

July 3, 1945.

G. A. STANZEL

2,379,838

SELF-STARTING CONSTANT PRESSURE INTERNAL-COMBUSTION ENGINE

Filed June 22, 1942

3 Sheets-Sheet 1

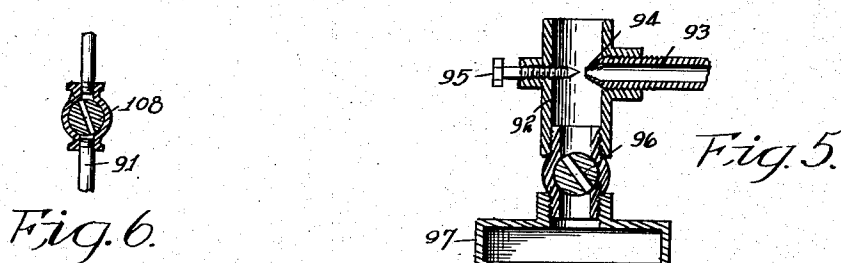
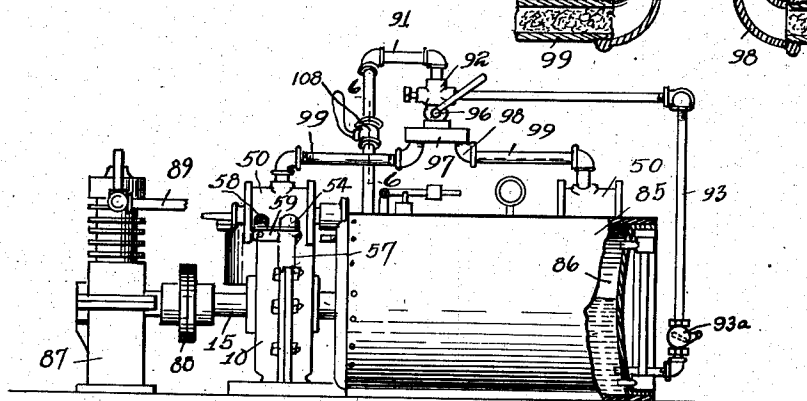


Fig. 1.

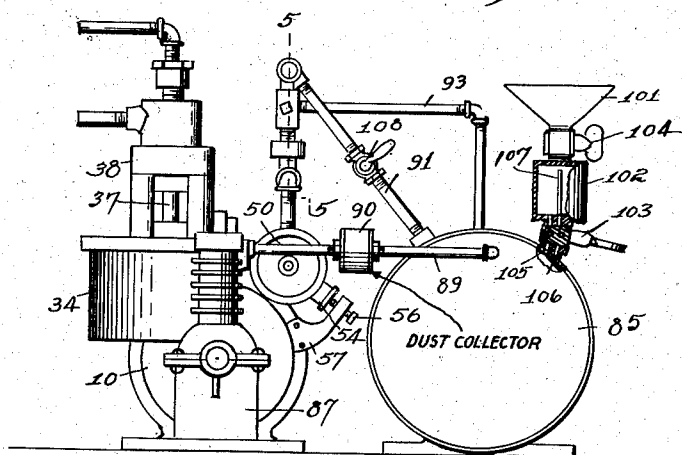


Fig. 2.

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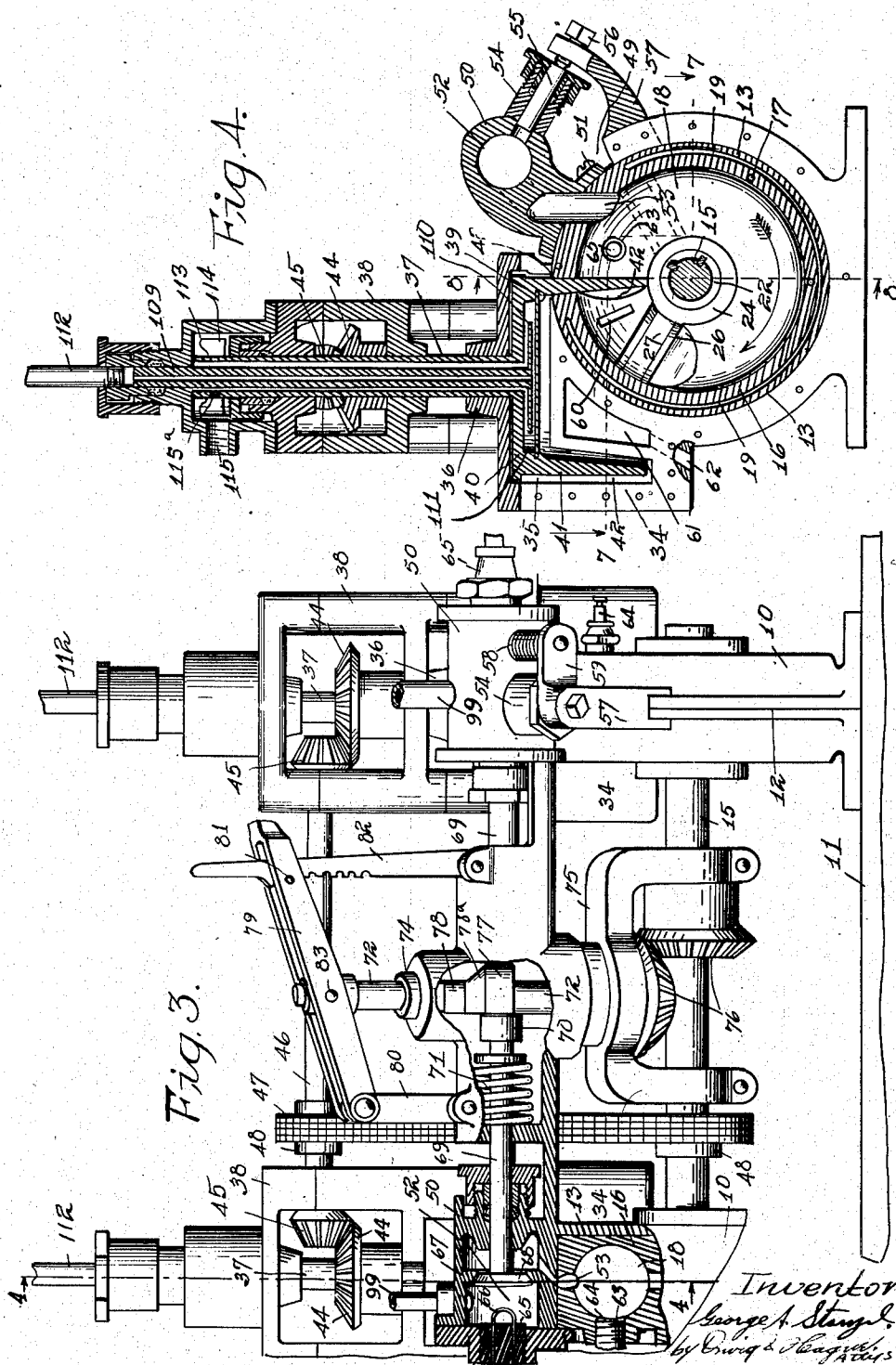
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3 Sheets-Sheet 3

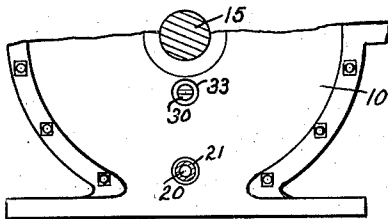


Fig. 8a.

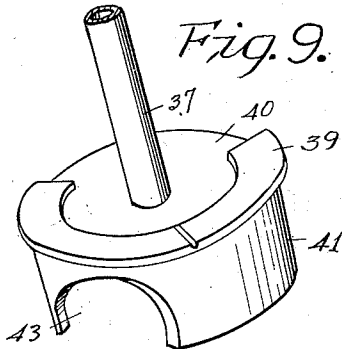


Fig. 9.

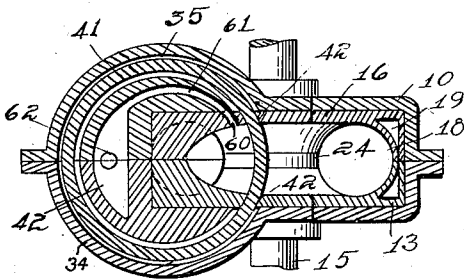


Fig. 7.

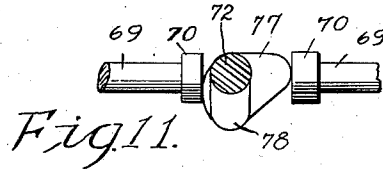


Fig. 11.

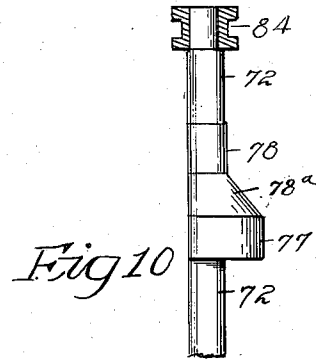


Fig. 10.

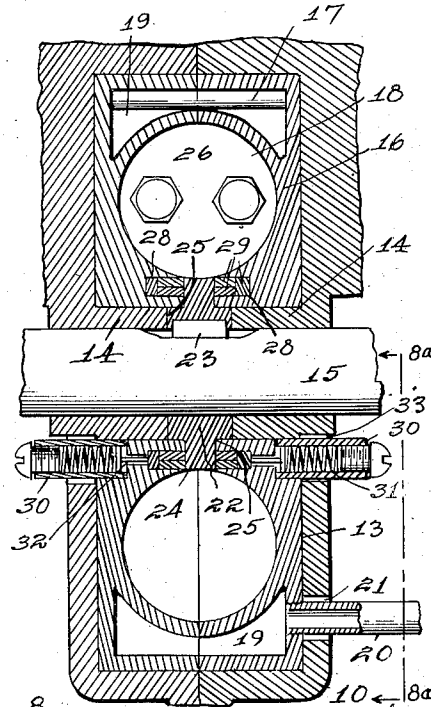


Fig. 8.

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UNITED STATES PATENT OFFICE

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SELF-STARTING CONSTANT PRESSURE
INTERNAL-COMBUSTION ENGINE

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Application June 22, 1942, Serial No. 447,952

9 Claims. (Cl. 60—44)

This invention relates to an improved internal combustion engine and more particularly to a type of engine adapted to utilize a mixture of air and gases or vapors for fuel, wherein the mixture is delivered to the engine at a constant pressure substantially equal to the working pressure of the fuel under combustion, rather than from a rapid increase in pressure of short duration such as employed in the ordinary internal combustion engine now in common use. By applying a constant pressure to the piston a more uniform torque will be applied to the engine shaft than would be possible with the explosive type of engine.

It is, therefore, the object of my invention to provide an improved internal combustion engine particularly adapted to be operated by a constant pressure and having a high piston velocity to reduce, as far as possible, heat radiation and vibration.

A further object of my invention is to provide an internal combustion engine wherein the torque applied to the engine shaft is substantially uniform with a comparatively minimum number of cylinders or working units involved.

To accomplish the above results it is believed that the rotary type of engine is best suited to my purpose and that a comparatively long piston stroke may be utilized as compared to its diameter. It is, therefore, a further object of my invention to provide a rotary engine wherein substantially all of the moving parts operate in a rotary manner to eliminate as far as possible all reciprocating elements and vibration resulting therefrom.

A further object is to provide in a rotary engine employing an annular working chamber and a piston rotatably mounted therein, an improved abutment which is also rotatably mounted to operate at synchronized speed therewith, and in connection therewith, improved means for seating or sealing the abutment against gas leakage.

A further object of my invention is to provide an internal combustion engine so constructed and arranged as to be substantially self-starting without the use of auxiliary devices or mechanisms such as batteries, springs, or auxiliary pneumatic or hydraulic starters.

A further object is to provide in an internal combustion engine of the type above described, improved means for controlling the flow of combustible fuel into the cylinders by the use of two units operated from a common shaft, which may develop a constant torque on the shaft through an angle of 360°, or wherein, for the sake of

maximum power and fuel economy, this constant torque may be somewhat varied at the will of the operator.

A further object of my invention is to provide an internal combustion engine of the type above described having means wherein various types of ignition may be employed to suit the type of fuel used.

A further object is to provide in an internal combustion engine of the rotary type employing a rotary abutment, improved means for internally cooling the abutment to prevent warpage, overheating, and burning of lubricant.

A further object is to provide in an internal combustion engine of the type above described, improved means for delivering combustible fuel to the engine under constant pressure.

My invention consists in the construction, arrangement and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which:

Figure 1 is a side elevation of my improved internal combustion engine, a portion of the fuel tank being broken away;

Figure 2 is an end elevation of the same;

Figure 3 is an enlarged segmental side elevation of the engine, portions being broken away to show the interior construction;

Figure 4 is a detail sectional view taken on the line 4—4 of Figure 3;

Figure 5 is an enlarged detail sectional view taken on the line 5—5 of Figure 2;

Figure 6 is an enlarged detail sectional view taken on the line 6—6 of Figure 1;

Figure 7 is a sectional view taken on the line 7—7 of Figure 4;

Figure 8 is an enlarged detail sectional view taken on the line 8—8 of Figure 4;

Figure 8a is a fragmentary view partly in section as seen on the line 8a—8a in Fig. 8;

Figure 9 is a perspective view of my improved abutment;

Figure 10 is a side elevation of the cam shaft for operating the valves; and

Figure 11 is a diagrammatical view illustrating the manner in which the ends of the valve stems engage one of the cams of said cam shaft.

My improved engine comprises a pair of outer casings or supports 10, spaced apart and operatively connected by means of a base 11. Each casing is preferably formed of two sections joined together on a central vertical plane 12, each casing 10 including a cylindrical cavity 13 substan-

tially rectangular in cross section, as clearly illustrated in Figure 8, having inwardly projecting hub members 14, the inner ends of the hub members being spaced apart a slight distance.

Rotatably mounted in the hubs 14 is a shaft 15 common to both casings, and mounted within each of the cavities 13 is an annular member 16 which is also formed of two halves connected together by means of bolts 17 forming a unit rotatably mounted on the hub members 14 and within the said cavity. The member 16 has formed therein a working chamber or cylinder 18 circular in cross section. The member 16 is also provided with cavities 19 surrounding the walls of the working chamber for receiving a cooling fluid, such as water or oil. A pipe 20 is projected through an enlarged opening 21 in the walls of the casing 10, into the walls of the members 16, and communicates with the cavities 19. A similar pipe, not shown, is also provided to form inlet and outlet means for circulating the cooling fluid. The opening 21 is of such a size that the pipe 20 is freely movable therein to permit the member 16 oscillating within the member 10 through an angularity of 2 or 3°, for the purposes hereinafter made clear.

Fixed to the shaft 15 and between the ends of the hubs 14 is a hub 22, fixed thereto by means of a key 23, the said hub having a flange 24 mounted between the inner edges 25 of the members 16 to form means for supporting the piston 26, said piston being fixed thereto and provided with a suitable packing ring 27, the edges 25 each being provided with an annular groove 28 in which are mounted packing rings 29 to prevent leakage from the cylinder chamber 18 past the flange 24. Supported in the members 16 are pipes 30, each of which is provided with a spring 31 having its inner end terminating in an inwardly extending portion 32 designed to rest against the outer rings 29 to yieldably retain said rings in operative position. The pipes 30 are extended through enlarged openings 33 formed in the member 10 large enough to permit rocking movement of the members 16. The casing 10 is provided with a portion 34 having an annular recess 35 concentric to a vertical axis which is substantially tangent with the combustion chamber 18. The member 34 has a hub 36 designed to rotatably support a vertical shaft 37, said shaft also being mounted in an upright frame member 38, the lower end of the shaft 37 terminating in what I shall term as an abutment 39, comprising a disc-like head 40 and a downwardly extending annular flange 41 designed to operate in the recess 35. The flange 41 is also mounted to rotate in an arcuate slot 42 formed in the member 16, as clearly shown in Figures 4 and 7, the said slot 42 being concentric to the axis of the shaft 37 and radially of the shaft 15, the bottom edge of said slot 42 terminating at the top edge of the member 24 so that the flange 41 forms an abutment closing transversely the working chamber 18 at a point above the shaft 15, the said flange 41 having a notch 43 through which the piston 26 may travel when the said flange 41 is in one position of its rotary movement. The said shaft 15, together with the flange 41, is synchronized by a pinion 45 mounted on a shaft 46, the said shaft being rotatably mounted in the frame 38 and driven by means of a chain 47 and sprocket wheels 48 mounted on the shafts 15 and 46, as illustrated in Figure 3, thus providing means whereby the abutment flange 41 is rotated continuously and in unison with the rotation of the

piston 26. The said piston and the notch 43 are timed so that the piston passes through the notch without engaging the said abutment flange.

In order to maintain a gas tight seal between the abutment flange and the right-hand side of the arcuate slot 42, as viewed in Figure 4, means is provided for moving the casing 16 in a direction counter to that of the piston and within the casing 10, so that a tight seal is always maintained to prevent leakage of gas. The top side of the outer casing 10 is provided with a notch 49 to permit the head 50 to be fixed to the top side of the casing 16 by means of bolts 51, said head 50 being formed with a combustion chamber 52 communicating with the working chamber 18 by means of a passage 53. The said head 50 is provided with a radially projecting lug 54 for slidably receiving a plunger 55 which is in communication with the combustion chamber 52 and has its outer end engaging a set screw 56 carried by a bracket 57 mounted on the casing 10. Fuel is supplied to the chamber 52 under pressure which is applied against the inner end of the plunger 55 tending to move the said plunger outwardly against the said screw which is fixed against movement, which will then in turn tend to rotate the head 50 in an anticlockwise direction and with it the member 16, causing pressure to be applied between the members 16 and 41, for the purpose of forming a gas-tight seal at that end of the working chamber 18.

To maintain a small amount of pressure on the said member 16 when there is no pressure in the chamber 52 I have provided a spring 58 having one end resting against the head 50 and the other end against a flange 59 projecting laterally from the bracket 57, this spring 58 being of such tension as to apply only enough pressure between the members 16 and 41 as to maintain contact between said members at such times as when pressure is not applied to the combustion chamber, the pressure of the fuel providing additional pressure to seal said members 41 and 16, the pressure as applied to said members being in proportion to the pressure within the combustion chamber. The member 16 is also provided with an exhaust opening 60 (see Figs. 4 and 7) communicating with the slot 61 and terminating in an outlet passage 62. The member 16 is also provided with an opening 63 for receiving a spark plug 64.

The outer end of each of the chambers 52 is provided with a plug 65 having electrically insulated wire 66 which serves as a hot wire when connected in a proper electric circuit, not shown. The walls of the chamber 52 are also provided with a valve seat 67 for supporting the valve 68 mounted on a valve shaft 69 projecting through the inner ends of the head 50. Both of the valve shafts 69 are in common longitudinal alignment and have their inner ends provided with heads 70, each of said valves being yieldably maintained in their closed position by means of a spring 71. For actuating said valve stems I have provided a shaft 72 having its lower end rotatably mounted in a bracket 75 and its upper end in a suitable bearing 74, said shaft being supported between the heads 70 and rotated by means of mitre gears 76, one of which is fixed to the shaft 15; said shaft 72 is provided with a cam 77 adapted to engage the valve heads 70 alternately as the shaft 72 is rotated. Since the valve stems 69 are arranged diametrically opposite, it will be seen that at no time are both of the valves 68 closed at the same time. The cam 77 is so de-

signed as to hold the valve 68 open while the piston 26 is passing through its angular path of 180° or more. A second cam 78 is also mounted on the shaft 72 above the cam 77, and so designed as to maintain the corresponding valve 68 in an open position during a time period as compared to the rotation of the piston 26 of less than 180°. The shaft 72 is slidably mounted longitudinally within the upper gear 76 and the bearing 74, so that either of the cams 77 or 78, or the intermediate cam portion 78a between them, may be shifted into operative relation with the valve heads 70. The longitudinal movement of the shaft is accomplished by means of a lever 79 having one end pivotally connected to a link 80, 15 and the other end provided with a pin 81 adapted to engage a notched latch bar 82, said latch bar 82 providing means for locking the lever 79 in any of its operative positions, said lever 79 being connected to the shaft 72 by means of a pin 83 20 operating in a groove 84 mounted on the upper end of the shaft 72.

For delivering a charge of fuel to the chambers 52 I have provided a pressure tank 85 adapted to support in its lower side liquid fuel such as gasoline or heavier fuels, if so desired, the tank being filled partially to provide a compressed air space 86 above the fuel.

Supported at one end of the shaft 15 is an air compressor 87 connected to said shaft by means of a suitable coupling 88, the air compressor being provided with a pipe 89 for delivering air under pressure to the upper portion of the tank 85, said pipe including a dust collector 90 or any suitable type for separating dust from the air as it enters the tank, 85. A pipe 91 leads from the tank 85 to a mixing head 92. A pipe 93 has one end connected at or near the bottom end of the tank 85, and its opposite end to said mixing head 92, the inner end of said pipe terminating in a nozzle 94. A check valve 93a is included in the pipe 93. Opposite the end of the nozzle 94 is a set screw 95 providing means for adjusting the mixture of fuel and air. The lower end of the head 92 is provided with a control valve 96 45 and a box 97. Elbows 98 are mounted in the lower side of the box 97, each being connected to the pipe 99, which in turn is connected to the corresponding head 50 and in communication with the corresponding chamber 52. Each of the pipes 99 is filled with a porous metallic material, such as steel wool 100, to prevent a flame from the combustion chamber 52 entering the box 97. Fuel is delivered to the tank 85 by means of a funnel 101 and a tank 102, a valve 103 operatively connecting the tanks 102 and 85, while a valve 104 operatively connects the funnel 101 and the tank 102. The tank 85 may then be filled by closing the valve 103 and opening the valve 104 and filling the tank 102 through the funnel 101 60 and closing the valve 104 and opening the valve 103. Fuel would then flow through the passage 105 and air upwardly through the passage 106 and the pipe 107. The valve 103 may then be closed and the operation completed, if so desired, thereby providing means whereby the fuel tank 85 may be filled with the tank under working pressure, which is more or less than 200 lbs. to the square inch.

The pipe 91 is provided with a valve 108, the said valve 108 providing means for differentiating the pressure between the pressure in the head 92 and the fuel pressure, the air pressure within the head 92 being slightly less than the fuel pressure so as to permit resistance of the 75

nozzle 94 and the pipe 93 to be overcome and to permit fuel to be injected into the head 92. The mixture of the charge may be varied by adjusting the set screw 95. The charge will then flow downwardly through the valve 96 into the box 97 and the pipes 99, into the chambers 52. The charge may then be ignited by the hot wire 66, heated preferably by an electric current from a battery and conductor, not shown. The current can usually be shut off after the engine is started, as the combustion in the chamber 52 is continuous. The ignited fuel will then be allowed to enter the passage 53, into the working chamber 18 at the time the piston 26 is at its dotted line position, as illustrated in Figure 4. Expansion of the fuel under combustion will cause the piston to rotate in a clockwise direction until it reaches a point near the exhaust 60, at which time the valve 68 is then closed by means of the cam 77 and the spring 71. The notch 43 on the abutment 41 will rotate into position to permit the piston 26 to pass therethrough, after which the above cycle of operations will again be repeated.

It will be seen from the cam and valve arrangement that fuel is admitted to the two chambers 52 and 18 alternately so that pressure is applied to one or the other of the pistons 26 all of the time, thereby providing means whereby a continuous and uniform torque may be applied to the shaft 15.

If it is desired to cut off the charge earlier so as to utilize the expansion of the heated gases, the lever 83 may be moved downwardly after disengaging the pin 81 from the latch 82, to position where the cam 78, or the intermediate portion 78a, will engage the valve heads 70.

If it is desired to operate the engine by utilizing an explosive fuel rather than a slow burning type, the fuel mixture may be changed by means of the set screw 95 and the ignition accomplished by means of the spark plugs 64 and suitable timing mechanism connected with the shaft 15, not illustrated, inasmuch as this timing mechanism is of ordinary construction and forms no part of my present invention.

In order to maintain the abutment 41 at such temperature that it will not become overheated to burn its lubricant, or become warped, I have supported in the hollow shaft 37 a pipe 109 having at its lower end a disc 110 supported within a chamber 111 formed in the member 40, the upper end of the pipe 102 being in communication with the water supply 112, permitting the water or any other cooling fluid to flow downwardly through the pipe 109 past the lower surface of the disc 110, thence upwardly over the top of the said disc around the outside of the pipe 109 into a chamber 113, through openings 113a. A fan 114 is mounted on the upper end of the said shaft 37 to assist in circulating said cooling fluid, the fluid being discharged from the chamber 113 through the opening 115 to any suitable supply tank.

Thus it will be seen that I have provided an internal combustion engine of comparatively simple construction which may be operated at comparatively high speed with a minimum amount of vibration, inasmuch as substantially all of the moving parts are rotating at uniform speed.

It will further be seen that I have provided an internal combustion engine wherein comparatively uniform torque may be applied to the engine shaft with the utilization of no more than

two power units, thereby simplifying the construction caused by the elimination of a large number of parts such as used in multiple cylinder engines of the explosive or the Diesel types.

It will further be seen that I have provided an internal combustion engine having some of the advantages of the Diesel type of engine without the utilization of such high pressure, and further having an advantage over the Diesel engine in that my improved engine may be started without the use of auxiliary starting devices such as springs, batteries or auxiliary pressure tanks, my improved engine being started simply by closing the ignition circuit and opening the valve 36, pressure of fuel and air from the tank 85 furnishing pressure to start the pistons in rotation, after which the rotation will continue under expansion from the fuel as ignition takes place and the temperature raises.

Another advantage in my construction lies in the manner in which an air tight seal is maintained between the abutment 41 and the walls of the working chamber and the manner in which this pressure is automatically varied to correspond to any change in the working fuel pressure.

A further advantage of my improved engine is that it may be operated on comparatively cheap fuel and at lower pressure than is possible in the Diesel type of engine, burning with approximately equal efficiency fuels of either high or low octane rating.

Another advantage of my invention is in forming the working chamber circular in cross section, and the piston carried by the disc-like flange 24 on the hub 22. By forming the working chamber circular in cross section, an expandable annular packing may be employed on the piston. The flange provides a support for the piston, having a comparatively small amount of circumferential area which minimizes the pressure from the working chamber as applied radially to the shaft 15 and the wear resulting therefrom.

The drawings illustrate my improved engine as being adapted for use in connection with burning material being fed directly to the working chamber. However, my engine may also be used in connection with steam or compressed air for furnishing power, if so desired, in which case, of course, the fuel is omitted from the tank and the pressure pump 87 removed. Steam or compressed air may then be introduced through the pipe 89. My improved abutment arrangement, together with the means for forming the working chamber and supporting the piston, is adapted to be used in connection with steam as well as explosive or slow burning fuels.

I claim as my invention:

1. In a device of the class described, a casing including a cylindrical recess, a second casing rotatably mounted in said recess, including an annular working chamber circular in cross section, a shaft concentrically supported within said casings, a rotatable piston within said working chamber carried by said shaft, said second casing being provided with an arcuate and radial slot, an annular abutment rotatable in said arcuate slot, means for rotating said abutment and piston in unison, means for applying a pressure to said second casing in a direction opposite to the direction of rotation of said piston to urge said second casing against said abutment, and means for injecting burning fuel and air mixture under pressure into said working chamber between said piston and said abutment.

2. In a rotary type engine, a support, a casing rotatably supported on said support and having an annular cylinder therein, a housing with a combustion chamber therein carried on said casing, passage means connecting said combustion chamber with said cylinder, a shaft mounted in said support and concentrically extended through said casing to rotatably support said casing, a piston carried on said shaft and rotatable within said cylinder, said casing being provided with a transversely extended arcuate slot, an annular abutment rotatable in said slot across said cylinder, means for synchronously operating said abutment and piston, means for feeding a combustible mixture under pressure into said combustion chamber, means for igniting the combustible mixture in said combustion chamber, with the burning mixture from said combustion chamber being admitted at said pressure through said passage means and into said cylinder between said piston and abutment, stop means on said support adjacent said housing, and a plunger slidably supported in said housing with one end open to said combustion chamber and an opposite end engageable with said stop means, with the pressure in said combustion chamber moving said plunger against said stop means and urging said housing and said casing therewith in a direction away from said stop means to force the casing at the slot therein against said abutment.

3. In a device of the class described, a stationary support, a casing rotatable within said support including an annular cylinder, a shaft mounted in said support and concentrically within said casing, said casing being mounted to oscillate about said shaft and provided with an arcuate and radial slot, an annular abutment, having a notch in the side thereof rotatable within said slot and adapted to close said cylinder during substantially three-fourths of its revolution, a piston supported by said shaft to rotate within said cylinder and to pass through the notch during the other one-fourth of the revolution of said abutment, means for injecting burning fuel under pressure into said cylinder between said piston and abutment, and means for applying a pressure on said casing to urge the same in a direction opposite to the rotation of said piston and against said abutment.

4. In a device of the class described, a stationary support, a casing including an annular working chamber, a shaft mounted in said support concentrically within said casing, and pivotally mounting said casing to rock relative to said support, said casing and said support including a transverse slot intercepting said working chamber, an abutment slidably mounted within said slot to shut off and open said chamber, a piston carried by said shaft within said chamber, means for synchronizing the movement of said piston with the movement of said abutment, wherein the piston will be permitted to pass the abutment when in its open position, means for applying yieldable pressure to said casing to cause contact between the walls of one side of said transverse slot of said casing with said abutment for sealing the same, means for introducing fluid under pressure into said chamber between said piston and said abutment at a point near one side of said abutment, and means for exhausting said fluid in said chamber at a point near the opposite side of said abutment.

5. In a rotary engine, a stationary support, a casing including an annular cylinder, a shaft

mounted in said support and concentrically within said casing, said casing being mounted on said support to oscillate about said shaft and provided with an arcuate and radial slot, an annular abutment having a notch in one edge, said abutment being rotatable within said slot and adapted to close said annular chamber during substantially three-fourths of its revolution, a piston supported by said shaft to rotate within said cylinder and to pass through the notch in said abutment during substantially the other one-fourth of the revolution of said abutment, a combustion chamber carried on said casing and connected with said cylinder, means for admitting a combustible mixture under pressure to said combustion chamber, with the burning mixture passing into said cylinder between said piston and abutment, means for applying a pressure to urge said casing in a direction opposite the rotation of said piston in proportion to the pressure within said combustion chamber to force said casing against said abutment, and means for applying a normal pressure in said direction to said casing.

6. In a rotary type engine, a support, a casing rotatably mounted on said support including an annular cylinder, a shaft mounted in said support in a concentric relation with said casing, a rotatable piston for said cylinder carried by said shaft, said casing being provided with an arcuate and radial slot, an annular abutment rotatable in said slot across said cylinder, means for rotating said abutment and piston in unison, and means for applying a pressure on said casing in a direction opposite to the direction of rotation of said piston to urge said casing against said abutment.

7. In a device of the class described, a stationary support, a casing including an annular working chamber, a shaft mounted in said support concentrically within said casing, and pivotally mounting said casing to rock relative to said support, said casing and said support including a transverse slot intercepting said working chamber, an abutment movable within said slot to close and open said chamber, a piston carried by said shaft within said chamber, means for synchronizing the movement of said piston with the move-

ment of said abutment, wherein the piston will pass said abutment when said cylinder is open, means for applying a yieldable pressure to said casing to rock said casing to maintain contact between the walls of one side of said transverse slot of said casing with said abutment for sealing the same, means for introducing fluid under pressure into said working chamber between said piston and said abutment at a point near one side of said abutment, and means for exhausting said fluid in said chamber at a point near the opposite side of said abutment.

8. In a rotary engine, a support, a casing rotatable in said support and having a circular cylinder therein, a piston for said cylinder, said casing having an arcuate slot extended transversely therethrough, a cup-shaped rotary abutment having the side wall thereof rotatable in said slot across said cylinder, said side wall having a notch therein to selectively open and close said cylinder as said abutment is rotated, means synchronously operating said abutment and said piston so that said piston passes through the notch in said abutment, combustion chamber means carried on said casing and connected with said cylinder adjacent one side of said slot, means for admitting a combustible mixture under pressure into said combustion chamber means, and means for applying the pressure in said combustion chamber means to said casing to urge said one side of the slot against said rotary abutment to maintain a fluid-tight seal therebetween.

9. In a rotary engine, a support, a casing rotatable on said support having an annular cylinder therein and an arcuate slot extended transversely thereof, a cup-shaped rotary abutment having the side wall thereof rotatable in said slot and across said cylinder, an exhaust passage adjacent one side of said slot, means for injecting a burning mixture into said cylinder adjacent the opposite side of said slot, and means for applying a pressure on said casing in a direction to urge the same toward said abutment to maintain said opposite side of the slot and said abutment in fluid sealing engagement.

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