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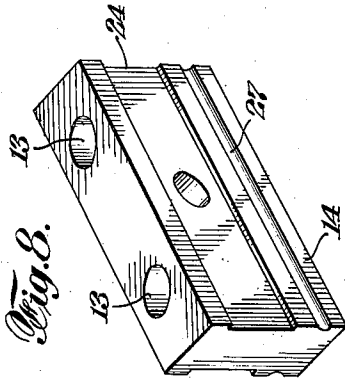
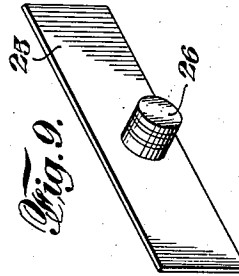
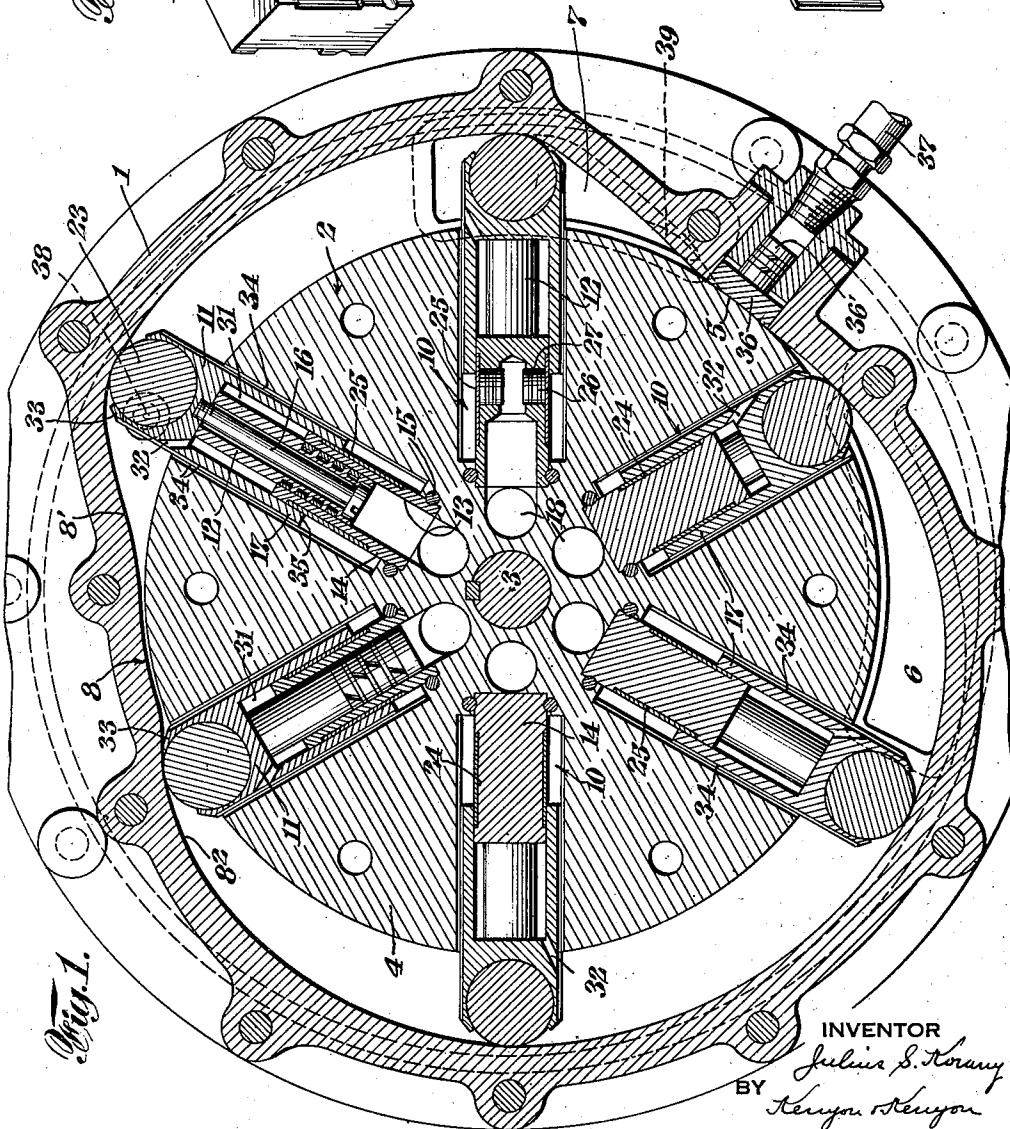
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2,174,664

ROTARY INTERNAL COMBUSTION ENGINE

Filed June 17, 1937

4 Sheets-Sheet 1



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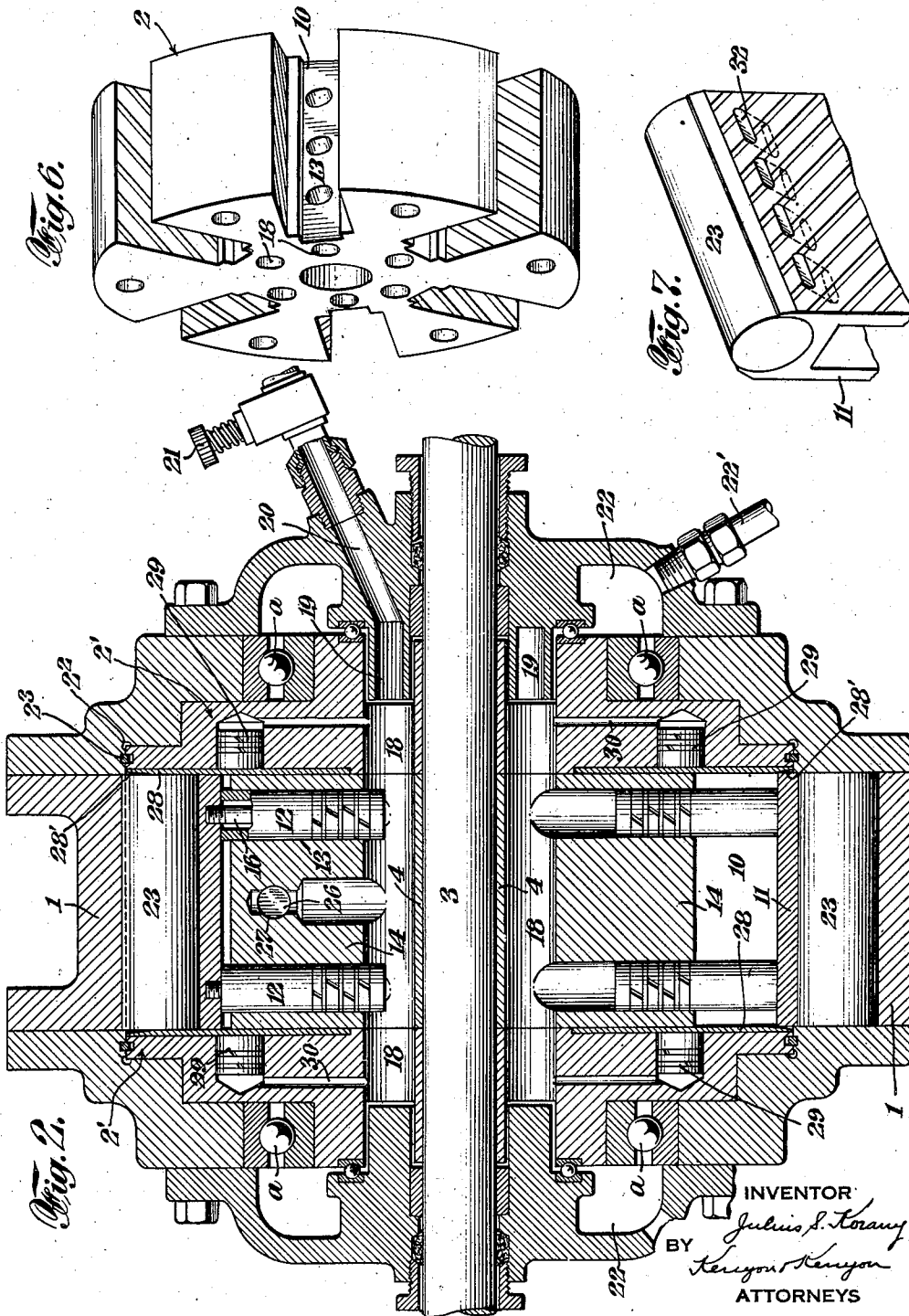
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4 Sheets-Sheet 2



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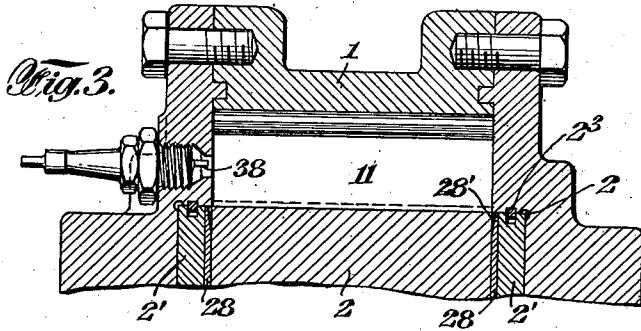
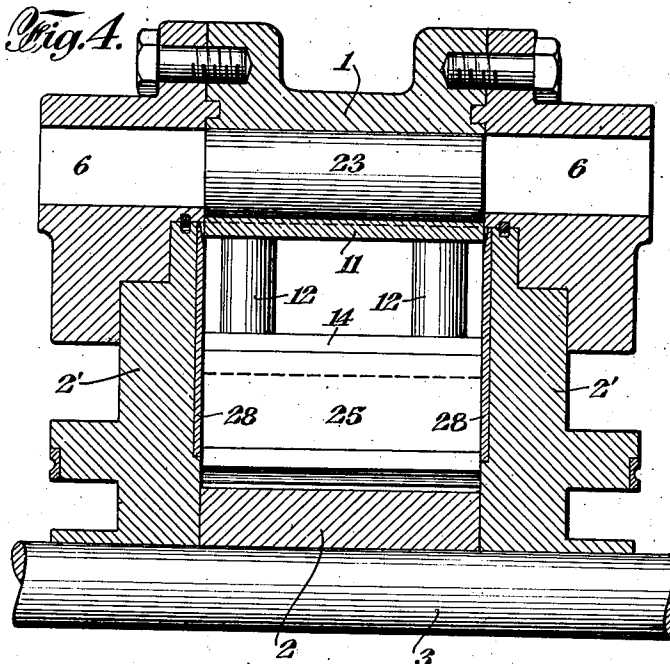
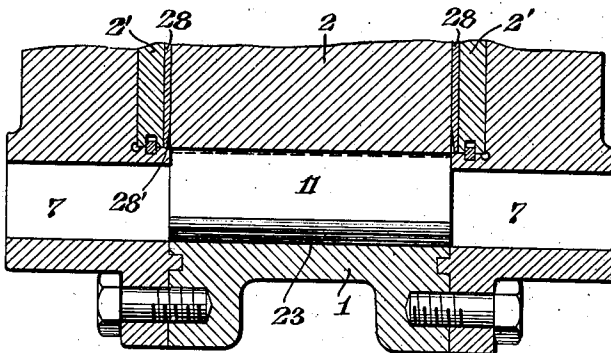
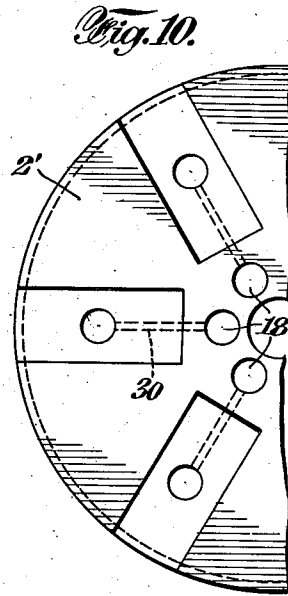
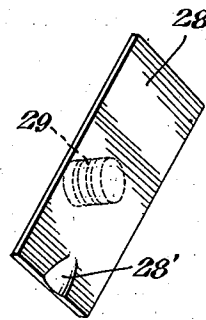
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4 Sheets-Sheet 3



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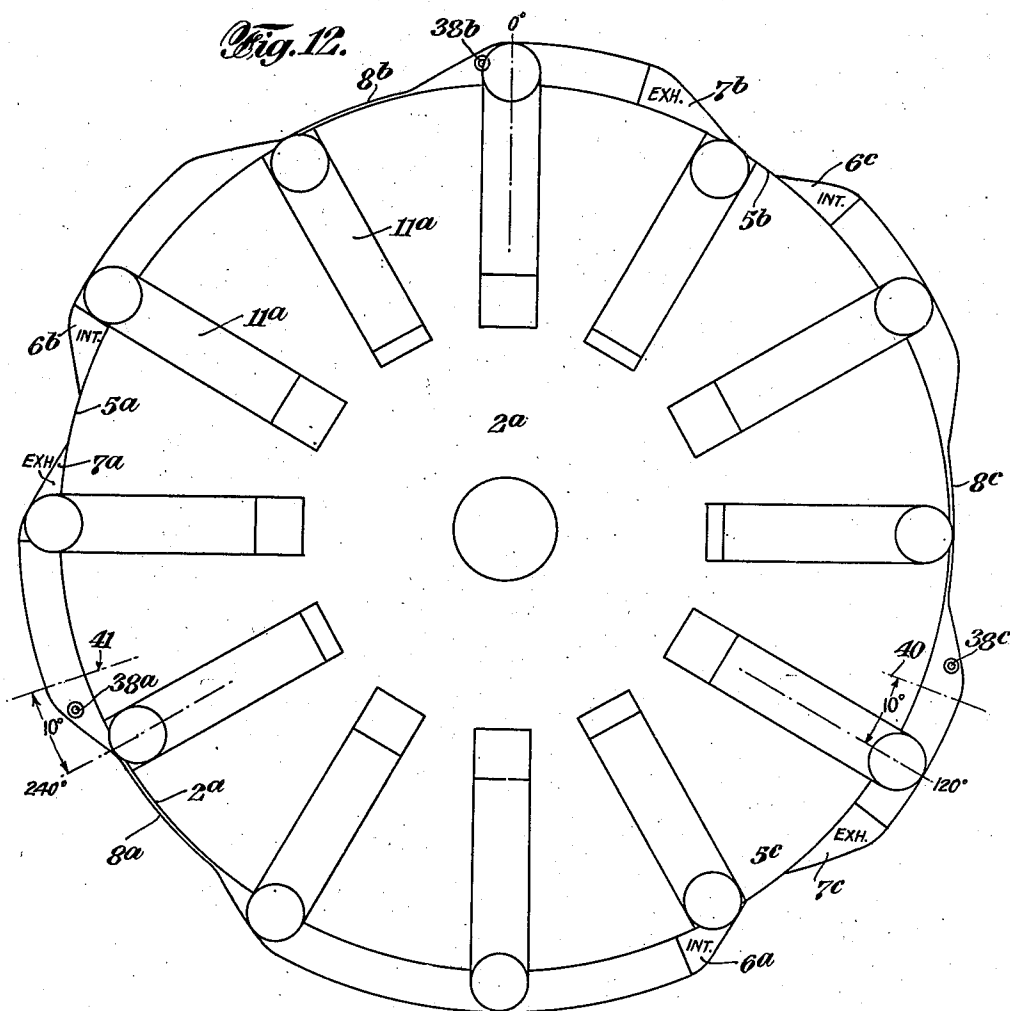
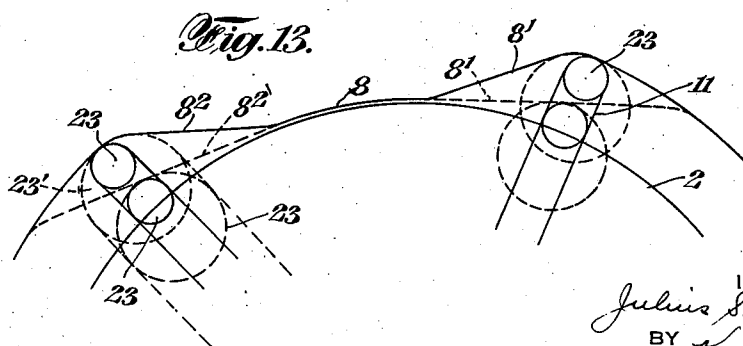
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ROTARY INTERNAL COMBUSTION ENGINE

Filed June 17, 1937

4 Sheets-Sheet 4



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2,174,664

ROTARY INTERNAL COMBUSTION ENGINE

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Application June 17, 1937, Serial No. 148,632

8 Claims. (Cl. 123-16)

My invention relates to rotary engines, particularly of the internal combustion type.

One of the objects of my invention is to provide a rotary engine which is simple and durable in construction and efficient in operation. In accordance with this object, I have provided a motor having a casing in which the combustible mixture is effectively compressed and ignited, and the products of combustion allowed to expand, and then exhausted, the expansive force being applied directly to produce rotation of the engine shaft and the parts carried thereby. The construction is preferably such that there are a number of power impulses for each rotation of the shaft, whereby a light weight engine of high power and speed is obtainable.

Other objects, features and advantages of the invention will appear more fully in the following detailed description and in the appended claims.

The accompanying drawings forming a part of this specification illustrate two embodiments of my invention.

In the drawings:

Figure 1 is a cross section of one of the said embodiments taken at right angles to the engine shaft;

Figure 2 is a section taken longitudinally of the engine shaft;

Figure 3 is a view partly in section and partly in elevation showing details of construction of the firing region;

Figure 4 is a view partly in section and partly in elevation showing details of construction in the fuel intake region;

Figure 5 is a view partly in section and partly in elevation showing details of construction in the exhaust region;

Figure 6 is a perspective view of the body of the engine rotor;

Figure 7 is a perspective view of one end of a rotor wing;

Figure 8 is a perspective view of a part of the rotor on which a wing reciprocates;

Figure 9 is a perspective view of a packing plate used with the rotor blocks of my device;

Figure 10 is a partial elevation of a rotor end plate used with my device;

Figure 11 is a perspective view of a packing plate applied at the end walls of said rotor blocks;

Fig. 12 is a diagrammatic view of another embodiment of the invention, and

Fig. 13 is a diagrammatic view showing how the degree of compression of the engine may be varied.

The motor comprises a casing 1, which constitutes the stationary part, or stator, thereof. The casing is provided with an internal chamber within which is arranged a rotor 2 rotatable about the axis of and suitably keyed or other-

wise locked to the horizontal shaft 3. The rotor comprises a body portion 4 which is substantially in the form of a horizontal cylinder. The body portion of the rotor is preferably made of such a diameter that it contacts the interior casing wall at the point 5 between the ports 6 and 7 in the casing, the port 6 serving for the admission of the fuel mixture and the port 7 serving for the exhaust of products of combustion. The interior wall of the casing 1 is so shaped as to provide a space 8 of reduced cross section for the compression of the fuel mixture prior to ignition. As shown, this compression space is formed by shaping the interior wall of the casing 1 so that at the point of maximum compression the wall is in very close proximity to the body of the rotor 2. At this point the space between the periphery of the rotor body and the interior of the casing may be in the neighborhood of four-hundredths of an inch. On both sides of this point of closest approach between the rotor body and the casing, the casing recedes gradually from the periphery of the rotor body. I thus provide for the gradual compression of the fuel and for the expansion of products of combustion after ignition.

Any desired degree of compression may be obtained by properly shaping the inner wall of the casing on opposite sides of the portion 8. For example, by lessening the slope of the walls at the points 8' and 8², that is bringing these walls nearer a tangential position with respect to the rotor, a higher degree of compression is obtained. This is shown in Fig. 13 where the solid lines 8', 8² show a slope for one degree of compression and the dotted lines 8', 8² a slope for a different and higher degree of compression. The fact that the compression is higher for the said dotted line arrangement of the casing wall than for the solid line arrangement is evident from the fact that the area between the wing or vane 11, the periphery of the rotor body 2 and the dotted line 8' or 8² is less than the area between the wing 11, the periphery of the rotor body 2 and the solid line 8' or 8². Similar results may be obtained by changing the size of the rollers 23 at the ends of the wings 11. As shown in Fig. 13, the wing with the larger roller 23' shown in dotted lines produces a higher degree of compression than the wing with the smaller roller 23 shown in solid lines. This is true because, as shown in Fig. 13, the space between the wing having the roller 23', the periphery of the rotor body 2, and the surface 8' or 8² is less than the space between the wing having the roller 23, the periphery of the rotor body and the surface 8' or 8². By changing both the size of rollers and their supports and the slope of the surfaces 8' and 8², very marked changes in compression may be obtained.

The rotor body is formed with radial slots or

grooves 10 extending throughout the length of the rotor. Within each of these slots a wing or vane 11 is mounted for sliding movement radially of the rotor. As shown, the rotor is provided with six wings; but different numbers of wings may be employed according to the effect desired. The construction is such that for each wing there is a complete cycle of operations for each rotation of the rotor.

The wings are held in engagement with the interior of the casing 1 throughout the rotation of the rotor. To achieve this purpose, each wing is provided with plungers 12 which are adapted to reciprocate radially of the rotor in bores 13 extending through a block 14 which is secured to the rotor body by suitable fastenings 15. The block projects into the rotor slot 10. The plungers 12 may be secured to the body of the wings 11 by any suitable means, such as the screws 16. As shown, each wing 11 is provided with a skirt portion 17 which reciprocates on the outside of block 14 radially of the rotor.

The plungers 12, as shown, are pressed outwardly so as to maintain the wings in engagement with the casing 1 by fluid pressure. To that end, the inner ends of the bores 13 of each block 14 lead to a passage 18 extending parallel to the engine shaft 3 in the rotor body. The various passages 18 communicate with an annular chamber 19 to which oil under pressure may be supplied through conduit 20 controlled by a pressure valve 21. Oil may be supplied to the conduit 20 from a suitable oil pump (not shown). From the passages 18, the oil passes through the spaces between the casing 1 and the end plates 2' secured to the rotor body and drains into the chambers 22 of the casing. The oil from the chambers 22 lubricates the bearings α and the contacting surfaces between the rotor-end-plates and the casing. From the chambers 22, the oil passes through conduits 22' back to the pump. It will be seen that with this arrangement oil under pressure is supplied to the inner ends of the plungers 12, thereby maintaining the wings yieldably in contact with the inner wall of the chamber 1. The circulation of the oil, as shown, preferably also serves to cool the rotor, the oil supplied by the conduit 20 being cooler than that withdrawn through the conduit 22.

During the rotation of the rotor a certain amount of oil which collects on the outer surface of the rotor-end-plates 2' is thrown by centrifugal force outwardly to the peripheries of these plates. As shown, I have provided a peripheral recess 22 to collect this oil. It is desirable to provide means whereby the oil collected in the recess 22 is prevented from entering the engine casing and being consumed or otherwise lost therein. To that end, I provide a sealing ring 23. This ring also serves to prevent the products of combustion of the engine from escaping past the periphery of the plates 2'. The oil in the recess 22 likewise serves as a seal tending to prevent the escape of the products of combustion.

In order to minimize wear between the wings and the interior wall of casing 1, I preferably provide the outer end of each wing with a roller-bearing 23 having rolling contact with the casing during the rotation of the rotor. The rollers, as shown, are housed in cylindrical recesses in the ends of the wings, the walls of the recesses extending more than half way around the rollers so as to effectively retain them in place on the wings. I order to maintain a close fit between the rotor-block 14 and the skirt 17 of each wing,

I provide opposite faces of each block with recesses 24 in each of which is mounted a packing-plate 25. To hold the outer face of the plate 25 in engagement with the interior of the skirt 17, I provide the rear of the plate with a plunger portion 26 which is arranged to reciprocate in an opening 27 in the block 14, the opening 27 communicating with the fluid passages 18; so that fluid pressure is applied to the rear of the plunger 26 to press the plate 25 against the skirt 17. Similar packing plates 28 are arranged in the end walls 2' of the rotor. These plates are likewise provided with plungers 29 to the rear of which fluid from the passages 18 is applied to press the plate against the end of the corresponding rotor wings. As shown in Fig. 2, a passage 30 establishes communication between the passage 18 and the rear of each plunger 29.

In order to facilitate the movement of the rollers inwardly past the outer edge of the plates 28, the latter are preferably each provided with a thumb nail recess 28' into which the end of the roller passes to force the plate 28 back a sufficient distance against the fluid pressure on the rear thereof.

In order to prevent interference with the inward movement of the wings by entrapment of air or vapor in the space 31 between the wing head and the outer end of the block 14, I form each wing with passages 32 between space 31 and the outside of the wing. These openings 32 not only permit the passage of air or vapor from or into the space 31 upon the movement of the wings, but they also permit the escape of the jets of the products of combustion from space 31, producing a reaction which adds to the force tending to turn the rotor.

During expansion, the products of combustion act to a certain extent upon the outer portion 33 of the wings and the exposed surface of the rollers 23 to exert a tendency to force the wings inwardly. To counteract that tendency, I preferably provide the rotor and the wings with bleed passages 34 whereby some of the products of combustion are admitted to the inner end 35 of the skirt 17 of each wing to exert an outward pressure upon the wing. These bleed passages 34 also coact with the openings 32 to maintain communication between these openings and the interior of the stator-casing when the wings are in their inner positions.

This inward pressure upon the wings and rollers is further counteracted by the gases within the space 31 which exert an outward pressure on the outer end wall of that space.

It is desirable to maintain close contact at the point 5 between the rotor and the casing so as to prevent products of combustion from being carried over to the fresh fuel admitted through the port 6. To maintain this close contact, I provide a packing plate 36 which is mounted in the casing 1 and held by fluid pressure against the periphery of the body of the rotor. The fluid pressure may be applied to the plunger 36' at the rear of the plate 36 through a conduit 37 leading from the oil pump (not shown). To permit products of combustion pocketed in the space between the rotor body, the inner wall of the casing and the forward edge of the wing near the plate 36 to escape to the exhaust port 7, I provide a bleed passage 39 in the inner wall of the casing.

Ignition of the fuel may be effected by any suitable means such as the spark-plug 38, located, for example, as shown in Fig. 3, in the side wall

of the stator, and, as indicated in Fig. 1, adjacent the compression region 8.

In operation, the fuel is admitted through the inlet 6. The fuel may be the usual mixture of gasoline vapor and air. There are a number of fuel admissions corresponding to the number of wings, each adjacent pair of wings serving with the end walls of the stator casing and the periphery of the rotor body to entrap a given volume of fuel. This volume of fuel is carried around by the rotation of the rotor to the point 8 where the fuel has been gradually compressed. The compressed fuel is thereupon ignited, as by the spark plug 38, whereupon the products of combustion expand, thereby driving the forward confining wing ahead and causing the rotation of the rotor and the engine shaft. The products of combustion are permitted to escape through the exhaust port 7.

For increased power and smoothness of operation, my improved engine may be arranged to effect a plurality of cycles of operation for each wing during each rotation of the rotor. Fig. 12 shows such an embodiment of the invention having twelve wings 11a and three cycles of operation, to wit, three cycles of intake, compression, ignition, expansion and exhaust, for each wing. The intakes are shown at 6a, 6b and 6c. The corresponding compressions are shown at 8a, 8b and 8c, respectively, where the inner wall of the casing is arranged in close proximity to the periphery of the body of the rotor 2a. The corresponding ignitions are shown at 38a, 38b and 38c, respectively, followed by the corresponding expansions and the exhausts 7a, 7b and 7c, respectively. Following each exhaust and ahead of the next succeeding intake, the rotor body is in sealing contact with the casing wall as shown at 5a, 5b and 5c, respectively, to prevent the hot products of combustion from being carried over to the fresh supply of fuel.

To secure a more uniform application of the power to the wings, the ignitions for the different cycles are arranged so as not to occur simultaneously but at uniformly spaced intervals. The arrangement as shown is such that between ignitions for successive wings at a particular point, for example 38b, there occur at uniform intervals ignitions for other wings. As shown, there is a 30° angle or interval between successive wings; and the proper spacing of the ignitions is obtained for the three cycles of operation by having the ignitions occur at intervals corresponding to a 10° movement of the rotor wings. This is achieved by having the ignition means operate upon the upper most wing when the latter is in a vertical position while the ignition means 38c is arranged to operate when the said wing is 10° in advance of its uppermost position, and the ignition means 38a is arranged to operate after the said wing has passed 10° beyond its upper most position.

In order that the wings may be in operative relation to the ignition means at each ignition point, the ignition means 38c is, as shown, arranged to operate when the adjacent wing is at an angle of 110° (120° minus 10°) from the upper vertical position and the ignition means 38a is arranged to operate when the adjacent wing is 250° (240° plus 10°) from the upper vertical position. The center of the wing at the time of ignition by the wing 38c is shown in Fig. 12 at 40; and the center of the wing for ignition by the wing 38a is shown at 41.

The detailed construction of the wings with the

means for maintaining them in engagement with an interior wall of the casing and in close engagement with the rotor body may be the same for the arrangement shown in Fig. 12 as for the other illustrated embodiment of the invention.

In operation each wing draws fuel from intake 6a, and compresses it at 8a, whereupon ignition takes place at 38a followed by expansion and by exhaust through the port 7a. The same wing then draws in fuel through the intake port 6b, and the fuel is compressed at 8b, ignited at 38b, followed by expansion and exhaust through the port 7b. The same wing draws in a further supply of fuel through the port 6c, compresses the same at 8c whereupon ignition takes place at 38c followed by expansion and exhaust through the port 7c. Thus in the form of invention shown in Fig. 12 there are three successive power impulses for each wing on each rotation of the rotor shaft. Furthermore at uniform intervals between the successive ignitions for each wing there are power impulses for the other wings. An engine capable of producing high power and a smooth application of power to the power shaft is thus obtained. Of course the number of cycles for each wing and the number of wings may be varied at will.

It is understood that I am not limited to the embodiments of the invention shown and described and that many changes and modifications may be made in the structure described without departing from the spirit of my invention. My invention is applicable to internal combustions of the Diesel type as well as the ordinary type of gasoline engine in which the fuel and air are admitted as a mixture. The fuel may be any combustible material, such as gasoline or crude oil.

I claim:

1. The combination of a casing having a fuel inlet, an exhaust port in its side walls, and a chamber for compression and ignition of the fuel, and expansion of the products of combustion, and a rotor arranged within said chamber, said rotor having a body portion contacting the casing between the exhaust port and fuel inlet, said rotor also having a radially extending slot, a stationary member mounted in said slot and having a bore therethrough, a movable wing mounted on said stationary member and having a plunger adapted to move in said bore and a telescoping portion adapted to slide over the outside of said stationary member toward and away from the axis of rotation of said rotor, and means for applying pressure to said plunger whereby said wing may be continuously maintained in engagement with the interior wall of the casing.

2. The combination of a casing, having a fuel inlet, an exhaust port located in the side walls thereof, and a chamber for compression and ignition of the fuel, and expansion of the products of combustion, and a rotor arranged within said chamber, said rotor having a body portion contacting the casing between the exhaust port and fuel inlet and arranged in close proximity to the casing at the compression portion of the chamber, said rotor also having a radially extending slot, a stationary member mounted in said slot and having a bore therethrough, a movable wing mounted on said stationary member and having a plunger adapted to move in said bore and a skirt portion adapted to move over the outside of said stationary member toward and away from the axis of rotation of said rotor, and means

for applying pressure to said plunger whereby said wing may be continuously maintained in engagement with the interior wall of the casing.

3. The combination of a casing having a fuel inlet, a chamber for ignition of the fuel and expansion of the products of combustion, and an exhaust port, and a rotor within said chamber comprising a rotor body, a wing rotatable therewith and movable towards and away from the axis of the rotor, means for movably mounting said wing on said rotor including a bored member on said rotor, said wing having a portion moving in the bore in said member and having a second telescoping portion mounted slidably over said bored member, fluid pressure means operating on said first named portion of said wing for maintaining said wing in engagement with the interior wall of the casing, and fluid pressure operated sealing means between said bored member and said telescoping portion of said wing for maintaining a close engagement of the said telescoping portion of said wing and said bored member.

4. The combination of a casing having a fuel inlet, an exhaust port, and a chamber for compression and ignition of the fuel and expansion of the products of combustion, and a rotor arranged within said chamber, said rotor having a body portion contacting the casing between the exhaust port and fuel inlet, and arranged in close proximity to the casing at the compression portion of the chamber, said rotor having also a wing contacting the interior wall of the casing and movable toward and away from the axis of rotation of the rotor, means for movably mounting said wing on said rotor including a bored member on said rotor, said wing having a plunger movable in the bore in said member, and having a skirt portion slidable over said bored member, fluid pressure means operating on said plunger whereby the wing may be continuously maintained in engagement with the interior wall of the casing, and fluid pressure operated sealing means between said bored member and said skirt portion for maintaining a close engagement of the said skirt portion with said bored member.

5. The combination of a casing having a fuel inlet, a chamber for ignition of the fuel and expansion of the products of combustion, and an exhaust port, and a rotor within said chamber comprising a rotor body and a wing rotatable therewith and movable towards and away from the axis of the rotor, means for movably mounting said wing in said rotor including a bored member on said rotor, said wing having a portion moving in the bore in said bored member and having a second telescoping portion mounted slidably over said bored member, said rotor and said wing being provided with means permitting a portion of said products of combustion during expansion thereof to enter behind the rear of said wing to counteract inward movement of said wing toward the axis of said rotor induced by said expansion and being provided with means permitting release of said portion of said products of expansion under pressure from the rear of the rotor wing, and means for maintaining said wing in engagement with the interior wall of the casing.

6. The combination of a casing having a fuel inlet, a chamber for ignition of the fuel and ex-

pansion of the products of combustion, and an exhaust port, and a rotor within said chamber comprising a rotor body and a wing rotatable therewith and movable towards and away from the axis of the rotor, means for movably mounting said wing in said rotor including a bored member on said rotor, said wing having a telescoping portion mounted slidably over said bored member, said rotor and said wing being provided with means permitting entry of a portion of said products of combustion during expansion thereof behind the rear of said wing to counteract inward movement of said wing toward the axis of said rotor induced by said expansion and being provided with means permitting release of said portion of said products of expansion under pressure from the rear of the rotor wing, and means including a fluid operated plunger movable in the bore of said bored member for maintaining said wing in engagement with the interior wall of the casing.

7. The combination of a casing having a fuel inlet, an exhaust port, and a chamber for compression and ignition of the fuel and expansion of the products of combustion, and a rotor arranged within said chamber, said rotor having a body portion contacting the casing between the exhaust port and fuel inlet and arranged in close proximity to the casing at the compression portion of the chamber, said rotor having also wings contacting the interior wall of the casing and movable toward and away from the axis of rotation of the rotor, means for movably mounting said wings on said rotor including bored members on said rotor, said wings having plungers movable in the bores of said members and having skirt portions slidable over said bored members, fluid pressure means operating on said plungers whereby the wings may be continuously maintained in engagement with the interior wall of the casing, said wings being provided with fluid operated means for maintaining a close engagement between the said skirt portions of said wings and said bored members on said rotor body.

8. The combination of a casing having a fuel inlet and exhaust port, and a chamber for compression and ignition of the fuel and expansion of the products of combustion, and a rotor arranged within said chamber, said rotor having a body portion contacting the casing between the exhaust port and fuel inlet and arranged in close proximity to the casing at the compression portion of the chamber, said rotor having also wings contacting the interior wall of the casing and movable toward and away from the axis of rotation of the rotor and fluid pressure means whereby the wings may be continuously maintained in engagement with the interior wall of the casing, said wings being provided with fluid operated means for maintaining a close engagement between the wings and rotor body, and with means permitting the entry during expansion of a portion of the gaseous products of combustion behind the undersides of said wings for counteracting the movement of said wings inwardly toward the axis of rotation of the rotor induced by said expansion, and with means permitting release of said portion of said gaseous products under pressure from the said undersides of the wings.

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