the universal couplings will take up the vibrations and prevent them from being transmitted to the bearings and also prevent to some extent heat from being transmitted to the bearings.

The distinctive, important, and salient elements or features of my invention are the bevels on the backs of the outer extremities of the spaced-apart fingers which create or form the steam, air, or gas pockets for easily and smoothly directing the working fluid--

such as steam, air, or gas—into the pockets; the side plates or flanges having the inward bevels on the inner sides to close the ends of the pockets and thereby temporarily confine the working fluid, so that it cannot easily escape from the pockets, but must effect its full working power; the nozzles having the uniformly-curved internal surfaces leading to a delivery-slot which tapers uniformly from the said curved internal surfaces to its delivery-mouth—that is to say, which widens gradually from its inner to its outer end; the construction of the sides of the piston-casing with seats against which the spring-pressed cup-shaped cases of the stuffing-boxes bear and on which they turn or rotate to prevent the escaping of the working fluid at the enlarged openings through which the piston-shaft passes; the construction of the stuffing-boxes of the three parts—to wit, the sleeves secured to the piston-shaft, the cup-shaped cases, and the springs surrounding the sleeves and acting to firmly but yieldingly press the cases against the ground seats on the piston-casing, and the oil-cups, oil delivery and escape channels or recesses, and oil-receptacles at opposite sides of the piston-casing. These distinctive elements or features materially promote the efficiency of the engine, increase its capacity and power, and generally render this class or type of rotary engines more efficient, effective, useful, and desirable.

Having thus described my invention, what I claim is—

35 1. The combination, in a rotary engine, of a rotary piston constructed with peripheral fingers each having one side straight and the other beveled, and rectangular pockets between said fingers, and nozzles for delivering the working fluid to said fingers and pockets, each nozzle having a delivery-slot uniformly widening from its inner end to its outer end or delivery-mouth, and the beveled portions of said fingers extending at an angle to the adjacent extremities of said nozzles so that the sharpened portions only of the ends of said fingers are nearest to said nozzles, substantially as and for the purposes described.

2. The combination, in a rotary engine, of a rotary piston constructed with the peripheral fingers each having one side straight and the other beveled, and rectangular pockets between said fingers, and nozzles for delivering the working fluid to said fingers and pockets, each nozzle having the uniformly-curved internal surfaces 35 and 36, and a delivery-slot 37 uniformly widening from its inner end to its outer end or delivery-mouth, and the beveled portions of said fingers extending at an angle to the adjacent extremities of said nozzles so that the sharpened portions only of the ends of said fingers are nearest to said nozzles, substantially as and for the purposes described.

3. The combination, in a rotary engine, of a rotary piston having pockets therein, side plates secured to said piston and having beveled portions which close the ends of said

pockets and confine the working fluid, and nozzles for delivering working fluid to said pockets, substantially as and for the purpose described.

4. The combination, in a rotary engine, of the rotary piston constructed with the peripheral fingers having beveled extremities, and rectangular pockets between said fingers, the side plates or flanges secured to opposite sides of the peripheral portion of the piston and having the inner surfaces of their outer circular portions inwardly beveled and closing the ends of the pockets in the piston, and the nozzles for delivering the working fluid to said fingers and pockets, each nozzle having a delivery-slot which uniformly widens from its inner end to its outer end or delivery-mouth, substantially as and for the purposes described.

5. The combination, in a rotary engine, of the rotary piston constructed with the peripheral fingers having beveled extremities, and rectangular pockets between said fingers, the side plates or flanges secured to opposite sides of the said piston and constructed with inwardly-beveled portions which close the ends of the pockets in the piston and serve to confine the working fluid, and the nozzles for delivering the working fluid to said fingers and pockets, each nozzle having a delivery-slot uniformly widened from its inner end to its outer end or delivery-mouth, substantially as and for the purposes described.

6. The combination, in a rotary engine, of the rotary piston constructed with the peripheral fingers having beveled extremities, and rectangular pockets between said fingers, the side plates or flanges secured to opposite sides of the piston and constructed with the inwardly-beveled surfaces which close the opposite ends of the pockets in the piston and serve to confine the working fluid as set forth, and nozzles for delivering the working fluid to said fingers and pockets, between the beveled portions of the said plates or flanges, substantially as and for the purposes described.

7. The combination, in a rotary engine, of a rotary piston constructed with the peripheral fingers each having one side straight and the other beveled and pockets between said fingers, and nozzles for delivering the working fluid to the beveled portions of the fingers and into said pockets, the beveled portions of said fingers extending at an angle to the adjacent extremities of said nozzles so that the sharpened portions only of the ends of said fingers are nearest to said nozzles, substantially as and for the purposes described.

8. In a rotary engine, a rotary piston having pockets therein, a surrounding ring or casing also having pockets therein adjoining the pockets in said piston, nozzles extending through said ring for delivering working fluid to said pockets, and side plates or flanges secured to said ring, provided with

beveled portions, which close the ends of the pockets in said ring and confine the working fluid, substantially as described.

9. The combination in a rotary engine, of a casing having at its opposite sides ground seats and constructed with an annular passage for the working fluid, a rotary piston in the casing, a shaft extending through the sides of the casing and on which the piston is mounted, nozzles leading from the annular passage for directing the working fluid onto the piston, cup-shaped cases bearing against the said ground seats, sleeves arranged in said cases and secured to the piston-shaft, and springs which press the cup-shaped cases against the ground seats, substantially as described.

10. The combination, in a rotary engine, of a casing having at its opposite sides ground seats and constructed with an annular passage for the working fluid, a rotary piston in the casing, a shaft extending through the sides of the casing and on which the piston is mounted, nozzles leading from the annular passage for directing the working fluid onto the piston, cup-shaped cases bearing against the said ground seats, sleeves arranged in

said cases and secured to the piston-shaft, and springs which press the cup-shaped cases against the ground seats, said casing having its side walls constructed with oil delivery and escape passages, oil-cups connected with the oil-delivery passages, and oil-receptacles connected with the oil-escape passages, substantially as described.

11. The combination, in a rotary engine, of a casing having its opposite sides constructed with the ground seats and orifices, a rotary piston-shaft passing through said orifices and carrying a piston, cup-shaped cases bearing against said ground seats and adapted to turn thereupon, sleeves arranged in said cases and secured to the shaft to turn therewith, and springs housed in the cases and acting to press the same against the ground seats to prevent the escape of working fluid at these points, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

LAMBERT IGELHORST.

Witnesses:

NICHOLAS LEONARD,
RUDOLPH TEUK.