G. J. FERGUSON.

FLUID PRESSURE GENERATOR WITH AUTOMATIC AIR COMPRESSOR.

APPLICATION FILED MAY 3, 1916. RENEWED MAY 7, 1921.

1,382,769. Patented June 28, 1921.

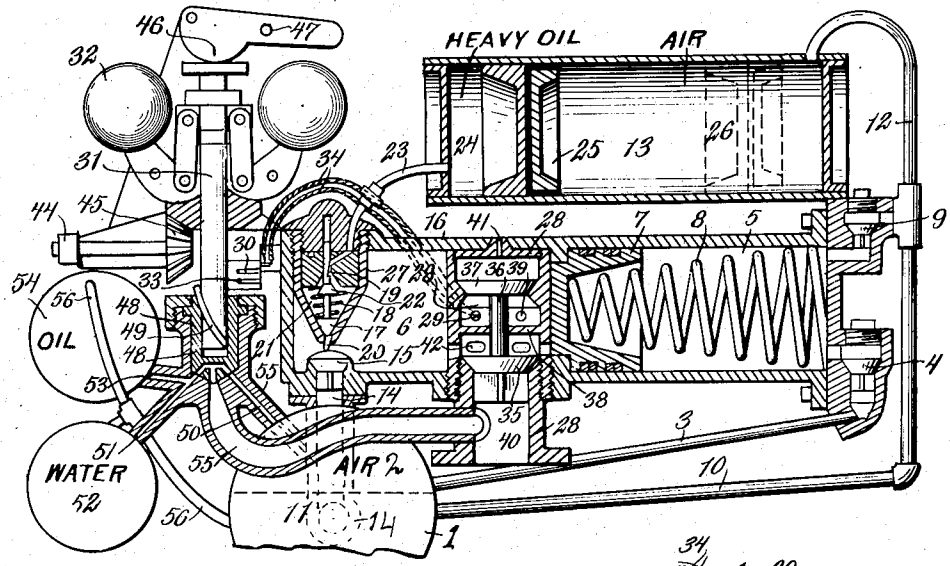


Fig. 1.

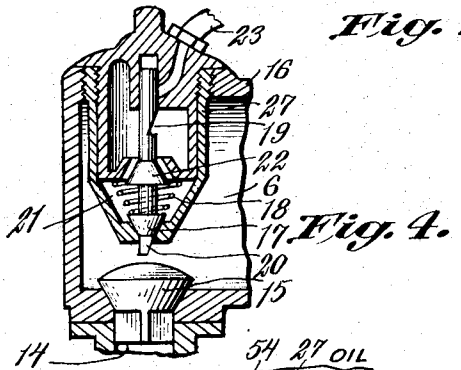


Fig. 4.

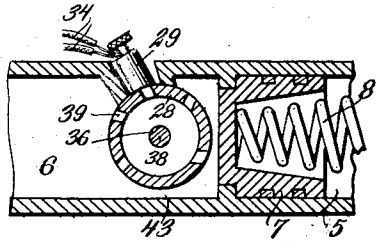


Fig. 2.

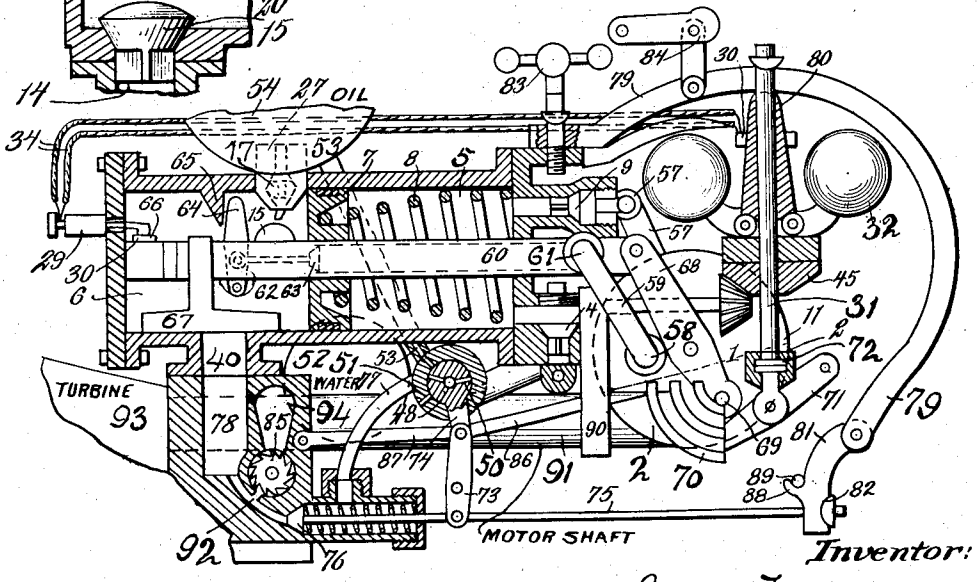


Fig. 3.

Inventor:

Geo. J. Ferguson

UNITED STATES PATENT OFFICE.

GEORGE JONES FERGUSON, OF ST. LOUIS, MISSOURI.

FLUID-PRESSURE GENERATOR WITH AUTOMATIC AIR-COMPRESSOR.

1,382,769. Specification of Letters Patent. Patented June 28, 1921.

Application filed May 3, 1916, Serial No. 95,249. Renewed May 7, 1921. Serial No. 467,736.

To all whom it may concern:

Be it known that I, GEORGE JONES FERGUSON, whose home is London, England, but now residing at St. Louis and State of Missouri, a subject of the King of Great Britain, have invented a new and useful Fluid-Pressure Generator with Automatic Air-Compressor, of which the following is a specification.

My invention involves five functions. 1st, a fuel air and fuel oil pressure equalizing chamber, 2nd, a fuel oil valve proportionably opened by the fuel air valve, 3rd, an automatic super compression of the fuel air, 4th, an auxiliary device, or devices to induct fuel from other sources or receptacles, in, or into the path of the exploded gases, 5th, automatic super-compression of the fuel oil.

My invention relates to a duplex mixing valve system combined with an automatically compressed air mechanism and means to automatically and proportionately mix the compressed air with the proper quantity of any fuel oil, but preferably a heavy oil (kerosene).

The air compression is effected by the movement of a piston compressing a recoil spring to cause the return of the piston, the piston movement being enforced by the explosion of the previous prepared charge of oxygen and carbon in a separate chamber at the end of the piston. This explosion chamber being cut off from the motor or engine by puppet valves or a slide valve adapted to be opened by the force of the explosion.

Other objects are to provide a reservoir to contain fuel oil at one end and super-compressed air at the other end to effect an equal pressure in each; to effect the super-compression of the air by means of the explosion of the mixture, and to provide a spring to return the air compressor piston, to provide valves that retain the mixture, but are automatically opened by the explosion, to provide a gas having an equable energy and a partial expansion, to provide a primary mixture whose explosion creates a highly heated gas and a secondary charge composed of pulverulent coal, and a third mixture under pressure to mix the pulverulent charge with air and oil, to provide governor regulation of the secondary and third charges and governor regulated ignition, and the third mixture will act as a retriever of super-heat in the apparatus. These methods provide for various modifications in the consistency and viscosity of the fuel oil, the main object being to thoroughly atomize, vaporize, and volatilize the oil fuel to insure a freedom from noxious odors, and the carbonization of the apparatus and motors, and a gas suitable for double acting engine cylinders.

I attain these objects by the mechanism illustrated in the accompanying drawing, in which—

Figure 1 is a vertical mid-section view of my automatic air compression self starting closed chamber carbureter, or fluid pressure generator, and shows the proportional opening mixing air and oil valve, the puppet valves that open automatically by the force of the explosion, and the piston actuated also by the explosion to compress air, and the recoil spring to return the piston and maintain the pressure of the gas; Fig. 2, is a horizontal cross section view of the puppet valve that retains the charge until it is exploded by the spark plug, it also shows a part of the air compressing piston, and contiguous casings; Fig. 3, is a vertical mid-section view of a modified plan of Fig. 1, the main difference being that a slide valve is substituted for the puppet valve, and that the motor shaft effects the return of the air compressor piston this may be applied in addition to the recoil spring, but the main difference consists in providing the mechanism to regulate the alternate injections of the cooling mixture and that is also capable of being adjusted to effect these injections at irregular periods, or at intervals. Fig. 4, is a view in detail of the air and fuel oil valves, on an enlarged scale, and slightly modified.

Similar numerals refer to similar parts throughout the several views.

It is proposed by this invention to increase the efficiency of internal combustion motors, of every kind, and to eliminate the destructive effects of a continuous series of explosions, I accomplish this function by providing a separate explosion chamber in which the gases are reduced to an equable energy, and temperature, before being admitted into the piston cylinder of a reciprocating motor, or the rotors of a rotary motor, and to still further develop this improvement, I provide the secondary method, comprising a jet of oxygen and carbon and the added spray of steam or water. This will act as a slow burning mixture that cools the internal superficies of the motor and simultaneously retrieves the heat now wasted by external

air or water cooling, and without any added parts steam alone can be substituted for the secondary method, or both steam, and the secondary method may be used alternately.

In my rotary motor application for Letters Patent Serial No. 715,927, filed Aug. 19, 1912, I am proposing plans in which multiplex cylinder rotors are telescoped onto each other and provide the unique element of supplying a pair of rotors for every different method of explosive mixture and interposed rotors will use steam, or the secondary method,—alternating, or at intervals, and one or more rotors may use steam continuously and this function applies to the steam reciprocating engine. It being clear that the intense heat of explosive gases used continuously within any class of motor will be destructive if some means of internal cooling is not provided, the ordinary external methods of cooling, to wit, an air blast, or water jacket do not reach every part of the contact surfaces therefore are inefficient, and it is obvious that the means described above will be efficacious in every class of engine or rotary motor, both as a cooling, retrieving, and power increasing element.

I will now describe consecutively the mechanism I employ in the above proposition. In Figs. 1 and 2, I show two distinct methods of mixing the fuel ingredients that are incorporated to effect the alternate or interval methods exhibited to simplify the description. I will designate them as the primary, and secondary, methods. In the primary method the compressed air reservoir 1 may be equipped with an air pump not shown to produce an initial low pressure into an upper compartment 2 of said reservoir 1, and to this compartment 2 is secured the pipe 3 which leads to the check-valve 4, and supplies the cylinder 5 with the initial pressure provided by the air pump, and the initial air pressure is super-compressed therein by the force of the explosion in the chamber 6 propelling the piston 7 to the right and compressing the spring 8 and super-compressing the air admitted from the compartment 2 of the reservoir 1 by way of the pipe 3.

This super-compressed air is forced through the check-valve 9 and by way of pipe 10 into the lower compartment 11 of the reservoir 1, and simultaneously by way of the pipe 12 in the combined air and oil reservoir 13.

The super-compressed air from the compartment 11 of the reservoir 1 passes by way of the outlet 14 shown in broken lines, the upper end of the outlet 14 is closed by the air valve 15, and through the air valve 15 into the explosion chamber 6, of fluid pressure generator, or carbureter 16, and as the super-compressed air enters it lifts the air valve 15 off its seat and this lifting of the air valve unseats the fuel oil valve 17 which is spring seated by the spring 18. The fuel oil valve has cut away stems at 19 and 20 to increase the flow of fuel oil in porportion to the increased opening of the air valve 15 this will have the effect of graduating the flow of fuel oil in exact proportion to the amount of super-compressed air being admitted past the air valve 15.

The chamber 21 which contains the fuel oil valve 17 will hold a normal charge of oil, and when the fuel oil valve 17 is fully open the reverse valve 22 on the same stem will close against more fuel oil flowing into the chamber 21, until the charge in the volatilizing chamber 21 has been discharged into the explosion chamber 6. In Fig. 4, the volatilizing chamber 21 is shown to extend above the valve 22, and both portions are in communication when the valve 17 is seated, this plan increases the capacity of the volatilizing element and its efficiency.

The fuel oil enters by way of the pipe 23 from the combined super-compressed air, and fuel oil reservoir 13, the fuel oil occupies the space 24 to the left of the dividing piston 25 which slides in the reservoir 13, and when much fuel oil is in the reservoir the piston 25 occupies the position shown by the broken lines at 26. This construction insures a uniform pressure in the super-compressed air, and in the fuel oil. This plan may be modified by simply placing the fuel oil outlet at a low position, when the high position of the air inlet will produce an equal pressure in both, but to prevent the fuel oil from being mixed with air when the oil is at a low level I prefer the sliding piston 25, because it maintains a high level in the oil at the end 24 of the reservoir 13, so that the pipe 23 can be placed at a higher position and prevent sediment from flowing into the oil valve casing 27. It will be understood that the pressure is always equal in the reservoir 13 and in the compartment 11 of the reservoir 1, therefore the fuel oil entering by way of the fuel oil valve casing 27 into the explosion chamber 6 has the same pressure as the super-compressed air entering by way of the outlet 14 from the compartment 11 of the reservoir 1 and said compressed air lifts the air valve 15 whenever the pressure in the explosion chamber 6 is less than the pressure in the compartment 11 of the reservoir 1.

This arrangement causes a proportional amount of fuel oil and super-compressed air to enter simultaneously into the explosion chamber 6 and be thoroughly mixed as the fuel oil is atomized by striking the convex top of the air valve 15 and the convex top and the fuel oil valve casing 27 being very hot the fuel oil is vaporized, and volatilized instantly in the volatilizing chamber 27′, and vaporized in the chamber 21 as shown in the preferred plan in Fig. 4. It has been demonstrated that heavy oil should be in a

highly volatilized and vaporized condition previous to its admixture with the fuel air. This function insures the practical application of a heavy fuel oil as it is instantly converted into a gas before it is ignited, and the heat in the walls of the explosion chamber 6 will be imparted to the gas and maintain a high temperature for a considerable time. While the air valve 15 and oil valve 17, are shown placed within the explosion chamber 6, it will be understood that I may place these valves outside in a separate compartment connected by suitable passages to the explosion chamber.

The practical use of a heavy oil (kerosene or residue) as a power medium for internal combustion motors is the crucial issue now being developed, particularly if it can be accomplished with a light weight mechanism. This is proven in other systems. The yielding nature of my explosion mechanism, it having the spring returned piston is necessary and adapted for a light weight construction, as the spring 8 acts as a relief abutment by absorbing the shock of the explosion. This invention will mitigate the obnoxious odors attending the use of kerosent oil as such offensive odor was mainly induced by imperfect combustion, the period of time that is available in a fast running motor being too short.

My plan also insures a perfect scavenging of a reciprocating cylinder as the exhaust valve can be kept open the full stroke of the piston, and can be used like steam at either or both sides of the piston.

When the super-compressed air in the reservoirs 1 and 13, and in the explosion chamber 6 equalize the air valve 15 closes automatically, and the fuel oil valve 17 is closed in the first instance by the duplex oil valve 22 seating at its highest position, and in the second instance by the valve stem at 21′ being the full size of its guide aperture and cutting off the ingress of oil from the reservoir or chamber 24 when the duplex valve 17 is seated at its lowest position by the impingement of the piston 25 against the fuel oil in the compartment 24, and the spring 18 insures the closure of the duplex oil valve 17 at its lowest position to retain a normal charge of fuel oil in the valve chamber 21 to be thoroughly vaporized. In Fig. 1, I show a means to volatilize the heavy oil by causing it to be circulated around in the groove in the top of the block 27, but a better and preferred method is shown in Fig. 4, in which a large chamber 27′ occupies the place of the block 27 in which the oil has room to expand as perfect volatilization is impossible under pressure in a confined space. In this position of the air valve 15 and the oil valve 17 a mixed charge is ready to be ignited in the puppet valve chamber 28, by the spark plug 29 which is wired to the make and break switch 30 on the governor stem 31. The drop of the governor balls 32 on account of slowing of the speed of the motor lifts the non-turning governor stem 31 and makes the electric circuit at 33, the wires 34 connect the switch 30 with the spark plug 29.

So far as described my invention performs the function of a carbureter combined with an air compressor, and a separate explosion chamber, to provide an equable pressure.

I will now describe the mechanical device adapted to introduce a mixture capable of creating power, and simultaneously acting as an overheat preventing medium, and suitable for any class of motor, but particularly for use with a rotary motor as it presents features that differ widely from that of a reciprocating motor, *a*, because a partial preliminary expansion is necessary in order to provide an equable power and distribute the power over the enlarged contact surface of the rotors, *b*, to effect a perfectly equalized energy at every part of the rotors, *d*, to admit the gases into the rotors automatically at the instant of ignition, and at a comparative slow speed to realize the full power of the expansion without the detriment of shock.

To attain these objects I provide the outlet puppet valve 35 which is opened against the pressure of the gases in the puppet valve chamber 28 by means of the stem 36 which connects the two puppet valves 35, and 37, the pressure under the puppet valve 37 lifts both valves as the diaphragm 38 prevents the pressure from holding the valve 35 to its seat, the stem 36 passes through the diaphragm 38 integral with the puppet valve chamber 28, the diaphragm 38 may be a separate part, (as I do not attempt to show the exact construction,) in any case the diaphragm 38 is a partition between the puppet valves 35 and 37 and forms the chamber 28 under the puppet valve 37.

The two valves 35 and 37 connected by the stem 36 form an automatic means of discharging the exploded charge of oxygen and carbon as the spark plug 29 is attached to the casing of the puppet valve 37 and immediately under it consequently the ignition takes place a fraction of an instant prior to the general combustion of the contents of the explosion chamber 6, as the communication between the chambers 6 and 28 is reduced to a few small holes 39 in the casing consequently the puppet valve 37 is forced up and of course carries the puppet valve 35 with it as they are connected by the stem 36 and the exploded gases pass out through the expansion or combustion chamber 40 may be enlarged to encircle the explosion chamber 6 in the form of a jacket, it also provides the outlet 40 to the motor,

the outlet 40 may be flanged or screw threaded for such attachment. A vent at 41 may be useful in accelerating the opening of the puppet valves, and to retain a longer full open position. The exploded gases from the explosion chamber 6 pass through the openings 42 in the puppet valve chamber 28 after the puppet valve 35 has moved to a position above them, the openings 42 being of considerable size. And at the instant of the explosion the piston 7 is forced back and compresses the recoil spring 8 in the cylinder 5, and provides a large space for the partial expansion of the exploded gases, and the pressure of the gas is maintained by the energy of the recoil spring 8, and the resistance which is elastic of the super compressed air, but of course this air pressure will be diminished to that of the compartment 2 of the reservoir 1 as soon as the check valve 9 closes. There is ample space at 43 for the passage back and forward of the exploded gases. The piston 7 in its back movement relieves the stress on all parts of the mechanism without reducing the energy of the exploded gases, therefore the expansion is effected without loss of power. It also gives a moment of time in which slow burning fuel oil is completely gasified, this is an absolutely necessary function, because the greatest defects in previous attempts to use heavy fuel oil has been the impossibility in high speed motors of igniting the whole charge of mixture in the fraction of a moment available.

The action of the governor in causing ignition has been already described, the stem being non-turning the pulley 44 drives the bevel gears 45 which revolves the balls 32 causing the stem 31 to move up and down in accordance with the speed of the motor, therefore it will be understood that the cam lever 46 can be connected at 47 to another lever whereby the governors action can be cut out to stop the motor, or its action made intermittent, as the cam lever 46 controls the action of the governor stem 31, but any excess speed will cause the governor to act and inject a cooling mixture, at the highest position of the balls 32 the mechanism will not start, as ignition is prevented, and the valve 48 is in its closed position, but at a position intermediate between the highest and lowest positions of the balls 32 ignition is effected by the electric contact at the switch 30 by way of the wires 34 causing the ignition of the charge in the chamber 28 containing the puppet valves 35 and 37. It is within the scope of my invention to place a spark plug in the combustion chamber 40.

Portions of the explosion chamber 6 may get overheated and cause premature ignition. In my plan of generator this will not cause back firing or have any deleterious effect on the motor it will merely cause an excessive speed and increase the centrifugal velocity causing the governor balls to assume their lowest position shown by broken lines. When an injection of the contents of the reservoir 52 which may be a water spray alone or the water spray mixed with heavy oil from the reservoir 54 by way of the ports 51 and 53 into the passage 55 leading to the combustion chamber 40, which may be much larger, and envelop a large portion of the explosion chamber 6 and retrieve the overheat therefrom and preserve an equable temperature therein. The tendency in apparatus of this kind is to get overheated when working to the maximum, in fact, in many plans of internal combustion engines it develops a serious danger, and requires a ponderous structure too heavy for portable apparatus. I provide an apparatus that removes such danger by effecting an equable pressure similar to steam. While ordinarily a spring is applied to hold the governor balls in cut-in position it is obvious that a spring cannot be adjustably manipulated.

This brings the description to the secondary method of mixing a charge that will act as a cooling element in addition to being highly explosive after being brought into contact with the super-heated internal superficies of the combustion chamber 78 and motor. The rotary valve 48 is actuated by the spiral projection 49 on the non-turning governor stem 31, this spiral projection 49 fits in a corresponding spiral groove in the rotary valve 48, but only partially turns the valve 48 so that the air port 50 from the compartment 11 of the reservoir 1, and the water port 51 from the reservoir 52, and the fuel oil port 53 from the reservoir 54 all connect in the rotary valve 48, and from thence pass into the pipe 55 leading into the gas outlet 40. I may put cut-out valves in each of the passages 50, 51, and 53, to temporarily cut-off all, or part of the ingredients. The air pipe 56 connects the compartment 11 of the air reservoir 1 with the water reservoir 52, and the fuel oil reservoir 54, and maintains a uniform pressure in each, a cross section of the rotary valve 48 is shown in Fig. 3. It will be understood that the pipe 55 and the passage 92 are identical in purpose and that the feed roller 85 can be connected to the pipe 55 in a similar manner to that shown in Fig. 3.

It will be understood that when the secondary mixture prepared by the rotary valve 48 reaches the cylinders or rotors of the motor it will be practically a water gas, and will be ignited in two different ways: 1st, by the retreating flash of the previous primary charge of gas, and 2nd. by the superheated interior superficies of the motor as it follows closely after the discharge of the primary explosion, and the fact that both the primary and secondary charges are

delivered almost simultaneously, will not overspeed a rotary motor as all rotary motors gain momentum very slowly, in this respect differing widely from reciprocating motors, but the absence of the direct impact of the explosion on the piston will reduce the shock in a reciprocating motor.

When running light the rotary valve 48 can be cut-out, or it may be only actuated at irregular intervals, as for instance actuated by the cut-out lever 46 which is normally intended as the throttle lever, as in one position it prevents the governor stem from rising and making the electric circuit connection this will prevent ignition. But a further traverse of the cut-out lever 46 can be arranged to effect the full action of the rotary valve 48 at intervals. This secondary method of mixture cools the cylinder, or rotors by retrieving the super-heat now wasted, and by an internal application of the cooling mixture, which will reach every contact surface. This brings the description to the modification shown in Fig. 3, and in so far as possible I will use corresponding reference numerals to designate the similar parts. The main features are identical with the description of Figs. 1 and 2. In the primary method as shown in Fig. 3, the air super-compressed by the piston 7 passes into a similar divided reservoir 1 having a low pressure air compartment 2, and a super-compressed air compartment 11. The low pressure being supplied by an air pump (not shown) driven by the motor, the only difference being that in Fig. 3, the low pressure compartment is at the bottom of the reservoir 1, from thence the air passes through the check valve 4 into the cylinder 5, and is there super-compressed and forced past the check valve 9, into the compartment 11 of the reservoir 1 at 57, and from thence by way of the outlet 58 into the flexible pipe, or hose 59, which is connected to the hollow piston rod 60 by the universal joint 61. The air then passes through the hollow piston rod 60 and this hollow rod 60 is closed at 62 by the valve 63 shown in broken lines. The valve 63 is opened when the piston 7 and its hollow piston rod 60 reaches the position shown in Fig. 3, by the operating lever 64 coming in contact with the projection 65 integral with the explosion chamber 6. The valve 63 is closed by the air pressure and a spring immediately after a short movement toward the right is made by the piston 7. The air valve 15 is a part of the hollow piston rod 60, and travels therewith, otherwise it is identical in shape and action with that shown in Fig. 1, except that in this plan the valve 63 cuts-off the air passage through the hollow piston rod at all positions except near the full stroke of the piston 7 toward the left, when the fuel oil valve 17 is above it and is opened by the air valve 15, to admit fuel oil from the reservoir 54 and as the fuel oil and the super compressed air enter they are atomized, and vaporized by contact with the hot surfaces of the air valve 15 and the casing of the fuel oil valve 17, and also volatilized as the air pressure will be near the ignition degree, and of course the fuel oil within the fuel oil valve casing will be near a boiling temperature.

The process described above thoroughly mixes a charge in the explosion chamber 6, when the drop of the governor balls 32 caused by the slowing of the motor will connect the make and break device 30 and ignite the charge, at 66 a wipe connection is arranged to keep the contact surface clean which connect the wires 34 to the spark plug 29 to explode the charge of mixture in the chamber 6. This exploded charge forces the piston 7 to the right and super-compresses the air in the cylinder 5 and forces the air into the compartment 11 of the reservoir 1. The piston 7 also compresses the recoil spring 8 which assists in returning the piston 7, and the super-compressed air will also act as a cushion to relieve the stress on all parts of the mechanism without reducing the energy of the exploded gases, therefore the expansion is effected without loss of power. And it also provides a moment of time in which the slow burning fuel oil is completely gasified. This is an absolutely necessary function, because the greatest defects in previous attempts to use heavy oil fuel has been the impossibility to perfectly ignite the whole charge in the fraction of a moment available. Instead of the puppet valves shown in Fig. 1, to liberate the exploded charge from the chamber 6 I use a slide-valve 67 in this modification. This slide valve 67 is loosely attached to the hollow piston rod 60 in order that the piston 7 travel a considerable distance before the slide-valve 67 is moved. This is necessary as otherwise the exploded charge in the chamber 6 would escape before the piston 7 had been forced to the right a sufficient distance to super-compress the air in the cylinder 5. In place of the slide valve I may use any of the well known rotary valves, without departing from the scope of my invention.

The return of the piston 7 can be effected as related above by the recoil spring 8 and the air pressure entering through the check valve 4 but I provide a more positive plan by means of the lever 68 whose end at 69 has a pin adapted to be thrown into connection with the spiral cam 70 by the lever 71 actuated by the governor stem 31 which in this case revolves with the balls 32; the swivel joint 72 effects the connection with the lever 71. The pin 69 on the lever 68 swings clear of the cam 70 except when it

is forced into contact by the governor stem 31 operating the lever 71.

In the secondary method as shown in Fig. 3, the mixing valve 48 is a cross section of the same valve in Fig. 1, but in this case it is shown to be operated by the lever 73 attached to the short lever 74 which is a part of the valve 48, the lever 73 is jointed to the rod 75 which also opens the inlet valve 76 to admit the mixture from the valve 48 by way of the pipe 77 into the combustion chamber 78. The rod 75 is actuated by the jointed lever 79 having the lug 88 engaging the pin 89 which is lifted by the drop of the governor balls 32 projecting the plunger 80 up and also lifting the lever 79 and its short fulcrumed foot 81 having the inclined bearings 82 adapted to operate the rod 75. A close adjustment of the lever 79 and its attachments is effected by the handled screw 83, and the cam 84 which in normal use is the throttle lever, also effects at one position the cut-out for the lever 79.

The object of this mechanism is to enable the regulation of the admittance of the charge by means of the secondary method into the motor alternately, or at any interval desired, to wit, a turn of the handle 83 will entirely cut-out the secondary charge of cooling mixture and it can be graduated between the cut-out and full-on position to any degree desired by a proper adjustment of the handle 83, and the cam 84.

In the practical operation of motors of every kind there are irregularities in the load, and during short intervals often the load is increased many times, as for instance, a locomotive climbing a hill, a steamship heading into a storm, or increasing the speed, and the same condition applies to nearly every application of power. Therefore it is obvious that some provision should be arranged to act as a booster at such times of overload.

There are well defined limits to the class of power medium capable of use in a reciprocating motor, as any gritty substance will soon destroy the packing rings in a piston, but a practically constructed rotary motor is well adapted to use a pulverulent or comminuted fuel, at least as a booster during periods of overload.

The most practical plan so far proposed is the combination of air and gas with the pulverulent fuel, but a prohibitive obstacle has heretofore been encountered in a practical method of injection of the pulverulent fuel (coal) in that regulating valves became coated with carbon because these valves were exposed to the high temperature of the combustion chamber. I overcome this obstacle by delivering the pulverized fuel from the hopper passage 94 into the air passage 92 that is open toward the motor 93 and the pulverized fuel is propelled into the combustion chamber 78 by the blast of air and gas entering the air passage 92 at a point on the rear of the pulverized fuel at the valve 76, consequently the pulverized fuel does not pass through any valves in its passage to the combustion chamber 78.

To provide such an adjunct I use the wheel or feed roller 85 having ratchet shaped teeth to supply any pulverized fuel in regular and suitable quantities into the combustion chamber 78, or other suitable gasifier. The wheel or roller 85 is turned in one direction by a step by step reciprocating motion which may be imparted by the rods 86 and 87 connected to the lever 68 and operated in advance of the discharge of the primary exploded mixture by way of the slide-valve 67, or the motion may be imparted by the rod 75 actuating the lever 73.

The rod 87 may be connected to the feed roller 85 by a pawl and ratchet, (not shown) as they will obscure and confuse the view of the essential features to wit, the feed roller 85, the hopper passage 94, and the air passage 92 leading into the combustion chamber 78. The combustion chamber 78 may have a throttle valve between it and the motor to regulate the admission of the gases into the motor.

The valve 48 as shown in Fig. 3, connects the air ports 50 from the compartment 11 of the reservoir 1, and the water port 51 from the reservoir 52, and the fuel oil port 53 from the oil reservoir 54, the ingredients being properly mixed and discharged into the pipe 77 and it will be understood that any one of these ingredients may be cut-out by simply applying cut-out valves in the connecting pipes, as it may not be advisable to use water or steam in connection with pulverulent fuel, but this feature is still in the experimental stage. Therefore I include it in the scope of my invention, as the production of a low cost fuel for internal combustion motors is the fundamental aim of my invention. At 90 is shown a belt to drive the governor from the motor shaft.

The feed roller 85 can be attached to the passage 55 (Fig. 1) in a similar manner as shown in (Fig. 3) as the passages 55 and 92 are identical in purpose, as the chambers 40 and 78 are strictly combustion chambers,

What I claim as new is:

1. In a fluid pressure generator, a combined fuel air and fuel oil reservoir, a sliding piston therein, an explosion chamber, inlets connecting the fuel reservoir and the explosion chamber, an oil valve, an air valve controlling said inlets, and said oil valve resting substantially on said air valve to effect a proportional opening of the valves.

2. In a fluid pressure generator, a partitioned fuel air and fuel oil pressure equalizing chamber, an explosion chamber, fuel air and fuel oil valves connecting said cham-

bers, said air valve adapted to automatically and proportionally open the oil valve, and means to utilize the explosion of the charge to compress the fuel air.

3. In a fluid pressure generator, a partitioned fuel air and fuel oil pressure equalizing chamber, an explosion chamber, fuel air and fuel oil valves connecting said chambers, said air valve adapted to automatically and proportionately open the oil valve, means to utilize the explosion of the charge to compress fuel air, an adjustable governor to normally regulate the timing of the ignition and effect the injection of extraneous fuel coefficients from separate sources, and capable of manual manipulation to effect intermittent action.

4. In a fluid pressure generator, a fuel air and fuel oil pressure equalizing chamber, an explosion chamber, a fuel air valve, a fuel oil valve connecting said chambers, and said air valve adapted to proportionally open said oil valve, and a separate means to induct fuel from extraneous sources into the path of the exploded gases.

5. In a fluid pressure generator, apparatus comprising, a partitioned fuel air and fuel oil pressure equalizing chamber, an explosion chamber, air and oil valves connecting said chambers, said air valve automatically and proportionally opening the oil valve, a combustion chamber contiguous to the explosion chamber and providing a passage therefrom, puppet valves in said passage adapted to retain the fuel charge, and to liberate the exploded gases automatically.

6. Apparatus comprising, a partitioned fuel air and fuel oil equalizing chamber, an explosion chamber, a spring seated piston in the explosion chamber to compress air and maintain an equable pressure in the exploded gases, air and oil valves connecting said chambers, and the air valve opening the oil valve, a combustion chamber contiguous to the explosion chamber and forming a passage therefrom, puppet valves in the passage to retain the fuel charge, and adapted to liberate the exploded gases automatically, an adjustable governor to normally effect ignition according to speed, and intermittent ignition by manual effort, and tc effect the injection of heat augmenting coefficients, heat retrieving coefficients, and cooling coefficients capable of expansion by contact with the heated walls encountered in its exit.

7. An apparatus comprising a combined air and oil fuel chamber, a combustion chamber, ports and passages connecting said chambers, valves in the passages, the air valve adapted to unseat the oil valve by contact therewith, to effect a proportional opening of each.

8. Apparatus comprising a fuel air and fuel oil equalizing chamber, a sliding partition therein, an explosion chamber, a piston therein, a spring to effect the recoil of the piston and to maintain an equable pressure in the gases in the explosion chamber, an air and oil valve connecting said chambers, said air valve adapted to proportionally open the oil valve, an oil valve casing forming a vaporizing chamber, duplex valve seats in the casing, a needle valve, duplex seats thereon, and said seats positioned so one is closed while the other is open, an adjustable governor to time the ignition.

9. Apparatus to produce an equable pressure in an explosive power medium, comprising, a sliding partitioned air and oil pressure equalizing chamber, an explosion chamber, a piston therein, a spring to effect the recoil of the piston and to maintain an equable pressure in the gases in the explosion chamber, air and oil valves connecting said chambers, said air valve proportionally opening the oil valve, puppet valves to retain the charge and automatically liberate the gases, an adjustable governor adapted to normally time the ignition, and the injection from various sources of different ingredients in series, the leading charge being an overheat producer, a second charge being inert as to self motion but explosive by the previous over-heat, and a third charge being an overheat retriever.

10. Apparatus to produce an equable pressure in explosive mixtures comprising a sliding partitioned air and oil equalizing chamber, an explosion chamber, a piston therein, a spring to return the piston, an air valve, an oil valve proportionally opened by said air valve to connect said chambers, means to retain the mixture and to liberate the exploded gases automatically, auxiliary fuel chambers, a combustion chamber, passages connecting said chambers, air adjustable governor means actuated by said governor to admit and cut-off fuel from said auxiliary fuel chambers to the combustion chamber, and to time the ignition by the speed and manually.

11. Apparatus to produce an equable pressure in explosive mixtures, comprising a manifold fuel pressure equalizing chamber, sliding piston partitions therein, an explosion chamber, valves connecting said chambers, one of said valves adapted to proportionally open the other, means to retain the mixed charge in the explosion chamber, and said retaining means actuated by the explosion to liberate the gases therefrom.

12. Apparatus to produce an equable pressure in explosive mixtures, comprising a fuel pressure equalizing chamber, an explosion chamber, an inlet air valve, an oil valve casing, a duplex valve therein connecting said chambers, said oil valve casing having a volatilizing chamber and a vaporizing chamber, said duplex valve dividing and control-

ling the passage of fuel oil therethrough, means to retain the mixed charge in the explosion chamber and said retaining means actuated by the explosion to liberate the gases therefrom.

13. Apparatus to produce an equable pressure in explosive mixtures comprising a fuel pressure equalizing chamber, an explosion chamber, an inlet air valve having a convex apex, an oil valve casing, a duplex oil valve having cut-away stems, said oil valve casing having a volatilizing and a vaporizing chamber, said duplex oil valve dividing and controlling the passage of fuel oil therethrough and actuated to open by the air valve, puppet valves to retain the charge in the explosion chamber and actuated by the explosion to liberate the gases therefrom.

14. Apparatus to produce an equable pressure in explosive mixtures, comprising a manifold pressure equalizing fuel chamber, sliding piston partitions therein, an explosion chamber, a piston therein, a spring to effect the recoil of the piston, an air valve to open the oil valve and said valves connecting said chambers, an oil valve casing, a volatilizing and vaporizing chamber in said casing, duplex valve seats, a duplex valve adapted to close the oil inlet while the oil outlet is open, and to close the oil outlet and open the oil inlet, cut-away stems on the duplex valve to effect positive graduation of the oil flow in proportion to the valve opening, puppet valves to retain the charge and to be opened by the explosion.

15. An apparatus to produce heat comprising a combined air and oil fuel reservoir, a sliding piston dividing the air and oil fuel, a combustion chamber, a piston actuated by the combustion, a spring to effect the recoil of the piston, passages connecting the fuel reservoir and the combustion chamber, an air valve contacting with an oil valve to control the fuel supply, puppet valves to retain the fuel and actuated by the explosion to liberate the gases and means effected by the explosion to compress air.

16. Apparatus to produce an equable pressure in explosive mixtures, comprising means to effect an equable pressure in the fuel air and fuel oil, means whereby the fuel air admits the fuel oil, means to proportionally graduate the admission of the fuel oil, an explosion chamber, means to compress air by the explosion therein, means to automatically prepare a charge of air and oil therein, automatic means to temporarily retain the charge, and to liberate the exploded gases, means to maintain an equable pressure in the gases, means to inject a heat retrieving charge, and means to regulate at unequal intervals the timing of the injections, and the ignition thereof.

17. An apparatus to produce heat, comprising means to equalize the fuel air and fuel oil pressure, means to proportionally mix the fuel air and fuel oil, means to ignite said mixture, means to compress the air by the gas expansion, means to retain the fuel air and fuel oil and the same retaining means adapted to release the gas.

Signed at St. Louis and State of Missouri this 23 day of March, 1916.

GEORGE JONES FERGUSON.