May 9, 1950 R. MOOSBRUGGER 2,507,481

REACTIVE IMPULSE ENGINE EMBODYING COMPLEMENTAL POCKETED ROTORS

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FIG. 1.

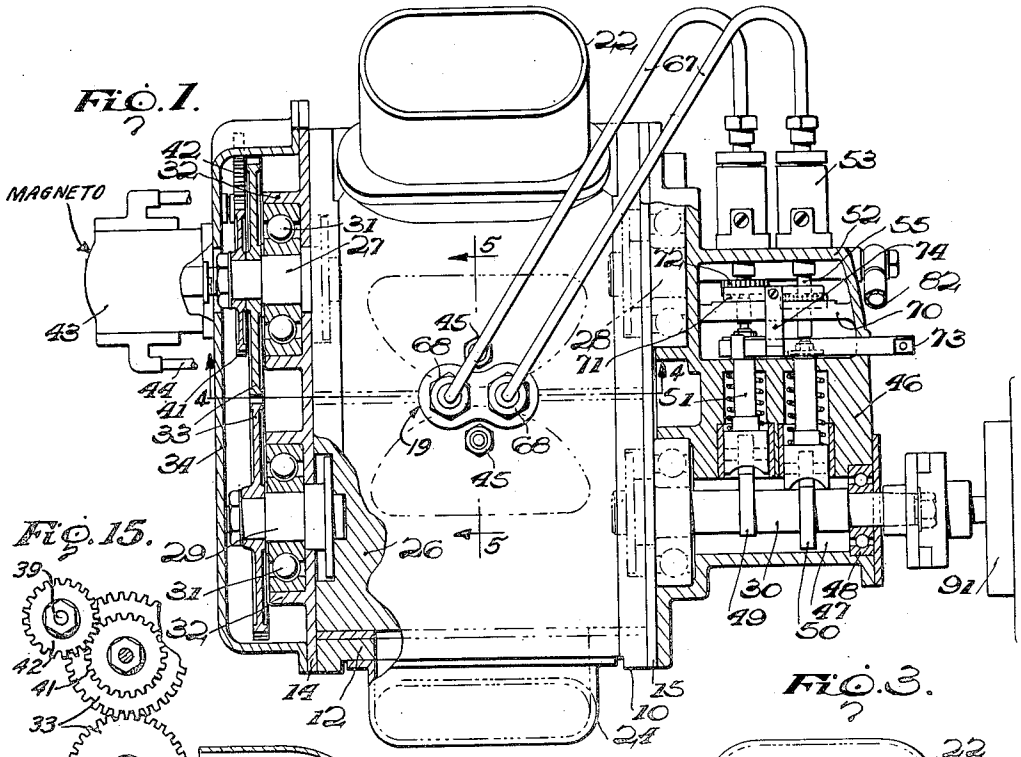


FIG. 15.

FIG. 3.

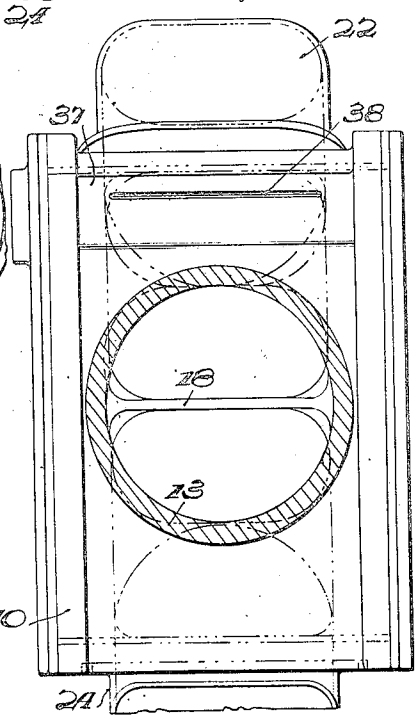
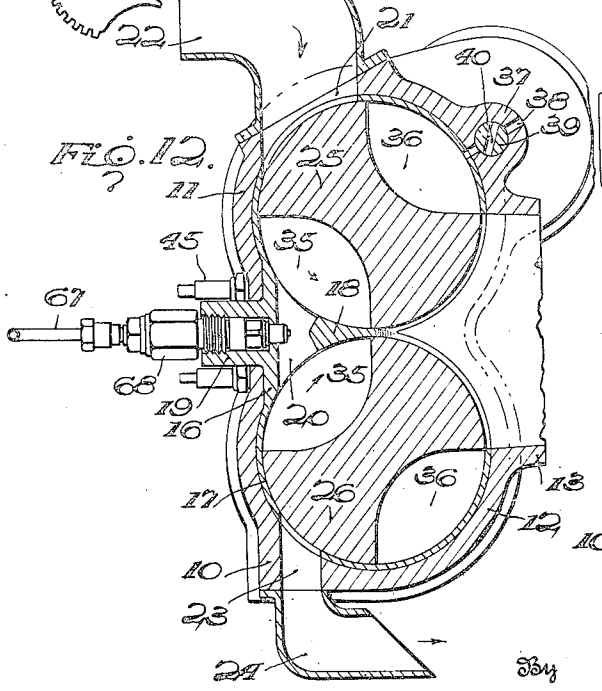


FIG. 12.



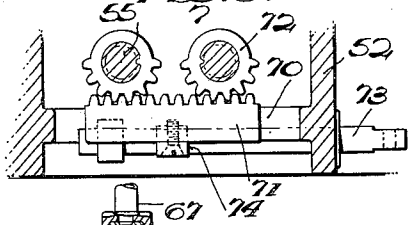
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Attorney

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FIG. 8.



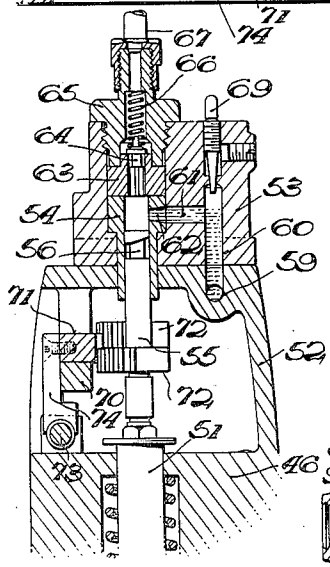


FIG. 7.

FIG. 6.

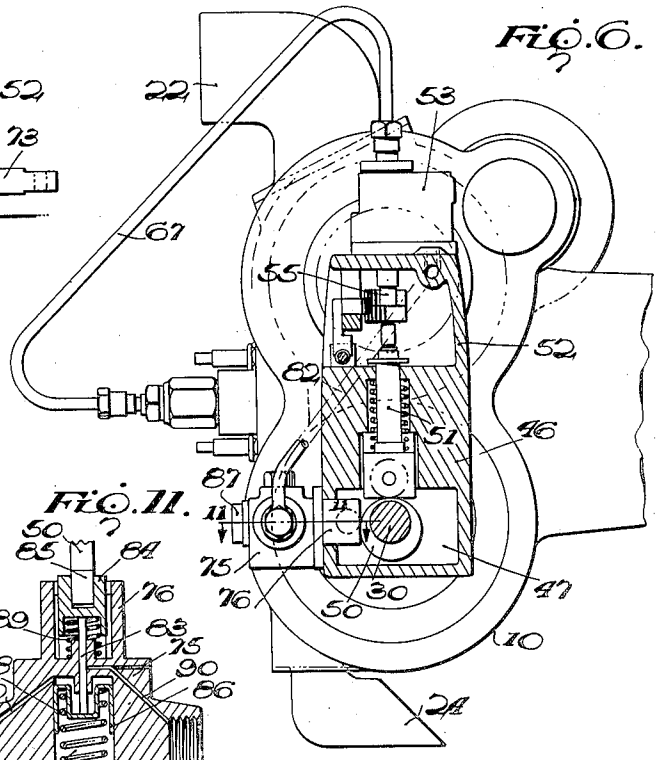


FIG. 11.

FIG. 10.

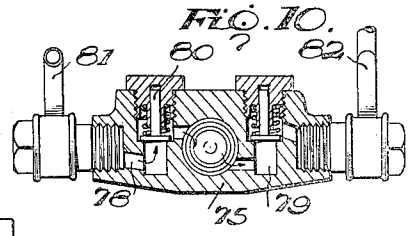


FIG. 2.

FIG. 9.

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FIG. 13.

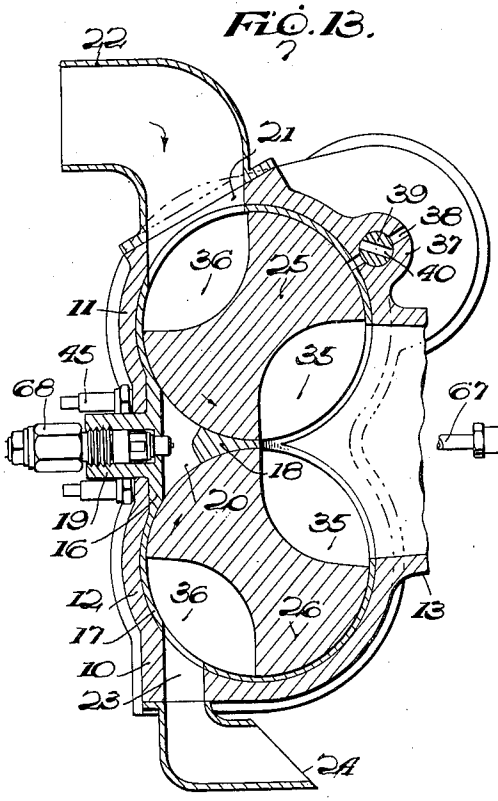


FIG. 14.

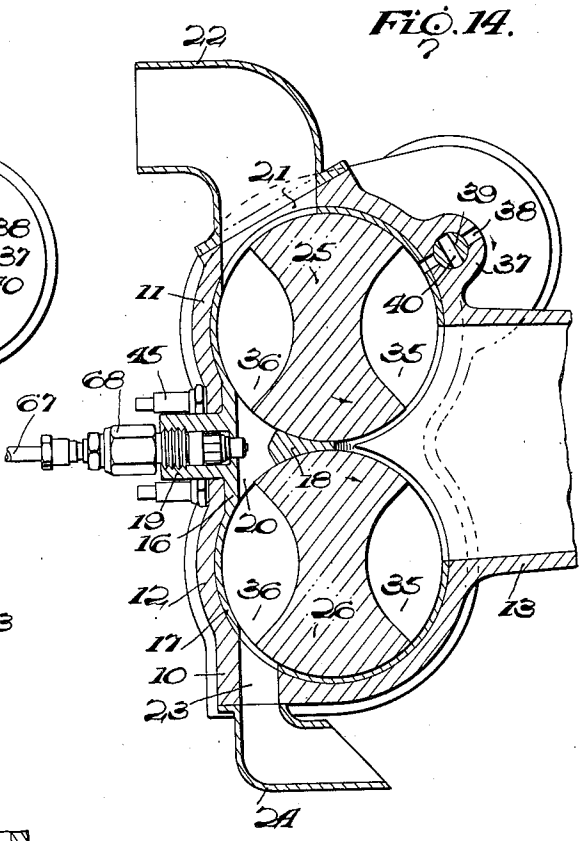


FIG. 4.

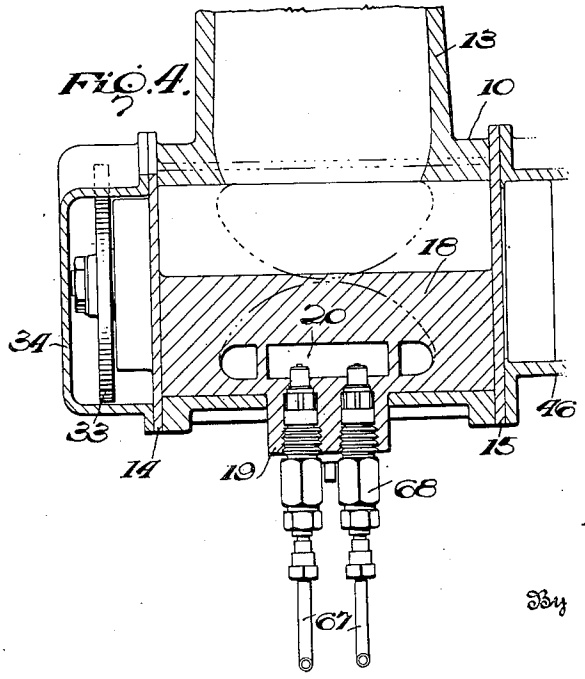
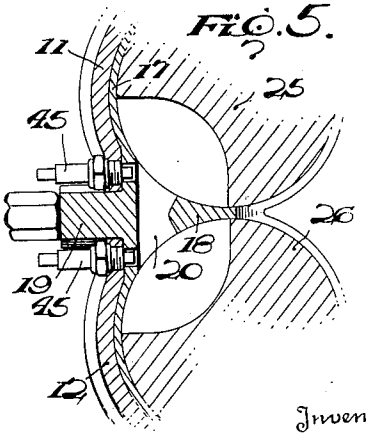


FIG. 5.



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2,507,481

REACTIVE IMPULSE ENGINE EMBODYING COMPLEMENTAL POCKETED ROTORS

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Application September 14, 1945, Serial No. 616,228

1 Claim. (Cl. 60—35.6)

1

This invention relates to an improved reactive impulse engine.

It is an object of the present invention to provide a reactive impulse engine wherein the frequency of the power impulses may be adjustably varied and regulated at will.

Another object of the invention is to provide a reactive impulse engine embodying complemental pocketed rotors, the pockets of each pair of pockets of which will, as the rotors revolve, match in one position to form a closed combustion chamber, and then again match in another position to form a reactance chamber open to the propulsion nozzle, and wherein external power means of adjustably variable speed will be provided for rotating the rotors and thus controlling the frequency of the power impulses.

Still another object of the invention is to provide a reactive impulse engine wherein the rotors will be formed with a plurality of pairs of pockets, the pockets of each pair of which will be adapted to match and provide for a corresponding number of power impulses during each revolution of the rotors, so that without driving the rotors at high speed, the power impulses, although in fact intermittent, will nevertheless be of such close sequence as to have the effect of creating a substantially constant reactive pressure.

A further object of the invention is to provide a reactive impulse engine wherein immediately prior to the matching of a pair of pockets to form a combustion chamber, a blast of air will be permitted to flow therethrough for scavenging the pockets and cooling the parts.

Another object of the invention is to provide a reactive impulse engine wherein the pockets of the rotors will be provided with straight trailing edges to afford quick closing of the pockets, and curved leading edges for releasing an ignited charge beginning at the axis of the propulsion nozzle and gradually enlarging radially from said axis.

And the invention seeks, as a still further object, to provide a reactive impulse engine wherein the intensity of the power impulses may be either increased or decreased by manual adjustment of the fuel injectors to vary the volume of liquid fuel injected, to the end that the engine will possess a correspondingly increased thermal efficiency.

Other and incidental objects of the invention will appear during the course of the following description, and in the drawings:

Figure 1 is a front elevation of my improved engine, parts being shown in section.

Figure 2 is a top plan view of the engine.

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Figure 3 is a section on the line 3—3 of Figure 2.

Figure 4 is a fragmentary horizontal section on the line 4—4 of Figure 1 particularly showing the fuel port in the web of the liner.

Figure 5 is a detail section at a right angle to Figure 4 on the line 5—5 of Figure 1 and showing the spark plugs.

Figure 6 is an end elevation, parts being in section, and showing the drive for the fuel injectors.

Figure 7 is an enlarged detail section particularly showing one of the injector plungers.

Figure 8 is a detail horizontal section showing the adjustment for the injector plungers.

Figure 9 is a detail of the head of one of the plungers.

Figure 10 is a vertical section showing the fuel pump supplying the injectors.

Figure 11 is a detail horizontal section on the line 11—11 of Figure 6 through the pump of Figure 10.

Figure 12 is a vertical section showing the pockets of one pair of pockets of the rotors matched to form a combustion chamber.

Figure 13 is a view similar to Figure 12 and showing the matched pair of pockets of Figure 12 disposed to form a reactance chamber.

Figure 14 is a view similar to Figure 13 and showing the other pair of pockets of the rotors disposed to receive a scavenging blast of air therethrough.

Figure 15 is a detail elevation particularly showing the drive gears for the relief valve employed.

In carrying the invention into effect, I employ a casing 10 shaped to form parallel upper and lower cylinders 11 and 12 respectively, and extending rearwardly from the casing medially between said cylinders is a propulsion nozzle 13 which may be of any approved length, size, and shape. Removably secured against the ends of the casing are end plates 14 and 15 respectively, and fitting within the casing is a preferably one-piece liner 16 comprising parallel cylindrical portions 17 connected at their forward sides by a more or less V-shaped web 18 having a head 19 thereon which projects forwardly through the casing 10. The tip of the web 18 terminates slightly beyond the vertical center line of the cylinders 11 and 12 while the sides of the web are curved to conform to the curvature of the cylindrical portions 17 of the liner, and formed through the base of said web, as particularly seen in Figure 4 of the drawings, is an elongated fuel inlet port 20. Preferably, the casing will be

moulded or otherwise formed around the liner.

As will be observed, the rear sides of the cylindrical portions 17 of the liner 16 beyond the tip of the web 18 are open to the nozzle 13, which latter is of an interior height at its base equal to the distance between the axes of the cylinders 11 and 12, and formed through the top of the cylinder 11 forwardly thereof is an air inlet port 21 to which is fitted a forwardly presented air funnel 22. Leading from the cylinder 12 opposite the port 21 is a much narrower outlet port 23 to which is fitted a rearwardly presented funnel 24.

Fitting in the cylindrical portions 17 of the liner 16 are complemental rotors 25 and 26 respectively. The rotor 25 is rotatably supported by like stub shafts 27 and 28 respectively, while the rotor 26 is supported at one end by a like stub shaft 29, and at its opposite end by a drive shaft 30. All of these shafts are journaled by bearings 31 which fit in flanges 32 on the end plates 14 and 15. Fixed to the stub shafts 27 and 29 of the rotors are meshing gears 33 connecting the rotors to turn at the same speed but in opposite directions, and enclosing said gears is a housing 34 detachably fixed to the end plate 14.

Formed in the rotors 25 and 26 are elongated pockets which function in pairs, and for convenience of description, one pair of said pockets is indicated at 35 while the other pair is indicated at 36. Each of the rotors is preferably provided with two of the pockets located opposite each other. A corresponding number of power impulses is thus had for each revolution of the rotors, as will presently appear. The pockets are all alike and each is provided with concave end, bottom, and front side walls, and more or less flat rear walls. Thus, the pockets are provided with substantially straight trailing edges to afford quick closing of the pockets, and curved leading edges to afford opening of the pockets beginning at the axis of the propulsion nozzle 13 and gradually enlarging radially from said axis to thus obtain a maximum reactance effect from an ignited fuel charge liberated into said nozzle.

Formed on the rear side of the cylinder 11 of the casing 10, as seen in Figure 2, is a longitudinally extending valve casing 37 having an elongated port 38 therethrough which communicates with the interior of said cylinder, and journaled in said casing is a relief valve 39 having longitudinally spaced ports 40 adapted to communicate with the port 38. Fixed to the stub shaft 27 of the rotor 25 is a gear 41, and meshing with said gear is a gear 42 fixed on the adjacent end of the valve 39, both of said gears being enclosed by the housing 34. Thus, the rotation of the valve will be synchronized with the rotation of said rotor. The purpose of the valve will be later explained.

Removably secured to the gear housing 34 is a suitable magneto 43 which may be of any conventional character suitable to the purpose. As seen in Figure 1, the magneto is connected to the stub shaft 27 of the rotor 25 to be driven thereby, and extending from the magneto are leads 44. Screwed through the casing 10 above and below the head 19 of the liner 16, as best seen in Figure 5, are suitable spark plugs 45 to which the leads 44 are connected, and, as will be noted, the plugs communicate with the fuel inlet port 20 near the sides of the web 18 of the liner. The plugs spark simultaneously and twice for each revolution of the rotors 25 and 26.

Removably secured to the end plate 15 of the casing 10 is an injector block 46, the base of

which forms a housing for the bearings of the stub shaft 28 and drive shaft 30. At its lower portion, the block is recessed to provide a cam housing 47 which receives the drive shaft therethrough, and mounted on the block is a bearing 48 for the outer end portion of said shaft. Formed on the shaft are spaced cams 49 and 50 respectively, the lobes of which are diametrically opposite each other, and slidable through the block to coact with said cams are spring pressed tappets 51. At its upper end portion, the block 46 is provided with a gear housing 52 which, as best seen in Figures 6 and 7, is open at its forward side, and, as will be observed, the tappets 51 project into said housing.

Fixed upon the upper end of the housing 52 are companion heads 53 in which are fitted bushings 54 extending into the housing, and slidable in said bushings are injector plungers 55 engaged at their lower ends by the tappets 51. As shown in detail in Figure 9, the plungers are provided near their upper ends with peripheral slots 56 which define heads 57 at the upper terminals of the plungers. The slots 56 are gradually widened circumferentially of the plungers, and formed in the heads 57 to communicate with the wide ends of said slots are grooves 58.

Formed in the top wall of the gear housing 52 is a fuel supply duct 59 from which lead passages 60 rising into the heads 53, and extending laterally from the passages 60 are passages 61 which terminate in tapered ports 62 in the bushings 54. Seated against said bushings are bushings 63 which carry check valves 64, and removably securing the parts in position are couplings 65 in which are fitted springs 66 acting on the check valves. Connected at corresponding ends thereof to the couplings 65 are fuel pipes 67, the opposite corresponding ends of which are connected to suitable fuel nozzles 68 which, as best seen in Figure 4, are screwed through the head 19 of the liner 16 to communicate with the fuel inlet port 20.

Due to the disposition of the cams 49 and 50 on the drive shaft 30, the tappets 51 will be alternately raised to alternately actuate the plungers 55 so that fuel will be injected by one of the nozzles in time with the pair of pockets 35 of the rotors 25 and 26, while fuel will be injected by the other of the nozzles in time with the pair of pockets 36, the operation being synchronized through the medium of the single drive shaft. The passages 60 of the heads 53 are preferably provided with bleeder plugs 69 which may be removed for relieving back pressure and, as will now be seen, the volume of fuel delivered upon each upward stroke of the plungers 55 respectively may, due to the taper of the slots 56 in said plungers, be varied by adjustably rotating said plungers.

Extending longitudinally of the gear housing 52 in front of the plungers 55 is a bracket 70 upon which is slidably seated a rack bar 71, and fixed to the lower ends of said plungers are gear segments 72 meshing with said bar, the gear teeth on the parts being of a length to permit the rise and fall of the tappets. Slidably mounted below the rack bar 71 is an adjustable fuel feed rod 73 which projects through the outer end wall of the housing 52, and connecting the rod with said bar is an arm 74. Thus, as will be appreciated, the rod may be manually adjusted longitudinally for turning the plungers 55 and so varying the volume of fuel delivered by said plungers.

Associated with the injectors is a supply pump

therefor which, as best seen in Figures 6, 10, and 11, includes a body 75 which is fixed to the lower end of the block 46 at its forward side and is provided with a sleeve 76 which enters the cam housing 47 in alignment with the cam 50 of the drive shaft 30. Formed in the body in alignment with said sleeve is a cylindrical chamber 77, and leading through one end of the body is an inlet passage 78 entering said chamber at one side thereof, while an outlet passage 79 leads from the opposite side of said chamber through the other end of the body. Interposed in said passages are spring pressed check valves 80. Connected at one end of the body is a fuel inlet pipe 81 in communication with a suitable source of fuel supply, and connected to the other end of the block is an outlet pipe 82 attached to the gear housing 52 of the block 46 to communicate with the duct 59.

Slidable through the bottom wall of the chamber 77 of the pump body 75 is a plunger rod 83 which carries a head 84 mounting a roller 85 to engage the cam 50 on the drive shaft 30, the head and said roller being housed by the sleeve 76, and engaged over the forward end of said rod is a piston 86 slidably fitting in said chamber. Closing the chamber at its outer end is a cap 87, and interposed between said cap and the piston is a spring 88, while a somewhat smaller spring 89 is interposed between the bottom wall of the chamber 77 and the head 84. These springs will hold the roller 85 against the cam 50 so that as the cam revolves with the drive shaft 30, the piston 86 will be reciprocated for pumping fuel to the duct 59 and so to the injector plungers 55. Formed in the valve body 75 are passages 90 adapted to bypass fuel when the output of the injector plungers is reduced. As previously pointed out, the volume of fuel delivered to the nozzles 68 by the plungers 55 may, by adjustably rotating said plungers, be increased or reduced. However, the volume of fuel delivered by the pump piston 86 is constant at any given speed thereof. Therefore, the passages 90 are provided so that when the output of the plungers is reduced, excess fuel pumped by the pump piston may cross from the outlet side of the pump to the inlet side thereof so as to prevent locking of the pump piston. The supply pump may be conventional in character and further description thereof is unnecessary.

Suitably connected to the outer end of the drive shaft 30 is a prime mover conventionally indicated at 91. This prime mover may be of any approved character, such as a four cycle internal combustion engine. However, in any event, the prime mover must be such that the speed thereof may be manually varied, adjusted, and regulated, so that the speed of the drive shaft 30 may be correspondingly controlled.

Referring now particularly to Figures 12, 13, and 14 of the drawings, the operation of the engine will be described. In the position of the rotors 25 and 26 shown in Figure 12, the pockets 35 thereof are matched and closed to form a closed combustion chamber, the pockets being in communication with each other through the fuel inlet port 20. Immediately prior to this point in the cycle, fuel has been injected by one of the nozzles 68, and substantially at the point shown, the fuel charge of mixed fuel and air is ignited by the spark plugs 45. Consequently, as the rotors continue to turn in the direction indicated by the arrows, the curved leading edges of the pockets 35, immediately after the firing of the fuel charge, will clear the tip of the web 18 so that the combustion chamber will be opened beginning axially of the propulsion nozzle 13 and gradually enlarging radially of said axis for liberating the ignited charge into said nozzle.

Continued rotation of the rotors 25 and 26 will then, as shown in Figure 13, dispose the pockets 35 in matched open position providing a reactance chamber open to the inner end of the propulsion nozzle 13, so that the expansion of the gases in said chamber tending to force said gases through the nozzle will produce a corresponding reactive pressure on the rotors tending to drive the engines forwardly.

As the rotation of the rotors continues, the pocket 35 of the rotor 25 will, as shown in Figure 14, move into communication with the port 38 of the valve casing 37. While the pocket is thus in communication with the port 38 but closed to the propulsion nozzle, the valve 39 will be rotated to dispose the ports 40 thereof in register with the port 38 for relieving the pocket of any residual gases therein.

Further rotation of the rotors 25 and 26 will then dispose the pockets 35 in the position in which the pockets 36 of the rotors are shown in Figure 14. As will be seen, any residual gases in the pocket 35 of the rotor 26 will have been relieved through the port 23 and funnel 24 while, in the position of the rotors stated, the pockets 35 of both rotors will be open to a blast of air flowing from the funnel 22 through the port 21, through the pockets, and out through the port 23 and funnel 24. The pockets will thus be effectively scavenged while also, the parts will be cooled.

Continuing with the assumption that the pockets 35 have reached the position of the pockets 36 shown in Figure 14, it will be seen that as rotation of the rotors 25 and 26 continues, the outlet port 23 will be closed by the rotor 26 before the inlet port 21 is closed by the rotor 25. Accordingly, a blast of air entering the funnel 22 will serve to ram air into both pockets until the inlet port is closed, following which the rotors will return to the position shown in Figure 12. Thus, air under pressure to receive a charge of fuel will be trapped in the combustion chamber again formed by the pockets 35 in matched closed position, when the cycle will be repeated.

As will be appreciated, the cycle just described in connection with the pair of pockets 35 will be duplicated in conjunction with the pair of pockets 36, so that two power impulses will be had for each revolution of the rotors 25 and 26. Accordingly, without operating the prime mover 91 at high speed, the rotors may be rotated fast enough to provide power impulses of such close sequence that, in effect, the reactance pressure on the rotors tending to drive the engine forwardly will be substantially continuous. The number of power impulses obtained for any given unit of time will, as will be perceived, depend upon the speed of rotation of the rotors which, in turn, is dependent upon the speed of the prime mover 91, and since the speed of the prime mover may be positively varied and regulated, the number of power impulses obtained during said unit of time may likewise be varied and regulated at will.

The intensity of the power impulses is controlled by the adjustment of the fuel feed rod 73. As the volume of air trapped in the combustion chamber formed either by the pockets 35 or the pockets 36 of the rotors 25 and 26 will

be limited by the size of said chamber, the fuel mixture may be rendered either richer or leaner by increasing or decreasing the volume of fuel injected into the chamber and, as previously described, this may be accomplished through the medium of the feed rod 73. As will be appreciated, the power impulses will be more intense when an increased volume of fuel is injected, and will be less intense when less fuel is injected. The consumption of fuel may thus be controlled to attain a reflected thermal efficiency of the engine.

Having thus described my invention, what I claim is:

A reactive impulse engine including a casing having parallel cylinders and provided with a propulsion nozzle, one of said cylinders being formed with an air inlet port and the other of said cylinders being formed with an air outlet port, companion rotors journaled in said cylinders and provided with pockets movable as the rotors revolve to close and form a combustion chamber, then to open into communication with the inner end of said nozzle, and then to a position in communication with said ports to permit a flow of air through the pockets, and means connecting the rotors to turn in unison.

ROBERT MOOSBRUGGER.

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