R. J. PARRISH.

INTERNAL COMBUSTION TURBINE.

APPLICATION FILED AUG. 29, 1917.

1,276,260.

Patented Aug. 20, 1918.

5 SHEETS—SHEET 1.

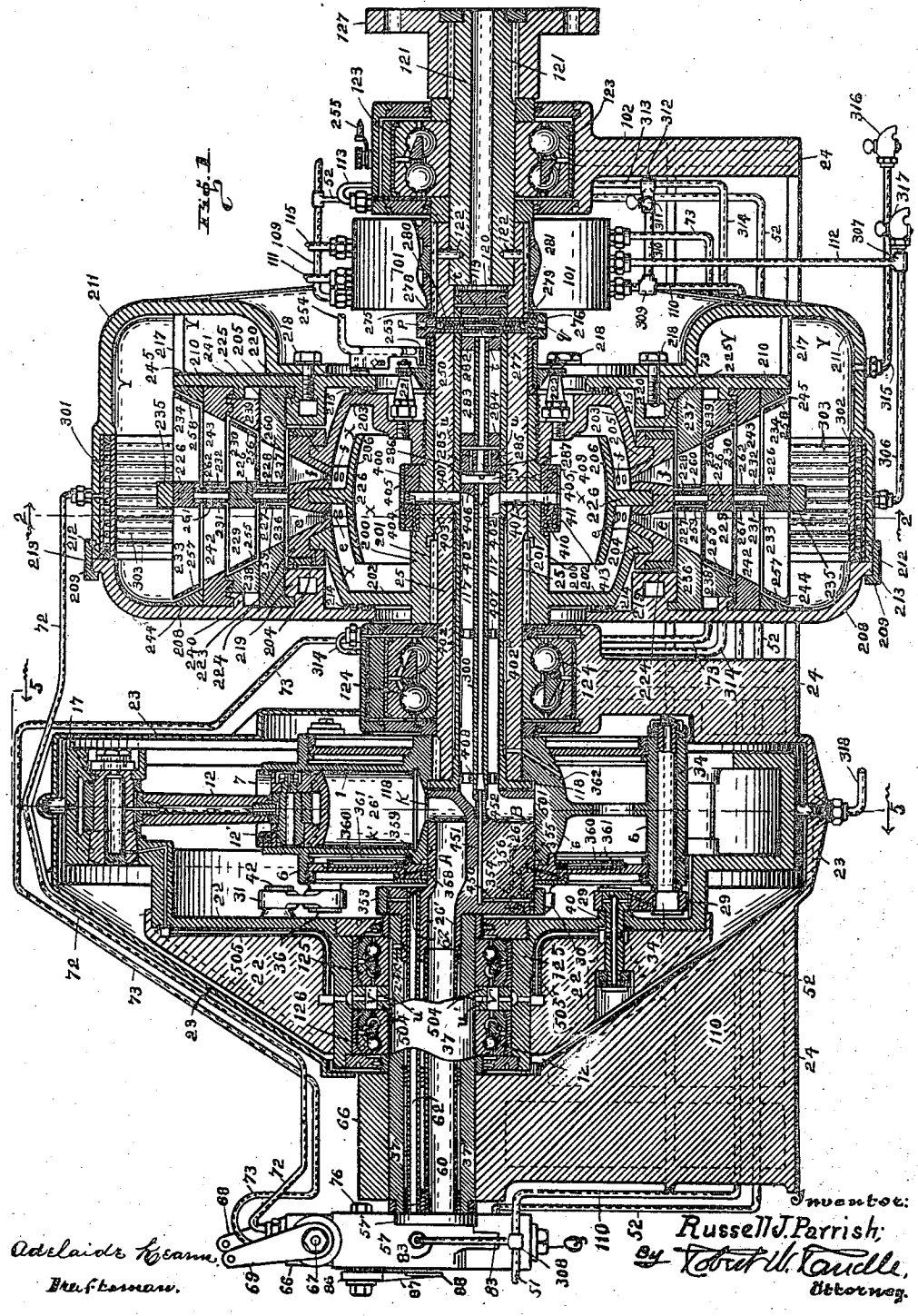


Fig. 1.

Witness:
Adelaide Kearns.

Draftsman.

Inventor:
Russell J. Parrish;
By Robert H. Caudle,
Attorney.

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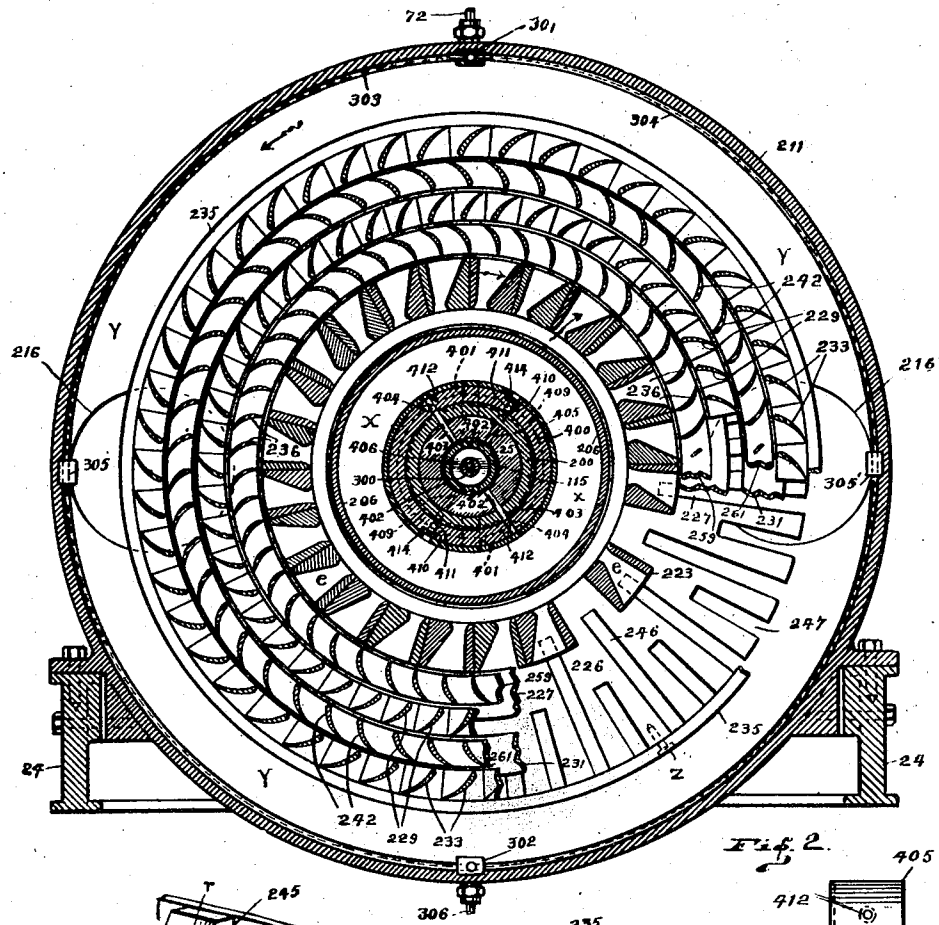


Fig. 2.

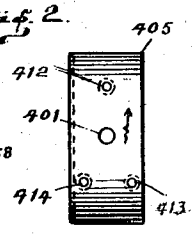


Fig. 2a.

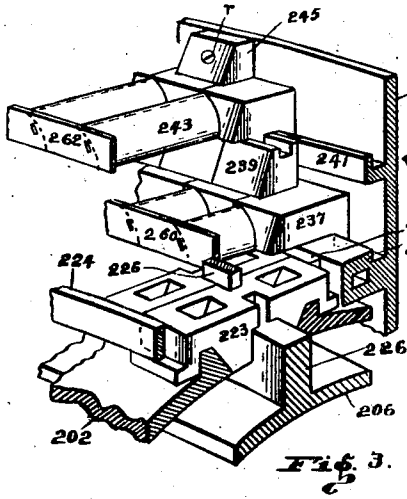


Fig. 3.

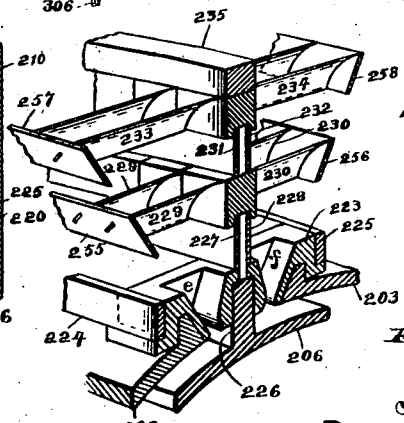


Fig. 4.

Inventor:
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Kaufman

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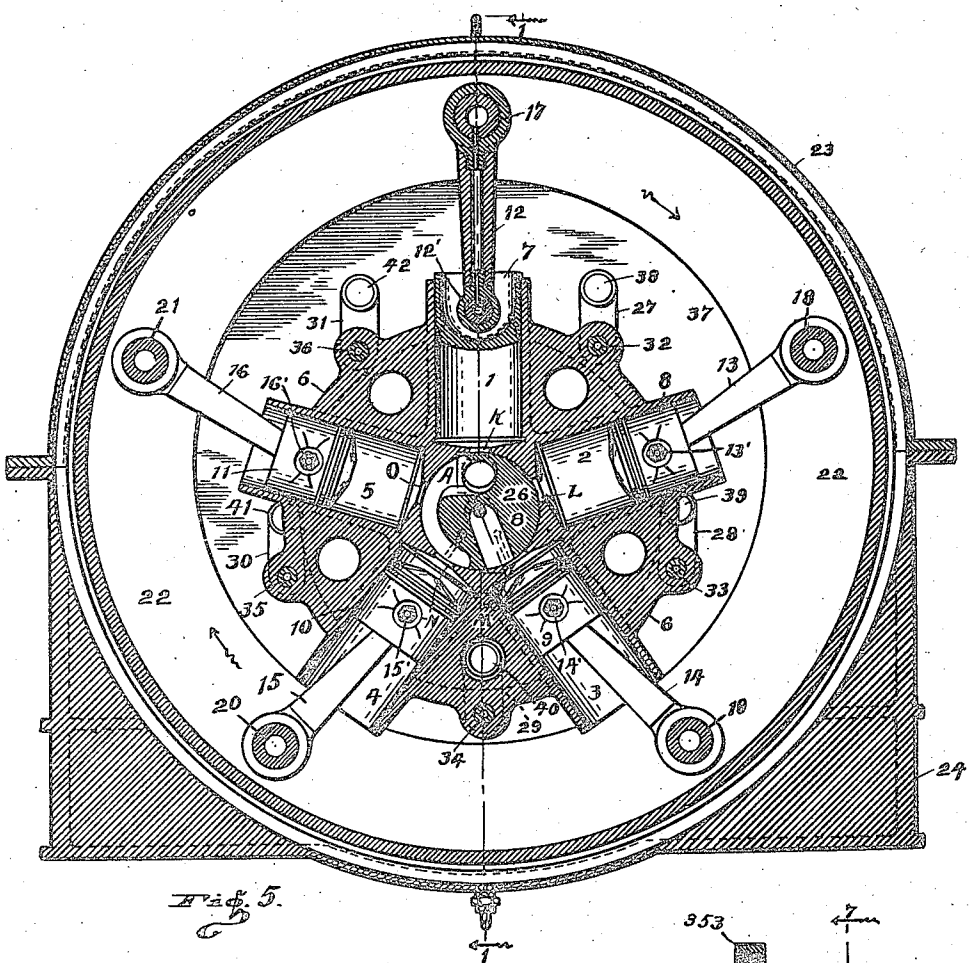


Fig. 5.

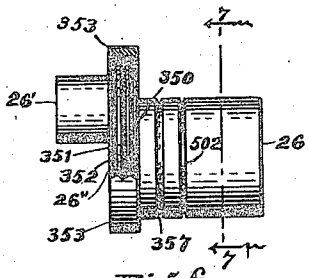


Fig. 6.

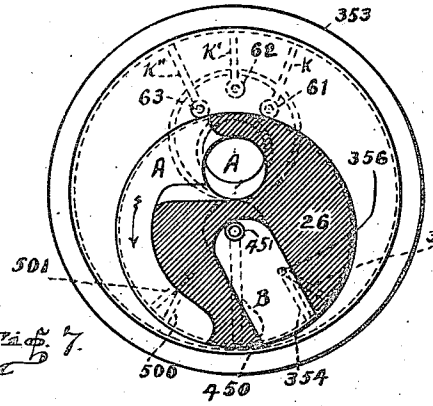


Fig. 7.

Inventor:

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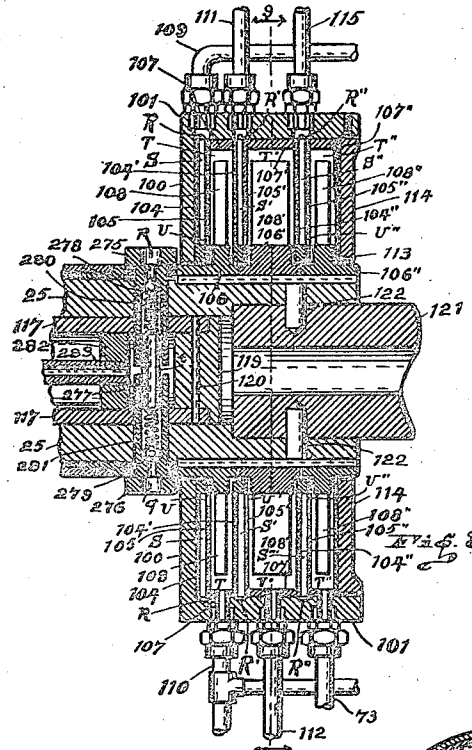


Fig. 8.

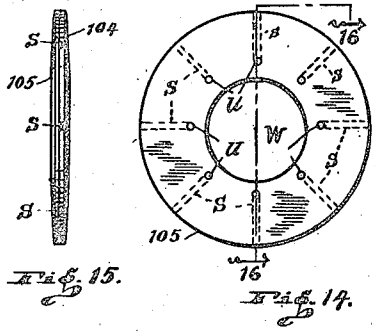


Fig. 15.

Fig. 14.

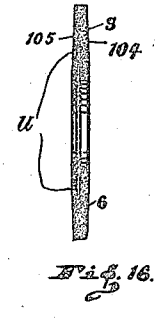


Fig. 16.

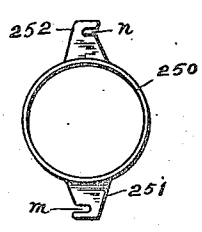


Fig. 17.

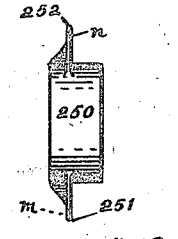


Fig. 18.

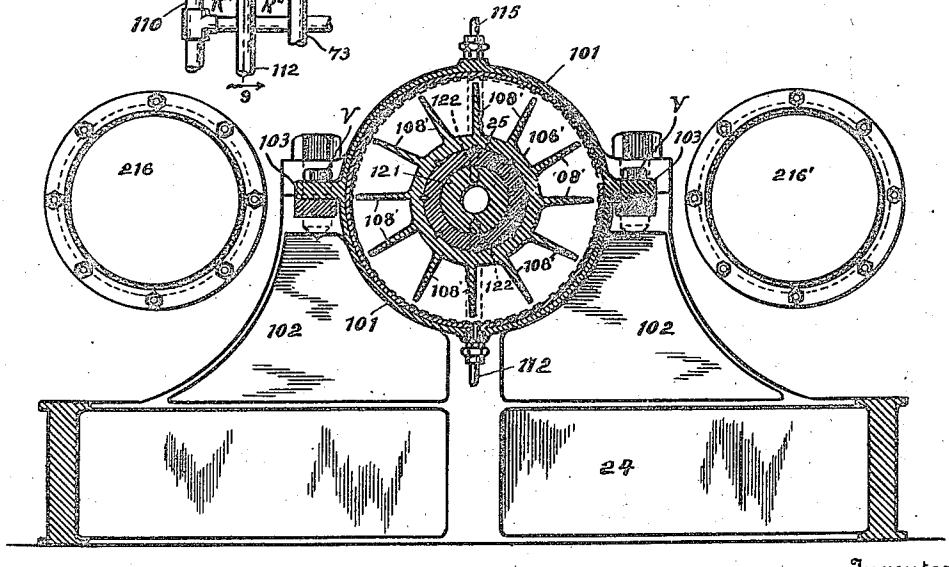


Fig. 9.

Inventor:

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Witness:

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1,276,260.

Patented Aug. 20, 1918.

5 SHEETS—SHEET 5.

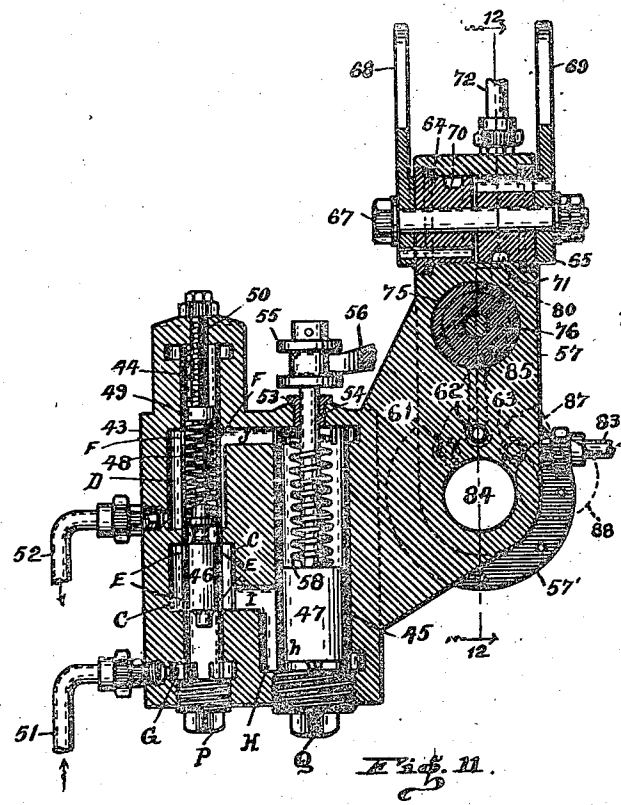


Fig. 11.

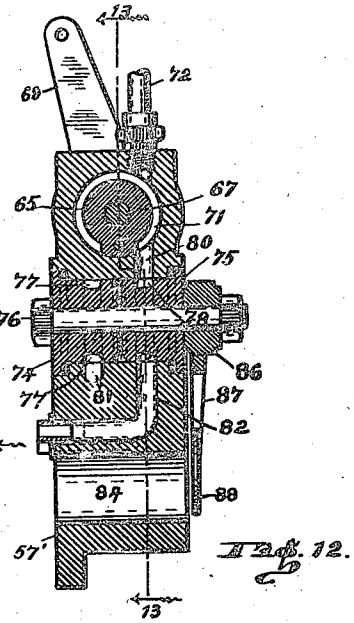


Fig. 12.

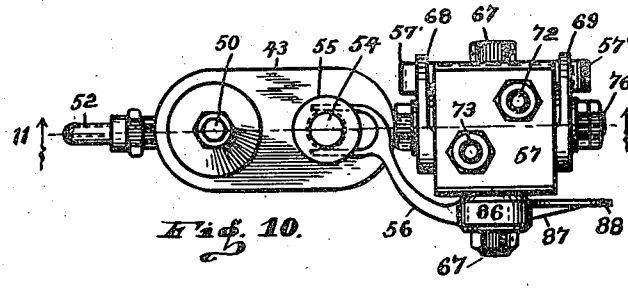


Fig. 10.

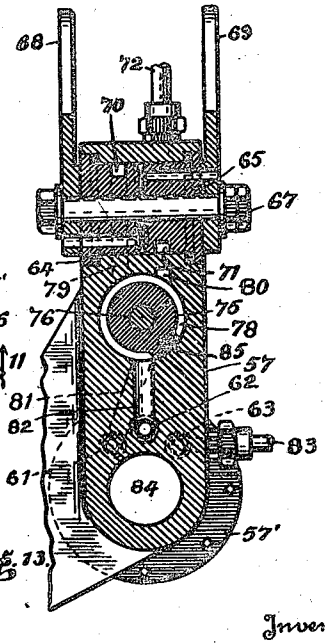


Fig. 13.

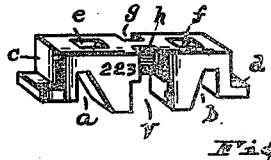


Fig. 19.

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Witnesses:

Adelaide Kearns,

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UNITED STATES PATENT OFFICE.

RUSSELL J. PARRISH, OF RICHMOND, INDIANA.

INTERNAL-COMBUSTION TURBINE.

1,276,260. Specification of Letters Patent. Patented Aug. 20, 1918.

Application filed August 29, 1917. Serial No. 188,705.

To all whom it may concern:

Be it known that I, RUSSELL J. PARRISH, a citizen of the United States, residing in the city of Richmond, in the county of Wayne, State of Indiana, have invented a new and useful construction for developing power to be applied as desired, which involves new and useful principles, which construction I denominate an Internal-Combustion Turbine, of which the following is a full, clear, and comprehensive specification and exposition, the same being such as will enable an expert mechanician to comprehend, construct, and operate the same with exactitude.

A careful consideration of the following description, when taken in connection with the accompanying drawings forming a part of this specification, will make clear the fact that my motor is capable of a high degree of efficiency whereby a comparatively small and light-weight motor will deliver an exceedingly large number of workable power units, thereby making it especially adapted to aeronautics or the like, however it may be found to be equally applicable for many other purposes. To be more specific, I have determined, after liberal allowances, that a motor constructed substantially as herein set forth and of a size approximating that of an ordinary thirty or forty horse motor will deliver at least three-hundred and fifty horse power; and that the consumption of fuel will be comparatively small, and that there will be no appreciable waste of oil or fuel.

And in addition to the above my motor will be entirely free from vibration and noise, not liable to excessive heating, will be entirely self cleaning, and will be capable of very high velocity.

Other objects of this invention broadly speaking are to provide in internal combustion turbine motor which will be comparatively light in weight; strong and durable in construction; not liable to become inoperative through wear and usage; easily operated and controlled; compact as to the space required therefor; adapted to develop a maximum of power with a minimum of fuel delivered thereto; in which the expense and trouble of attention will be practically *nil;* and which can be manufactured and sold at a comparatively low price when compared with other motors of a similar power capacity and corresponding weight.

Other objects and particular advantages of the several features of this invention will be brought out and attention called thereto throughout the course of this description.

The preferred means for carrying out my invention in a practical, a mechanical, and a scientific manner is clearly shown in the accompanying five-sheets of drawings, in which—Figure 1 is a longitudinal vertical section taken centrally through the entire assembled construction. Fig. 2 is a cross section, as taken on the line 2—2 of Fig. 1. Fig. 3 is a detail perspective view showing the form, construction, arrangement, and the manner of mounting the stationary blades of the turbine, and also showing a portion of the movable parts of the turbine. Fig. 4 is also a detail perspective view, partly in section, showing the form, construction, arrangement, and manner of mounting the movable blades with relation to the baffle-plate and the delivery nozzles. Fig. 5 shows a cross section of the compressor, as taken partly on the line 5—5 of Fig. 1, showing the cylinder casting or carriage and the arrangement of the pistons, only certain of which are in section, and showing the manner of connecting up the pistons. Fig. 6 is a side elevation of the main or stationary valve member. Fig. 7 is a cross section of the main valve member, taken on an enlarged scale from that of Fig. 6, and as taken on line 7—7 of Fig. 6, which is the same as if it were taken on the line 5—5 of Fig. 1, and as looking in the direction indicated by the arrows on said line. Fig. 8 is a vertical central section of the pump, as taken on an enlarged scale from that of Fig. 1. Fig. 9 is a cross section of the pump, as if it were taken at right-angles to that of Fig. 8 and as taken on the line 9—9 of said view. Fig. 10 is a top plan view of the regulator. Fig. 11 is a central vertical cross section of the regulator, as taken on the line 11—11 of Fig. 10. Fig. 12 is a vertical longitudinal section of the regulator, as taken on the line 12—12 of Fig. 11. Fig. 13 is a vertical cross section of the regulator, as taken on the line 13—13 of Fig. 12. Fig. 14 is a face view of the partition plates of the pump. Fig. 15 is an edge view of a pair of the partition

plates of the pump. Fig. 16 is a central section taken through a pair of the partition plates of the pump, and as taken on the line 16—16 of Fig. 14. Fig. 17 is an end view of the collar for connecting up the spark-plugs. Fig. 18 is a side elevation of said collar shown in Fig. 17. Fig. 19 is a perspective view of one of the nozzle members which are arranged around the combustion chamber. And Fig. 20 is a plan view of the ports and the jet system which leads into the combustion chamber.

Similar indices denote like parts throughout the several views.

In order that the construction, the operation, and the advantages of the invention may be more fully understood and appreciated, I will now take up a complete detailed description thereof, in which I will set forth the various parts and the functions thereof as fully and as comprehensively as I may.

The term "fuel" when used herein will denote "oil," "kerosene," "petrol," "alcohol," or any other liquid which may be found adapted to this invention, but I have determined that ordinary kerosene will be the most effective and economical fuel; and also herein the term "oil" will denote any lubricant which may be employed. Also the terms "inward," "outward," "up," "down," "channel," "groove," and other similar terms are employed simply for convenience of description, and the invention is not to be limited in any manner by the employment of such terms.

The arrangement in the construction of the invention comprises four main divisions: The air compressor; the pump; the regulator; and the turbine, which together with the auxiliary parts are so arranged and combined and interconnected as to form a complete *ensemble* or unitary structure of simple and compact arrangement which is capable of developing a maximum of usable power with a minimum of weight and expense.

The air compressor.—In this instance the compressor, Fig. 5, comprises a plurality of cylinders 1, 2, 3, 4 and 5, which are cast *en bloc*, or otherwise rigidly connected with the carriage or cylinder block or casting 6 which carries all of said cylinders, the cylinders being arranged radially with relation to each other, with their heads directed toward a common center.

Reciprocately positioned in the cylinders are the respective pistons 7, 8, 9, 10 and 11, which are provided with piston-rings as indicated. Pivoted at their inner ends, on the respective wrist-pins 12′, 13′, 14′, 15′ and 16′, to the respective pistons, are the connecting-rods 12, 13, 14, 15 and 16, which project outward beyond their respective cylinders to where each is mounted to its respective pivot 17, 18, 19, 20 and 21, which pivots are carried by the body 22 of the compressor which surrounds all of said cylinders, and which is adapted to rotate in the case.

As stated, said body 22 is revolubly mounted, in the casing 23, which latter is supported by the base 24 common to all parts of the motor.

Numeral 25 denotes the main shaft, which is hollow for the purposes hereinafter explained. Abutting the inner (left) end of a flange 118, hereinafter referred to, is the main stationary valve member, hereinafter described in detail, which has an inlet port A and an outlet port B, which are spaced apart, the said valve and its ports being common to all of said cylinders.

The ports K, L, M, N and O in the heads of the respective cylinders are adapted to open into both of the ports A and B, opening and closing thereto alternately as the cylinders revolve around concentric with the shaft 25.

The body 22 revolves about an axis parallel to the shaft 25, but it is offset one-half the length of a piston stroke with relation thereto, thereby making said axis off-center with relation to the shaft 25, but each rotating in perfect and independent circles, for the purpose of operating the pistons in said cylinders, as will hereinafter be made more clear. The body 22 is driven by the cylinders casting 6 by means of a series of links 27, 28, 29, 30 and 31. One end of each of the links is connected to the cylinder carriage 6 by means of the respective pivots 32, 33, 34, 35 and 36, and their other ends are connected to the body 22 by the respective pivots 38, 39, 40, 41 and 42. The pistons and the bodies of the connecting-rods are made of very light weight metal alloy, in order that the pressure on the bearings, due to centrifugal force, is minimized.

In practice the rotation of the cylinders will cause the pivots 32, 33, 34, 35 and 36, and the pivots 38, 39, 40, 41 and 42 to travel planetarily around each other, but the links will at all times remain parallel with each other, and the port ends, or heads, of the cylinders will at all times be in contact, or nearly so, with the main stationary valve member, traveling therearound. The ports A and B of the stationary valve member are so arranged that as the pistons move outward the ports in the cylinder heads are open into the port A, while there is an interval during which the pistons are moving inward that the ports in the cylinders are closed by the body portion of the said valve member, thereby allowing time for the air in the cylinders to be compressed therein as the pistons move inward, and then as the pistons near their inward limit of movement

the port of the respective cylinder will register with the port B, thereby permitting the compressed air in the cylinder to pass into the interior of the shaft 25, for the purpose hereinafter stated.

The regulator.—This comprises a body 43 (see Figs. 10, 11, 12 and 13) which is integral with or secured to the main body 57 of the regulator as shown. The entire regulator is connected to the left-hand end of the stationary shaft, or conduit, 37, which is accomplished by means of bolts or screws inserted through the flange 57'.

The body 43 has therein two vertical and parallel cylinders: The main cylinder 44 and the relay or secondary cylinder 45. Said cylinders are simply brass tubes inserted in apertures therefor in the body 43, where they are retained in place by the respective plugs P and Q. Operative in the cylinder 44 is the piston 46, and likewise operative in the cylinder 45 is the piston 47. A compression spring 48 is located in the cylinder 44 and it is adapted to press on the piston 46. The upper end of said spring engages the head 49 which is slidable in the cylinder 44, and the compression of said spring is made adjustable by the screw 50, operative from outside the regulator as shown. Chambers C and D are formed in the body 43 and around the cylinder 44. Ports E are formed through the cylinder 44 and leading into the chamber C, and ports F are formed through the cylinder 44 into the chamber D. Formed in the body 43 around the lower end of the cylinder 44 is the chamber G, which is connected with the interior of the cylinder 44 as shown. An oil inlet pipe 51 leads into the chamber G, and an oil outlet pipe 52 leads from the chamber D, and they lead to points as hereinafter explained under the caption of "oil circuit."

Formed in the body 43, around the lower portion of the cylinder 45, is the chamber H, which is connected with the interior of the cylinder 45 by the port *h*. The lower portion of the chamber C is connected with the upper portion of the chamber H by the passage I. The upper portion of the chamber D is connected with the interior of the chamber 45 by the passage J.

Extending upward from the piston 47, through the bushing 53, is the stem 54 which has on its upper end the channeled-head 55, in the channel of which is located the prongs of the lever 56. Coiled around the stem 54 and extending from the bushing 53 to the piston 47 is the compression spring 58.

Rotatably mounted in the upper portion of the body 57 are the two valve-cores 64 and 65; said cores are clamped together by the bolt 67, but they are adapted to be rotated independently of each other. Connected to the core 64 is the hand-lever 68, and connected to the core 65 is the hand lever 69. Numerals 70 and 71 denote each a channel formed around in the periphery of the respective cores 64 and 65, but they do not extend entirely around the cores, see Fig. 12, that is their ends do not meet, leaving a space therebetween corresponding with the face of the core. The channel 70 is adapted to register with the interior of the fuel-pipe 73, and the channel 71 is adapted to register with the water-pipe 72.

Identical with the valve cores 64 and 65 are the valve-cores 74 and 75, the latter however being located below and at right-angles to the former, and the cores 74 and 75 are rotatably mounted in an aperture formed therefor through the body 57, and they are clamped together in operative position by the bolt 76. A channel 77 extends partly around in the periphery of the core 74, and a like channel 78 is formed in the periphery of the core 75. A duct 79 connects channel 70 with the channel 77, and a duct 80 connects the channel 71 with the channel 78, except when the cores are turned to move said channel out of register with the ducts, that is by bringing the spaces between the ends of the channels over their respective ducts, which of course closes the passage therebetween. Also extending down and then to the right from the channel 77 is a duct 81 which connects with the fuel tube 61; and extending down and to the left, Fig. 12, from the channel 78 is the duct 82 which connects with the water tube 62. Numeral 83 denotes an oil pipe which extends into the body 57 and connects with the oil tube 63.

Numeral 84 denotes the air inlet which extends through the body 57 and connects with the comparatively large air conduit 60.

As shown in Fig. 1 the tubes 60, 61, 62 and 63 all extend into, and are parallel with, the hollow shaft 37, which is secured horizontally to the base 24 by the cap 66, and it is rigidly connected with the stationary valve member. The inner or right-hand end of the water-tube 62 is permanently closed by the plug 62' which is secured therein.

The cores 74 and 75 are connected to rotate together at all times by means of the bar 85 which extends across through both, also the bolt 76 is secured in the cores 74 and 75 whereby they will rotate therewith. Secured on one end of the bolt 76 is the hub 86. Extending down from the said hub is the arm 87 which carries the shutter 88, which latter is adapted to cover the outer end of the air inlet 84. The inner end of the lever 56 is also connected to the hub 86, whereby the raising and lowering of the outer end of the lever 56 will turn the cores 74 and 75, and it will also operate the shutter 88 which controls the air inlet 84.

In practice the oil for controlling the automatic action of the regulators enters through the pipe 51, under pressure of the

pump, the pressure depending upon the speed of the motor. The oil pressure may raise the piston 46, against the adjusted compression of the spring 48. Then as soon as the lower end of the piston 46 begins to open a port E to the chamber C it is evident that the oil will flow into the chamber C, over through the passage I, into the chamber H, and then into the cylinder 45, which will tend to raise the piston 47, and the stem 54, against the pressure of the spring 58, thereby lifting the outer end of the lever 56, by means of the stem 54 carried by the piston 47. Lifting the lever 56 will of course cause said lever to turn the cores 74 and 75, thereby closing (or partly closing) the ducts 81 and 82, thereby shutting off, or decreasing, the supply of water and fuel, and at the same time the shutter 88 will move over the air inlet 84, thereby cutting down the air supply, which manifestly will cause the motor to slow down, thereby reducing the oil pressure through the pipe 51, which of course will cause the piston 46 to drop, thereby permitting the oil underneath the piston 47 to be pushed, by the spring 58, into the chamber H, through the passage I, into the cylinder 44 above the piston 46, then into the chamber D, and then into the pipe 52, from which it will be sucked back to the source of supply or to the pump to be used again.

By the above it is apparent that a constant speed will be automatically maintained, the rate being pre-determined by the adjustment of the compression of the spring 48, by means of the screw 50. The piston 46 will remain in the neutral position in which it is shown in Fig. 11, and the piston 47 will remain stationary at a height depending upon the motor load, the same being low for a heavy load and high for a light load.

The pump.—As shown in Figs. 8 and 9, the pump comprises a case or body which is cup-shaped, and it includes the end disk portion 100, and the flange or ring portion 101 which is located at right angles to the former and is integral therewith. The case is supported by the standard 102 which extends up from the base 24, the case being provided with lugs 103 extending from each side thereof which are secured to the lugs of the standard by the screws V, which screws pass through said lugs as shown. The disk 100 of the case has a central aperture, corresponding in size with the aperture W shown in Fig. 14, and the said aperture of the disk 100 is larger than are the hubs 106, 106′ and 106″, with no possibility of friction therebetween. Adjoining the inner face of the disk portion of the case is the plate 104, which corresponds with the disk 100. A plurality of grooves, which are U-shaped in cross section, are formed radially in the right-hand face of the plate 104 and they open at their ends into the space R which is formed in the inner face of the flange 101, but they terminate a short distance outward from the inner edge of said plate, that is they do not extend to the central aperture thereof, said central aperture being of the same diameter as the aperture in the disk 100. A thin plate 105, of the same dimensions as the plate 104, contacts with the face of the plate 104. Numeral 106 denotes a hub which is secured to the shaft 25 and it extends therearound, the lateral extending flange portion of said hub projects through the central apertures of the plates 105 and 104 and of the disk 100, which fit thereabout as shown. The central portion of said hub extends into the chamber T. A spacer-ring 107, which is slightly wider than the central portion of the hub 106, is placed around flat against the inner face of the flange 101, with one edge thereof in contact with the plate 105. At the inner terminal of each of the grooves S there is a port U formed through the plate 105, which ports connect the grooves S with the chamber T. Radiating out into the chamber T, from the central portion of the hub 106, are a plurality of blades or vanes 108, which are arranged similar to that of the vanes 108′ shown in Fig. 9. The oil supply pipe 109 passes through the flange 101 and leads into the space R. The oil outlet pipe 110 leads outward from the chamber T, as shown.

The above comprises the oil portion of the pump, and the water portion thereof is similar thereto except that it is of larger capacity, and it comprises the plate 104′, which is identical with the plate 104, and it contacts with the central portion of the hub 106 and surrounds the shorter lateral portion thereof, and it contacts with the spacer ring 107, and it has like radial grooves S′. Contacting with the face of the plate 104′ is the thin plate 105′. Numeral 106′ denotes a hub which is also secured to the shaft 25 and its flanges extend in an axial direction, the one to the left contacting with the shorter flange of the hub 106, and the central portion is adapted to contact with the plate 105′. A spacer ring 107′, which is slightly wider than is the central portion of the hub 106′, is placed around flat against the inner face of the flange 101, with one edge in contact with the plate 105′. At the inner terminal of each of the grooves S′ there is a port U′ formed through the plate 105′, which port connects the channel S′ with the chamber T′. Radiating out into the chamber T′ from the central portion of the hub 106′ are a plurality of blades or vanes 108′, which are arranged as shown in Fig. 9. The water supply pipe 111 passes through the flange 101 and leads into the space R′. The water outlet pipe 112 leads from the chamber T′. The above comprises the water

portion of the pump, and the fuel portion of the pump is almost identical with the oil portion thereof, and it comprises the plate 104″, which is identical with the plate 104, and it contacts with the central portion of the hub 106′, and it surrounds one flange of said hub and contacts with the spacer ring 107′, and it has like radial grooves S″. Contacting with the face of the plate 104″ is the thin plate 105″. The character 106″ denotes the third hub, which also is secured to the shaft 25, and it is identical with the hub 106, but it is oppositely disposed with relation thereto. The shorter flange of the hub 106″ contacts with the hub 106′, while its longer flange extends out even with the end of the shaft 25. At the inner terminal of each of the grooves S″ there is a port U″ formed through the plate 105″, which port connects the groove S″ and the chamber T″. Radiating out into the chamber T″, from the central portion of the hub 106″, are a plurality of blades or vanes 108″ which are arranged in the same manner as are the vanes 108′ shown in Fig. 9. A spacer ring 107″, which is slightly wider than the central portion of the hub 106″, is placed against the inner face of the flange 101, with one edge in contact with the plate 105″. Numeral 113 denotes the final plate, which contacts at its outer edge with the spacer ring 107″ and its inner edge contacts with the central portion of the hub 106″, thereby forming the outer wall of the chamber T″.

The fuel supply pipe 115 passes through the flange 101 and leads into the space R″. And the fuel outlet pipe 73 leads outward from the chamber T″. The above comprises the fuel portion of the pump. Numeral 114 denotes the screw disk, forming the right-hand side of the pump-case, the outer edge of the disk 114 is threaded into the inner face of the flange 101, with its inner edge fitting around the outer flange of the hub 106″, but without frictional contact therewith.

In practice the plates 104, 104′, 104″, 105, 105′, 105″ and 113 are made of rather thin spring material, and before being placed in position they are slightly convex in form, whereby when the motor is at rest the central portions of said plates press tightly against the respective central portions of the hubs and prevent leakage from one to the other of the three divisions of the pump, but after the motor has attained considerable speed the centrifugal force of the fluids will press said plates so there will be no frictional contact, and as the pressure of the fluids is outward it is evident that there will be no leakage around the hubs when the motor is in operation at its normal speed.

The pump above set forth is radically different from the so-called centrifugal pumps, particularly in the fact that the vanes thereof do not impart velocity, but only create centrifugal pressure, to supply the various elements, as will hereinafter be explained.

The pump herein set forth is constructed triune, or triplicate, controlling the movements of "oil", "water" and "fuel", but all of the parts are contained in a single case and are operated by the same source and moving at the same time in the same way.

The hubs 106, 106′ and 106″, together with the respective vanes 108, 108′ and 108″, are the only parts of the pump that rotate or move, and they revolve with the shaft 25 to which they are rigidly connected by means of keys, or otherwise if desired.

It will now be observed that the oil may enter through the pipe 109, passing into the space R, from which it will move centerward through the grooves S, then passing through the port U into the chamber T where it will be taken up by the vanes 108 and pressed by centrifugal force to the outer extremity of the chamber T, from which the only outlet is through the pipe 110, through which latter it will be forced to the various points to be utilized as hereinafter set forth.

A description of the movements of the water and the fuel through the pump would, manifestly, be a replica of the description above given of the movements of the oil, except as to the indices of the duplicate elements, therefore a description thereof is not required as it would add more to prolixity than to clearness of comprehension.

Stationary valve member.—As shown in Fig. 6 this comprises the main or body portion 26, having therein the air-inlet A and the air-outlet B, which have no communication with each other, the former being offset and it leads in through the stem portion 26′. The central part 26″ is in the nature of a projecting flange which has three channels 350, 351 and 352 extending entirely around in the periphery thereof. The three tubes 61, 62 and 63 are connected with the respective channels 350, 351 and 352 each by the respective radial passage *k*, *k′* and *k″*, as indicated in Fig. 7. Numeral 353 denotes a ring which tightly surrounds the periphery of the flange portion 26″ and thereby incloses said channels, as indicated. By the above it is apparent that I provide a single valve which is common to all of the cylinders, and I provide for uniflow of air, which means both mechanical and thermal efficiency. Also a single port in each cylinder head makes possible maximum compression, by reason of minimum clearance space.

The turbine.—Secured around the shaft 25 is the turbine-hub 200, the same being retained rigidly therewith by keys 201. The combustion chamber is formed by two outwardly and centerwardly extending walls 202 and 203 whose free edges approach each other, and they extend entirely around the

shaft 25 forming a continuous combustion chamber X. The wall 202 is integral with the hub 201, and it extends out from near the left end of said hub; and the wall 203 is threaded onto the right-hand end of said hub, as indicated in Fig. 1. The edges of the walls 202 and 203 which approach toward each other terminate in the respective outwardly directed flanges 204 and 205. Numeral 206 denotes the baffle plate which is located between the walls of the combustion chamber and the hub, being nearer to the former, and it extends entirely around and concentric with the hub, but located some distance therefrom. The baffle plate is retained in place in a manner hereinafter stated.

The outer case or container comprises a left side wall 208, whose outer portion curves to the right and terminates in an outwardly extending flange 209. The right-hand side wall 210, which does not extend outward as far as does the wall 208, has no centerwardly curved portion. The peripheral portion 211 has an inner flange portion which contacts with the outer face of the wall 210, which is located inward from the outer edge thereof, and it extends to the right from said flange and then extends outward and then to the left to where it terminates in the flange 212 which contacts with the flange 209. The flanges 209 and 212 are clamped together by the two-part channeled locking ring 213. The adjoining surfaces of the wall 208 with the wall 202 are slidably connected by series of interlocking tongues and grooves 214; and in like manner the adjoining faces of the wall 210 with the wall 203 are connected by a series of interlocking tongues and grooves 215, each forming a labyrinth against the escape of back pressure. The said tongues and grooves are formed around concentric with the shaft 25, and they permit the combustion chamber to revolve with the shaft 25 while the case remains relatively stationary and still provide sufficiently tight joints to provide against the possible leakage of low pressure, but without frictional contact of the said tongues and grooves.

The member 211 of the case is rigidly secured to and it is supported by the base 24, as shown in Fig. 2. Letter Y denotes the exhaust chamber which extends entirely around concentric with the shaft 25 and the combustion chamber X, and it occupies the outer or peripheral portion of the interior of the turbine case.

Extending outward to the right from the chamber Y, through the wall 211, are the two exhausts 216 and 216′, indicated in Fig. 2.

The outer portion of the wall 210 is prevented from spreading to the right by a plurality of staves 217 which extend to the right through the chamber Y and then contact with the wall 211, the same bing integral with the wall 210, all as indicated in Fig. 1.

The inner portion of the wall 211 is secured to the outer face of the wall 210 by a plurality of machine screws 218.

Extending toward each other from the walls 208 and 210 are the abutments 219 and 220, respectively, which extend entirely around in the case, and each has a channel in its outer edge, for the purpose hereinafter explained.

The nozzle members are each in the nature of a block 223, as shown in Fig. 19, each half of which is a duplicate of the other half, and it is located between the abutments 219 and 220, and it has notches, *a* and *b*, in its inner edge, which notches fit over the respective flanges 204 and 205, as shown in Fig. 1. Apertures, forming the nozzles *e* and *f*, extend outward radially through the member 223, and their smaller ends, or throats, open into the combustion chamber X, as shown in Fig. 1. In the center of member 223, and on each side thereof, are the grooves *g* and *h* which fit in the slotted disk 226 which project outward as in Fig. 1.

The said disk 226 is formed integral with and it radiates outward at right-angles from the baffle-plate 206, as shown. And as shown in Fig. 2 alternately long slots 246, and short slots 247, extend from the periphery of the said disk toward the center thereof. Each of the nozzle members 223 are positioned from the periphery of said disk inward toward the center thereof, with the notches *g* and *h* fitting around the edges of a notch 246, with the notch *v* fitting around the base edge of said slot 246, whereby each of the members 223 are held in position, and all are arranged side-to-side in a circle which is concentric of the disk 226, and of the shaft 25, and also concentric with the combustion chamber X.

The nozzle members 223 are retained in against centrifugal force by the rings 224 and 225, which rings rest in notches *c* and *d*, and they extend around all of the nozzle members concentric with the shaft 25. Similar rings 227 and 228 are placed on each side of the disk 226, as shown in Figs. 1, 2 and 4, and they are concentric with the rings 224 and 225.

The inner set of movable-blades, 229 and 230, are slid centerward through the slots 246 and 247, and they are notched over the outer edges of the rings 227 and 228, thus holding them in place. The outer set of movable blades, 233 and 234, are notched into the slots 246 and 247, slid centerward, and are then notched over the rings 231 and 232. All of said parts are then retained in place and are locked by the ring 235 which fits around on the periphery of the disk 226, where it is secured by a plurality of screws Z, see Fig. 2.

From the above it is apparent that all of the movable parts are interlocked into a single movable unit.

The outer set of movable blades are duplicates of the inner set, except that they are longer and slightly different in curvature. The outer ends of all of said blades are formed at acute angles, which angles are in line with the angular flaring walls of the nozzles *e* and *f*, as shown in Fig. 1.

The projecting ends of the blades 229 and 230 are connected by the respective angular rings 255 and 256, which are located adjacent to the abutment rings 238 and 239, respectively.

The projecting ends of the blades 233 and 234 are connected by the respective angular rings 257 and 258, which are located adjacent to the abutment rings 244 and 245, respectively.

The inner stationary blades 236 and 237 are hooked onto the abutments 219 and 220, respectively, and they are retained in place by the respective abutment-rings 238 and 239 which contact with the respective hook-flanges 240 and 241, which latter project from the walls 208 and 210. The said rings 238 and 239 form abutments for the blades 242 and 243 which are supported thereby, substantially as shown.

The outer stationary blades 242 and 243 are hooked onto the flanges 240 and 241, respectively, and onto the respective abutment-rings 238 and 239, substantially as shown.

The projecting ends of the blades 236 and 237 are connected by the respective angular rings 259 and 260, which are adjacent to the moving rings 227 and 228, respectively.

The projecting ends of the blades 242 and 243 are connected by the respective rings 261 and 262, which are located adjacent to the moving rings 231 and 232, respectively.

The final securing rings 244 and 245 are secured by screws, as the screw *r* shown in Fig. 3, to the inner faces of the respective walls 208 and 210, which manifestly locks the stationary blades in operative position, substantially as shown.

From the above it will be apparent that the movable and the stationary blades alternate with relation to each other, and the shape of said blades is clearly shown in Figs. 2, 3 and 4.

As is shown in Fig. 2 the said blades, both stationary and movable, and the nozzles, or nozzle members, are arranged continuously in circles which are concentric with the shaft 25.

Electrical equipment.—It is contemplated that but one spark-plug will be required for starting purposes, but I prefer to provide two such plugs, in order to guard against accident and to preserve balance in the turbine. Said spark-plugs are designated by the numerals 221 and 222, and are located opposite to each other on each side of the shaft 25, the same being located in depressions provided therefor in the member 203, and they are threaded through the wall thereof, whereby the sparking points of the plugs will be in the combustion chamber X, as shown in Fig. 1. The said spark-plugs are of course carried around with the shaft 25 and the other movable parts of the turbine. The means for supplying current to the spark-plugs includes a collar 250 which surrounds the shaft 25 adjoining the wall 203, and this collar has two oppositely directed arms 251 and 252 in which are the respective notches *m* and *n* to receive therein the outer projecting portions of the binding-posts of the respective spark-plugs 221 and 222, after which the usual nuts on said plugs may be tightened which will lock the collar to rotate with the plugs and the other rotating parts of the turbine, and then by simply loosening said nuts on the spark-plugs the collar may be turned to move the arms 251 and 252 aside, in order that the spark-plugs may be removed or replaced in the usual manner. The said collar is insulated from all adjacent parts of the motor. A brush 253 is attached to any relatively stationary member, as the wall 211, or wall 210, from which it is insulated, whereby the points of the brush will at all times be in sliding contact with the periphery of the collar 250.

A wire 254 is connected to the brush, and a ground wire 255 is attached to some stationary part of the construction, for instance to the cap of the bearing 123, as shown in Fig. 1. The said wires 254 and 255 lead to the electrical supply, not shown, whereby a circuit may be established in the usual manner.

It is to be understood that after the motor is in full operation the current may be switched off from the spark-plugs, as the turbine will then be self-firing, by reason of the fact that combustion in the combustion chamber will be continuous.

Primer.—As shown in Figs. 1 and 8, the primer is made double ended, for centrifugal balance and to provide dual priming places, and it consists of two shouldered tubes 275 and 276, which are inserted into the shaft 25, extending through the wall of the conduit 117, but their inner ends do not contact with each other, there being a space therebetween as indicated. The interior of the inner portions of the tubes 275 and 276 are threaded to run on the ends of the central tube 277 which connects the tubes 275 and 276. Balls 278 and 279 are located in the respective tubes 275 and 276 and they are adapted to close the apertures *p* and *q* in the ends of the respective tubes 275 and

276. Compression springs 280 and 281 rest on the ends of the tube 277 and press the respective balls 278 and 279 outward to close the said apertures *p* and *q*, yet permitting said balls to be pressed inward for the insertion of the priming liquid, as hereinafter explained.

The tube 277 is located a short distance to the left of the cap or plug 119. Closing the conduit 117, a short distance to the left of the tube 277 is the spacer 282 into the center of which is secured the right-hand end of the pipe 283. A spacer 284, like the spacer 282, supports the left-hand end of the pipe 283. In the center of the tube 277 is a plurality of apertures *t*, which open into the space between the plug 119 and the spacer 282 and directly opposite to the interior of the pipe 283. Located slightly to the left of the spacer 284 is the wide disk 285 having a plurality of small apertures *u* formed in an axial direction therethrough. Numeral 286 denotes a disk cap having a central stem 287 which stem is adapted to slide in a central aperture in the disk 285, the said cap 286 being adapted, when moved to the right, to close the apertures *u*, or when moved to the left to open said apertures *u*, and then when moved to the extreme left it will close the right-hand end of the conduit 300, as hereinafter referred to.

Incidentally the said primer serves to lock the conduit 117 in place within the interior of the shaft 25, and thereby cause the flange 118 to retain the body of the compressor in operative position, as shown in Fig. 1.

Water heater.—This element is shown in Figs. 1 and 2, and it is located entirely within the exhaust chamber Y of the turbine, and its purpose is to recover and utilize the surplus heat by heating the water to be delivered into the combustion chamber in a manner hereinafter described.

The water heater comprises two head-pipes, 301 and 302, which are located across above and below, respectively, in offsets therefor formed in the peripheral wall 211, their ends being closed and sealed they are secured in place when the members 211 and 208 are clamped together by the ring 213. The said head pipes are interiorly connected by two sets of pipes, 303 and 304, which lie parallel and concentric with the inner face of the peripheral wall 211 of the case. Near their centers each set of pipes 303 and 304 is supported by the spacers or hangers 305 and 305′, and by which said pipes are secured to the wall 211.

The pipe 72 leads from the center of the head-pipe 301, and the pipe 306 opens into the head-pipe 302.

Injection to combustion chamber.—As shown in Figs. 1 and 2, a ring 400, which surrounds the central portion of the hub 200 to which it is secured, which ring has central air-passages 401 therethrough, which passages also continue through the hub 200, the shaft 25, and the wall of the conduit 117. Formed through the ring 400, the hub 200, and with its inner end terminating in the channel 402, which latter is formed entirely around in the periphery of the conduit 117 adjoining the shaft 25, is the passage 403. And at right-angles to the latter is the passage 404 which intersects the passage 403 and opens outward through the jet-disk 412. Numeral 405 denotes a cap which covers the entire periphery and the left-hand end of the ring 400, thereby closing the left end of the passages 404 and the outer end of passages 403, and it also retains in place the various jet disks. The ring 400 and the cap 405 are clamped in place by the threaded portion of the wall 203 when it is secured in position, as shown in Fig. 1.

The conduit 300 is suspended in the center of the conduit 117 by the suspension disks or spacers 406, 407 and 408, the latter two having a plurality of apertures therethrough, eccentric thereof, and extending in an axial direction. The compressed air from the port B is forced to pass through the conduit 117, passing through the apertures in the suspension disks 407 and 408, and then entering the passage 401, from which it is injected into the combustion chamber through an aperture in the cap 405, which is of the same diameter as the passage 401. There are of course a plurality of passages 401, the same being arranged radially as indicated.

Letter *j* denotes a water space which is located between the disk 406 and the disk 285, in which may operate the cap 286, as stated.

Extending radially from said space *j* are a plurality of passages 409, which pass through the wall of the conduit 117, the shaft 25, the hub 200, and the ring 400, said passages are on the right of the passages 401, Fig. 1, and similar passages 410 (on the left in Fig. 1) are formed through the ring 400 only, but they are connected with their mate passages 409 by cross passages 411. The passages 409 terminate in the jet disks 413, Fig. 20, and the passages 410 terminate in the jet disks 414, Figs. 2 and 20. The purpose of the cap 405 is to retain the jet disks in place, as said jet disks are made in the manner indicated in order to form fine jet apertures therethrough.

The arrangement of the delivery nozzles is clearly shown in Fig. 20, by which it is apparent that, considering the direction of rotation, as indicated by the arrow in Fig. 20, the fuel is injected in through the jet-disks 412 slightly in advance of the air, and the fuel and the air each having been previously heated, therefore as they unite in the combustion chamber it is manifest that combustion will be almost instantaneous and complete, and since both the supply of fuel

and air are continuous combustion will be continuous. After the turbine has attained its normal running speed the resultant pressure of combustion in the combustion chamber will equal the pressure of the incoming air, therefore there will be no danger of back firing or of other undesirable results. The water is introduced into the combustion chamber on each side of the fuel and the air, thereby protecting the walls of the combustion chamber by two curtains of water or steam, and this will also keep the combustion chamber, the fuel chamber, and the blades free from carbon or other deposits.

A large part of the resultant heat from the combustion is used in vaporizing the water and superheating the steam therefrom, therefore the ejectment from the exhausts will be practically cool and, as combustion is complete, it will be practically odorless.

Generalities, not previously explained.—Fitting the interior of the shaft 25 is the conduit 117, which has on its left end a right-angular flange 118 which adjoins with the end of the shaft 25, and which is of larger diameter than is said shaft 25 to retain the cylinder casting in position. The inner end of the stationary valve member adjoins said flange 118, but without frictional contact therewith, and the port B of said valve registers with the interior of the shaft 25. Closing the right-hand end of the conduit 117 is the cap 119 which is secured in place by the pin 120 which extends therethrough as shown in Fig. 1.

Secured on the projecting right-hand end of the shaft 25 is the power delivery shaft 121, the same being secured thereto by the pins 122, or otherwise as desired.

The shaft 121 is frictionlessly supported in the ball, or roller, bearing 123, the latter being supported by the base 24.

Also a similar ball, or roller, bearing 124 is provided which frictionlessly supports the left-hand portion of the shaft 25, and it is also supported by the base 24.

Also a double set of ball, or roller, bearings 125 and 126 are disposed around the stationary shaft 37 and they are carried thereby and which frictionlessly supports the body 22 of the compressor, as indicated.

In view of the fact that all of said ball-bearings are of ordinary construction, and that other types of bearings may be substituted, and that their specific construction forms no part of this invention, therefore a detail description thereof will not be made. Means may be secured on the outer end of the shaft 121, as the coupling member 129, by which the motor may be connected to the element to be driven thereby in any manner desired.

Fuel circuit.—The liquid fuel may lead from a tank, not shown, through the pipe 115 into the pump, where it is placed under pressure as previously stated. The fuel leaves the pump through the pipe 73 which leads around the turbine and the compressor and finally enters the regulator, passing therethrough as previously described, entering the tube 61 which leads it to the flange portion of the stationary valve member, through the passage *k* and then into the channel 350. Leaving said channel the fuel passes through the passage 354, indicated in Fig. 7, then to the right through the passage 356 and into the passage 355, as indicated in Fig. 1. The latter leads the fuel into the channel 357 which is formed around on the periphery of the member 26. All of said parts are stationary, and the fuel is then led to the movable cylinder-casting, passing outward through the angular passage 358, then to the right through the passage 359 into the radial tubes 360, which carries the fuel outward to near the ends of the compression cylinders, passing outward through the ends of said tubes the fuel then moves inward through the cooling space 361 and around the cylinders, and through apertures in the web of the cylinders casting, to the passage 362 which carries the fuel into the channels 402′ and 402″, which are connected by the grooves 402, and from the grooves 402 the fuel is conducted to the combustion chamber as previously described.

It will be realized that by passing the fuel around the compression cylinders, which are inclined to become heated by compressing the air, the fuel thus passing will absorb the excess heat from said cylinders and thereby keep them in proper condition and, owing to the difference in the temperature of the fuel in the tubes 360 and that in the space 361, respectively, the density is greater in the former. Since both are subjected to the same velocity of rotation it is evident that the centrifugal pressure will be greater in the tube 360, thereby aiding the pump to deliver the fuel to the combustion chamber.

Water circuit.—The water may lead from the source of supply, as a tank, not shown, passing through the pipe 111 into the pump, leaving under pressure of the pump through the pipe 112, then through the fitting 307, through the pipe 306 into the head-pipe 302, then through the pipes 303 and 304 into the head-pipe 301, from the latter the water passes through the pipe 72 into the regulator. From the regulator, which the water passes through as previously described, it enters the tube 62 which carries it to the flange 26″ of the valve member, through which it passes radially through the passages *k*′ into the channel 352, passing thereabout it will leave said channel through the passage 450 and will enter the passage 451, which is located in line with the conduit 300. A taper nozzle 452 connects with the right-hand end of the passage 451, and

said nozzle is inserted into the flaring left-end of the conduit 300 through which the water is carried to the elements which conduct it into the combustion chamber as previously described.

By the above it is apparent that the water is heated in transit by means of the heater in the turbine case, whereby it will be injected into the combustion chamber at the desired degree of temperature to be easily converted into steam, thereby aiding in the combustion of the fuel, preventing the turbine from becoming foul, and preserving the interior of the turbine from overheating. The water which enters the turbine, with the air, as vapor, together with the water resulting from the combustion of hydrogen in the fuel, and the condensation from the exhaust chamber, will keep the water supply almost constant with very little addition thereto. Located in the lowest portion of the exhaust chamber Y, leading through the wall 211, is the drain pipe 315 which is controlled by the drain-cock 316 whereby, if required, the condensation may be drained from the exhaust chamber.

Attached to the fitting 307 is the drain-cock 317 by which the water may be drained from the entire water system when desired.

Oil circuit.—The oil is led from a source of supply through the pipe 109 to the pump, where it is placed under pressure, as stated, and it then leaves the pump through the pipe 110 to the fitting 308. From the latter the oil may pass through the pipe 83, and then through the body of the regulator, which however does not act thereon, and it then passes centerward through the tube 63, by which it is conducted to the passages leading to the various elements to be oiled under pressure.

From the pipe 63 the oil may flow to the flange 26″ of the valve member, through which it flows radially through the passages *k*″ into the channel 351, passing around in said channel and leaving it through the passage 500, from which it moves to the right and outward through the L-shaped passage 501 into the channel 502 which is formed in the periphery of the member 26, from which latter the oil works around the surfaces of the stationary valve member thereby lubricating the parts adjacent thereto as required.

Also extending outward from the tube 63, through the wall of the member 26′, and the shaft 37, is the passage *x*′ which opens into the groove *z*′ which is formed in the periphery of the hollow shaft 37 and extending longitudinally thereof. From the channel *z*′ the oil moves outward through the channels *u*′ in the spacer-ring 504 into the space *v*′. From the space *v*′ the oil is conducted to the right and the left into the ball-bearings 125 and 126 which extend entirely around the shaft 37. Also extending outward and to the right from the space *v*′ are passages 505 and 505′, each corresponding in number to the number of cylinders in the compressor, the route of two of said passages being shown in Fig. 1, and as all of said routes are similar to each other therefore a description of one of each will answer for all. Continuing as above mentioned, the oil from passage 505′ will be led to the hollow pivot 40, passing then to the hollow pivot 34, thereby oiling both ends of the link bearings 39. The oil will pass through the passage 505 which will lead it to the hollow pivot 17, both ends of said pivot being sealed, and from said pivot the oil will pass inward through the hollow connecting rod 12 into the hollow wrist-pin 12′, both ends of the latter being open, therefore the oil will escape to the cylinder wall. The oil moving as just stated will result in lubricating both of the connecting-rod bearings.

In like manner all of the links, connecting-rod bearings, and the wrist-pins of the compressor are automatically supplied with forced lubrication.

Extending from the fitting 308 is the pipe 51 which leads oil into the regulator, which it automatically controls as previously described, and it passes out from the regulator through the pipe 52 which returns it to the right into the pipe 109, as indicated.

Numeral 309 denotes a fitting interposed in the pipe 110 and a branch 310 leads therefrom to the pet-cock 311 which connects with the fitting 312. A pipe 313 leads from the fitting 312 into the main right-hand bearing 123, as shown in Fig. 1. Also a pipe 314 leads from the fitting 312 to the central bearing 124, as shown.

Leading from the lowest point in the air compressor case is the pipe 318 by which oil which may accumulate in said said case may be returned to the reservoir from which it was drawn.

Air circuit.—The air enters through the inlet 84, passes through the tube 60 into the stationary valve, from which it is drawn into each compression cylinder on each outward stroke of the pistons, passing into the cylinders in succession through the port A, and through the successive ports in the center of the cylinder-heads. After being compressed in the cylinders the air passes out through the successive ports in the cylinder heads through the port B of said valve into the conduit 117, around the conduit 300, passing through apertures in the spacers 408 and 407, and finally being deflected outward by the pointed spacer 406 and passing outward through the passages 401 into the combustion chamber, as previously described, and finally forming a part of the fuel mix-

ture which is consumed in the combustion chamber.

Modus operandi.—The construction and the relative arrangement of the several elements, and the details thereof, having been fully described, the assembled operation thereof will be substantially as follows: The parts being inert it is therefore necessary to inject high-test priming fluid, such as gasolene, into the combustion chamber in order to start the turbine. Therefore I inject priming fluid into the one of the apertures, *p* or *q*, passing it around one of the balls, 278 or 279, and entering it into the interior of the tube 277, from the latter the fluid, or the vapor thereof, will pass out through the aperture *t*, then through the pipe 283, through the aperture *u*, passing the cap 286, and then passing into the space *j*, then through the pipe 409, through the jets 413 and 414 into the chamber X. Then by passing an electric current through one, or both, of the spark-plugs 221, or 222, the vapor will be fired, the pressure from the combustion will pass through the nozzles *e* and *f* and will press against the movable blades causing the movable parts to turn or revolve. The priming fluid should be injected by means of a hand pump, or otherwise, in order to give it sufficient pressure to force it into the combustion chamber, this of course will move the cap 286 to the left, thereby closing the end of the conduit 300 and thereby shutting off the possible inflow of water, which may enter therethrough when the turbine is in full operation. This not only provides means for the injection of priming fluid but it shuts off the water until it is required, which should be the last element to enter the combustion chamber.

As soon as the movable parts turn a short distance, by the pressure given by the priming fluid, it is evident that the pump will then be in operation forcing the fuel into the combustion chamber through the regular channels as described, and at the same time the compressor will commence to deliver compressed air over the route described. Then as the turbine revolves it is evident that the pump will impart pressure to the fuel, water, and oil in the usual manner. The oil and the fuel will thereby be conducted through the regulator as set forth. By the manual operation of the levers 68 and 69 the admission of fuel and water may be placed at the points to give the proper adjustment to attain the speed desired, and then when said levers are released it is evident that the oil pressure will automatically maintain the turbine at the speed to which it has been set by the operator regardless of the load to which the motor is subjected.

It is also evident that the pressure of the oil will automatically lubricate all of the various movable parts which require lubrication, as the motor has provision for forced lubrication throughout.

Attention is called to the fact that the pressure on the bearings of the connecting rods of the compressor is always outward, therefore there will be no lost motion or rattle. The centrifugal force is greatest when the compressor pistons are farthest from the center, and the air pressure is greatest when the pistons are nearest the center, therefore since the bearing pressure is the sum of the two, it is evident that the bearing pressure is nearly constant. The above, together with the fact that all motion is rotary instead of reciprocal, eliminates all vibration. Also since the combustion is continuous, and by reason of the fact that all of the power is extracted from the fuel by the time the residue enters the exhaust chamber, it is evident that there will be no appreciable noise issuing from the exhaust.

It should be understood that the combustion of the fuel, the formation of steam, and the action of the resulting mixture in passing through the turbine are, substantially, as follows: As previously stated, the liquid fuel (preheated by having been passed around the compression cylinders), and the air (preheated by compression), each enters the combustion chamber through openings adjacent to each other and revolving in the same plane. The fuel is, therefore, readily vaporized and mixed with the hot air, thereby making combustion nearly instantaneous and complete.

By reason of the continuous combustion the walls of the combustion chamber must be protected from the excessive heat which is generated. This is accomplished, as previously described, by two curtains of water, one on each side of the fuel and air inlets. The water, however, does not merely absorb the excess heat and carry it to the radiator or cooler, from which it is lost, as in other motors, but by being formed into superheated steam it conserves the heat to be utilized in the turbine.

The mixture of the steam and the products of combustion in the combustion-chamber are at high pressure and temperature, therefore by means of the adiabatic expansion of the mixture, through the nozzles and the blades, the potential energy of the mixture is changed to kinetic energy, which is utilized, the gases leaving the exhaust-chamber at low pressure and comparatively low temperature. The action of the gases upon the blades is identical with that of other so-called "reaction turbines." The moving parts rotate in a counter-clockwise direction, as is indicated in Fig. 2.

In following the actions it will be seen that a stream of gases leaving the nozzle *f*, for instance, impinges on a stationary blade 236, the direction being changed by said

blade. The stream in its new direction impinges on a movable blade 229, the direction of the stream again being changed so as to impinge the stationary blade 242. The stream passes in like manner from the blade 242 to the blade 233, and from the latter to the exhaust chamber. Since every force has its equal and opposite reaction, therefore each portion of the stream in passing from one blade to the next will exert a force on both, tending thereby to push them apart, but since the alternate blades 236 and 242 are rigidly connected to the stationary case, and the other blades and the nozzles are rigidly, but indirectly, connected to the shaft 25, therefore the latter will be rotated by the power developed in the turbine. The advantages of the arrangement of the blades as described are, conservation of space, elimination of end thrust on the bearings and the attainment of radial flow of the gases. The advantages of the radial flow of the gases are two-fold: The centrifugal force of the gases being in the direction of the flow is added to the force due to the pressure of the gases, thereby increasing the velocity of flow; and the density of the gases at any point will be equal the full length of the blades, instead of being greater near the outer ends of the blades, as in the case when the flow is in an axial direction.

In this description the driving element, or propeller, denotes the turbine proper; the fluid pressure element denotes the pump; the air pressure element denotes the compressor; the regulator denotes the means for controlling the speed of the motor automatically and manually; the valve designates the stationary valve member which is denoted by the indices 26, 26′, and 26″; the lubricator denotes the means for lubricating the various bearings throughout the construction; and the main, or driving shaft, denotes the shaft 25.

It is to be understood that various changes may be made in the several details of construction, within the limits of the appended claims, from that herein shown and described, without departing from the spirit of the invention and without sacrificing any of the advantages thereof which are new and useful.

Having now fully shown and described my invention in detail, what I claim and desire to secure by Letters Patent of the United States, is—

1. An internal combustion motor comprising a turbine, an air compressor, a triple pump adapted to deliver fuel, water, and oil under pressure, and a regulator adapted to control the supply of air, fuel, and water, a main shaft and a stationary shaft, a stationary valve member located between the ends of the stationary shaft and the main shaft and adapted to conduct free air into the compressor and to conduct the compressed air from the compressor and deliver it through the main shaft to the turbine to be utilized in connection with the fuel.

2. An internal combustion motor comprising a turbine adapted to be operated by continuous combustion, an air compressor, a pump adapted to deliver fuel, water, and oil under pressure, a regulator adapted to control the supply of air, fuel, and water, a main shaft which is adapted to rotate, a stationary shaft, a stationary valve member located between the ends of the stationary shaft and the main shaft and adapted to conduct outside air into the compressor and to conduct compressed air from the compressor and deliver it through the main shaft to the turbine, means for delivering fuel into the turbine, and means whereby the turbine may be primed for starting purposes, all substantially as described.

3. An internal combustion motor comprising a turbine adapted to be operated by continuous combustion, an air compressor for compressing air and forcing it into the turbine, a pump adapted to deliver fuel, water and oil under pressure, a regulator adapted to control the supply of air, fuel, and water which is admitted to the turbine, a main shaft which is adapted to rotate, a stationary shaft, a valve member located between the ends of the stationary shaft and the main shaft and adapted to conduct air from the regulator into the compressor and to conduct the compressed air from the regulator into the hollow main shaft by which it is conducted to the turbine, means for delivering fuel and water into the turbine, means whereby the turbine may be primed for starting purposes, and means for producing electric sparks for firing the priming charge, all substantially as shown and described.

4. An internal combustion motor comprising a turbine having a single firing chamber in the center thereof and adapted to be operated by continuous combustion in the combustion chamber, an air compressor adapted to provide compressed air for the combustion chamber, a pump adapted to deliver fuel and water into the combustion chamber and to deliver oil for lubrication at various points, a regulator adapted to control the supply of air, fuel and water, a main rotatable shaft having a passage-way longitudinally through the center thereof through which passes the supply of air, fuel, and water, as it is delivered to the turbine, and means for forming electric sparks in the firing chamber of the turbine.

5. An internal combustion turbine comprising in combination, a hollow main shaft, a stationary shaft located off center with relation to the main shaft but located parallel therewith, a stationary valve member located between the stationary shaft and the

main shaft and having communication with each, an air compressor surrounding said valve and adapted to deliver compressed air through the main shaft, a turbine surrounding the main shaft and comprising stationary blades alternating with movable blades connected with the main shaft, there being a continuous combustion chamber formed around the main shaft with nozzles leading from the combustion chamber to said blades, means for conducting compressed air to the combustion chamber from said compressor, means for conducting fuel and water into the combustion chamber through said main shaft, means for conducting oil under pressure to the bearings, a single pump operated by the main shaft and adapted to impart pressure to the fuel, water, and oil, and a regulator for the fuel, water, and air, the same being controlled automatically by the oil pressure from the pump, all substantially as shown and described.

6. An internal combustion turbine including a compressor, a turbine adapted to operate in one direction continuously, a main shaft, a stationary valve member having ports to lead free air into the compressor and to lead the air from the compressor under pressure to be forced to the turbine, means for conducting fuel and water and delivering each separately to the turbine, an oiling system, a pump to impart pressure to the fuel, water, and oil, a regulator for controlling the fuel, water, and air, automatic means for controlling the regulator, and means for manually adjusting the regulator for a determined speed of the turbine.

7. An internal combustion turbine including a stationary case for the turbine, a plurality of stationary blades secured in the case, a hollow rotatable shaft extending through the case and around which said blades are disposed, a disk extending out into the case and carried by said shaft, a plurality of movable blades carried by said disk and alternating with the stationary blades, a baffle-plate extending around said shaft and spaced therefrom with a combustion chamber formed between the baffle plate and said shaft, there being an exhaust chamber formed between the outer extremities of the blades and the peripheral wall of the case, there also being nozzles leading from the combustion chamber to the space occupied by the blades and then to the exhaust chamber, means for delivering fluids and air into the combustion chamber, and means for firing the fuel in the combustion chamber.

8. An internal combustion turbine including a rotatable main hollow shaft, a hub secured around the shaft, a stationary case surrounding the hub, inturned walls forming a combustion chamber around said hub and located within the case, a baffle plate extending around in said combustion chamber, a radial disk extending out from the center of the baffle plate, there being an exhaust chamber formed in the case outward and laterally from said disk, there being flaring nozzles radiating outward from the combustion chamber and adapted to discharge on each side of the disk, a plurality of laterally disposed blades carried by said disk, and a plurality of laterally disposed blades extending toward said disk from the interior of the case and alternating with the blades carried by the disk, means for delivering air and fluids into the combustion chamber, means for forcing the fuel into the combustion chamber, and means for controlling the speed of the turbine by reason of the volume of fuel delivered into the combustion chamber.

9. An interval combustion turbine comprising a fixed inclosing case, a hollow rotary shaft extending through said case, a hub secured around the shaft, series of movable blades carried by the hub, series of stationary blades carried by the case and alternating with the movable blades, there being a combustion chamber formed centrally and concentric of the said blades, means for conducting fuel to said chamber, means for providing continuous combustion in said chamber, there being nozzles for delivering the power of said combustion to the blades, a pump and a compressor operated by said shaft, and a regulator for controlling the flow of fuel to the turbine automatically, and means for adjusting said regulator by hand, all substantially as shown and described.

10. In an internal combustion turbine comprising a stationary turbine casing, a hollow shaft extending through and concentric of the casing, a hub secured to the shaft with its ends slidably communicating with the casing, interior walls forming a combustion chamber around said hub and rotatable therewith, a baffle-plate extending around in said chamber and rotatable therewith, a series of nozzle members connecting the ends of the interior walls, a disk connected with the nozzle members and extending outward at right angles to said shaft, a plurality of blades connected to said disk, a plurality of blades connected to the walls of the case and alternating with the blades carried by the disk, the nozzles formed in the nozzle members being adapted to conduct pressure onto said blades from the combustion chamber in order to revolve said disk and to rotate the shaft connected thereto.

11. In an internal combustion turbine, a pump operated by the turbine and adapted to impart pressure to oil, water, and fuel, the speed of the motor depending on said pressure, a regulator to receive the oil, water, and fuel under pressure imparted thereto by the pump and to permit them to continue

therefrom to the turbine, automatic means for controlling the regulator to maintain the pressure to the degree to which it has been adjusted by the operator, a hollow shaft concentric with the pump, the regulator and the turbine, there being a combustion chamber in the turbine which is formed around and concentric with said hollow shaft, means for admitting water and fuel through the hollow shaft into the combustion chamber, means whereby the combustion chamber may be primed independently of the means by which the fuel is conducted, and means for forming electric sparks in the combustion chamber to fire the priming charge, the combustion being self maintained after firing the initial priming charge, all substantially as shown and described.

12. In an internal combustion turbine comprising a pump operated by the turbine and adapted to impart pressure to oil, water, and fuel, the speed of the turbine depending on said pressure, a regulator connected to receive the oil, water and fuel under pressure from the pump and allow them to continue therefrom to the points to be utilized, automatic means for controlling the regulator to cause it to sustain the pressure to a predetermined degree to which it has been set by the operator, and an air compressor operated by the turbine for delivering a constant stream of compressed air to the turbine, and means carried by the regulator for controlling the delivery of air to the compressor.

13. In an internal combustion motor, comprising a pump adapted to impart pressure to oil delivered to the bearings and to a regulator, and to impart pressure to water and fuel delivered to the turbine, the degree of pressure depending on the speed of the turbine and the speed of the turbine depending upon the said pressure, means for automatically maintaining said pressure constant, means for supplying compressed air to the turbine, means for combining the products of the compressed air, the water, and the fuel in a combustion chamber located in the turbine, means for firing the fuel to transmit power to the turbine, and means for cooling the combustion chamber and for utilizing the heat thereof.

14. In an internal combustion motor, comprising a turbine having fixed-blades and movable blades, there being a combustion chamber concentric of the blades, a hollow shaft rotatable with the movable blades, means for conducting water, fuel, and air into the combustion chamber through conduits therefor in the hollow shaft, means operated by the hollow shaft for compressing the air before its admission into the combustion chamber, means operated by the hollow shaft for imparting pressure to water and fuel before their admission into the combustion chamber, automatic means for maintaining the pressure of the water and fuel constant, and hand operated means for changing said pressure.

15. In an internal combustion motor comprising in combination a main hollow shaft, a turbine surrounding said shaft and including a stationary casing having a single combustion chamber therein concentric with said shaft, stationary blades carried by the casing, movable blades connected to the shaft indirectly and adapted to be driven around the combustion chamber by continuous combustion in the combustion chamber, means for conducting fuel into the combustion chamber to form continuous combustion in said chamber, means for conducting water into the combustion chamber to be transformed into steam by the combustion of the fuel, means for compressing air and injecting it into the combustion chamber, means for maintaining constant the pressure of the fuel and means for priming and for firing the priming charge for starting the operation of the motor.

16. An internal combustion motor, comprising a base, a casing secured to the base, a hollow shaft extending through said casing and supported by said shaft, a hub secured around the shaft and located in said casing, a pair of outward and centerward extending walls slidably connected with the casing and rigidly secured to said hub for forming a combustion chamber around the hub, a baffle plate extending entirely around in said chamber but spaced from said walls and from the hub, laterally extending blades extending toward each other from the stationary walls of the case, a disk rotative with said hub and located between the free ends of said blades, laterally extending blades secured to said disk and alternating with the first mentioned blades, there being outwardly flaring nozzles connecting the combustion chamber with the space in which the said blades are located, there also being an exhaust chamber formed around said blades with exhausts leading out from the exhaust chamber, all substantially as shown and described.

17. In an internal combustion motor, the combination with a turbine, an air compressor, a regulator for air and liquids, tubes for conducting air and fluids from the regulator; a single stationary valve member comprising a main body portion having an air inlet and an air outlet which are not connected with each other but which are adapted to open alternately into the cylinders of the air compressor as the cylinders revolve therearound, a central portion of said valve which is in the nature of a projecting flange having channels independent of and parallel with each other in and extending around in the periphery thereof, a ring tightly sur-

rounding the periphery of said flange and inclosing said channels, there being radial passages independent of each other for connecting said channels to the respective tubes above mentioned.

18. In an internal combustion turbine motor having a stationary hollow shaft and a rotatable hollow shaft, a regulator controlled by oil pressure developed by the power of the turbine with which it is employed, said regulator being attached to one end of said stationary shaft, and comprising a main body portion, a secondary body portion attached to the main body portion, a main cylinder contained in the secondary body portion, a secondary cylinder contained in the secondary body portion, a piston operative in each of said cylinders, a spring for each piston, there being passageways to and from said cylinders to admit and discharge fluid under pressure, a lever operative by one of said pistons, rotary valves carried by the main body portion of the regulator, said lever being connected to said rotary valves for controlling the flow of fuel, water and oil, a shutter operative by said lever for controlling the admission of air to said hollow shaft, and a second set of rotary valves adapted to be operated manually for controlling the admission of fuel, water and oil, substantially as set forth.

19. In an internal combustion turbine motor including a propeller having a continuous combustion chamber, means for supplying fuel to the combustion chamber, means for supplying water to the combustion chamber, means for supplying air to the combustion chamber, means for providing forced feed for the fuel, water, air, and oil, means for recovering excess heat from the exhaust chamber and applying it to the water prior to its delivery into the comb tion chamber, and means for recovering excess heat developed in placing the air under pressure and applying it to the fuel prior to its delivery into the combustion chamber.

20. An internal combustion turbine motor comprising the turbine element having stationary blades and movable blades, a case containing said blades and having a single combustion chamber in the center thereof and a single exhaust chamber in the peripheral portion thereof, said blades being located between said chambers and the space occupied by said blades being formed to increase in dimensions from the combustion chamber to the exhaust chamber with the length of said blades formed to correspond therewith, and a water heater located entirely around within the exhaust chamber.

21. An internal combustion turbine motor comprising the turbine proper including a case, fixed blades secured in the case, there being a combustion chamber in the center of the case and an exhaust chamber in the outer portion of the case concentric with the combustion chamber with said blades located therebetween, a circular baffle plate extending around in and concentric of the combustion chamber, a disk extending out from around the baffle plate and projecting to the exhaust chamber, blades carried by said disk and extending laterally therefrom to positions between the fixed blades, nozzle members also arranged adjacent to the combustion chamber and closing the entrance from the combustion chamber to said blades and having nozzle apertures therethrough to conduct compression from the combustion chamber to said blades, said blades being constructed to fit an outwardly flaring passage leading from the combustion chamber to the exhaust chamber, a hollow shaft adapted to be driven by the turbine and extending through the turbine concentric of the combustion chamber, and means for conducting fuel, water, and air through said shaft and for delivering them separately into the combustion chamber.

22. An internal combustion turbine comprising the turbine proper which includes a case, a hollow shaft extending centrally through the case, the outer portion of the case being stationary and the inner portion of the case being rotatable with said shaft, there being a single combustion chamber concentric with the shaft and a single exhaust chamber concentric with the combustion chamber but spaced outward therefrom, a baffle plate extending around in the combustion chamber, a disk extending out at right angles from the baffle plate to the exhaust chamber, means for connecting said disk and baffle plate to the said shaft, laterally extending blades secured to said disk, laterally extending blades carried by the stationary portion of the case and adapted to coact with the movable blades carried by the disk, means for injecting liquid fuel, air and water into the center of the combustion chamber, and means for heating the water and the fuel prior to their injection into the combustion chamber, all substantially as shown and described.

23. A rotary motor comprising a turbine element including fixed blades and movable blades, a case containing all of said blades, a shaft to which the movable blades are indirectly connected, there being a single combustion chamber located around the shaft and a single exhaust chamber spaced outward from the combustion chamber, a pump mounted around said shaft and adapted to be driven thereby, said pump being adapted to receive oil, water, and fuel and to simultaneously impart pressure thereto, a regulator controlled by the pressure imparted to the oil by the pump and adapted to control the speed of the motor by the action thereof upon the supply of fuel, water, and

air which is delivered to the combustion chamber, and an air compressor operated by said shaft for compressing the air prior to its delivery into the combustion chamber.

24. A motor of the nature set forth, comprising a turbine including a case the outer portion of which is stationary and the central portion being adapted to revolve, a shaft extending through and connected with the central portion of the case, there being a combustion chamber formed around the shaft in the central portion of the case and an exhaust chamber concentric with the combustion chamber and spaced outward therefrom, there being an outwardly flaring passage connecting the combustion chamber and the exhaust chamber and extending entirely around concentric with the shaft, a baffle plate extending around in the combustion chamber, a disk connected to said plate and extending out through the center of said flaring passage to the exhaust chamber, laterally extending blades carried by said disk, laterally extending blades directed toward said disk from the walls of the case, the said blades being arranged alternately with relation to each other, means for conducting fuel, air, and water into the combustion chamber each through a separate nozzle therefor, and with reference to the direction of rotation the fuel being delivered in advance of the air, and the water being delivered on each side of the fuel and air and slightly in the rear thereof to form curtains of water or steam protecting the walls of the combustion chamber.

25. A turbine motor comprising a unitary structure whose parts are interdependent, comprising a turbine including a stationary containing case, a hollow rotatable shaft extending through the case, a baffle plate located in the case and surrounding said shaft and spaced therefrom forming a single combustion chamber between the said shaft and the baffle plate, a disk adapted to rotate in the case, the same being connected to said baffle plate, blades extending laterally from each side of said disk, blades extending laterally from each side of the case and projecting inward toward each other and alternating with the blades carried by the disk, there being an exhaust chamber located around in the outer portion of the case concentric with the combustion chamber, a water heater located around in the exhaust chamber and through which a circulation of water may be maintained, means for admitting air, fuel, and water through the hollow shaft radially into the combustion chamber, a spark plug secured in the wall of the combustion chamber, means for conducting electric current through said spark plug, and priming means for injecting priming fluid into the combustion chamber independently of the means for the admission of fuel, means whereby the act of injecting priming fluid will automatically shut off the admission of fuel and water as first mentioned, and means for maintaining a determined pressure upon the fuel, water, and air when the motor is in operation.

In testimony whereof I have hereunto subscribed my name to this specification in the presence of two subscribing witnesses.

RUSSELL J. PARRISH.

Witnesses:

WILLIAM N. PARRISH,

ROBERT W. RANDLE.