(No Model.) 2 Sheets—Sheet 1.

F. C. ROMKEY.

METHOD OF AND APPARATUS FOR GENERATING MOTIVE POWER.

No. 467,834. Patented Jan. 26, 1892.

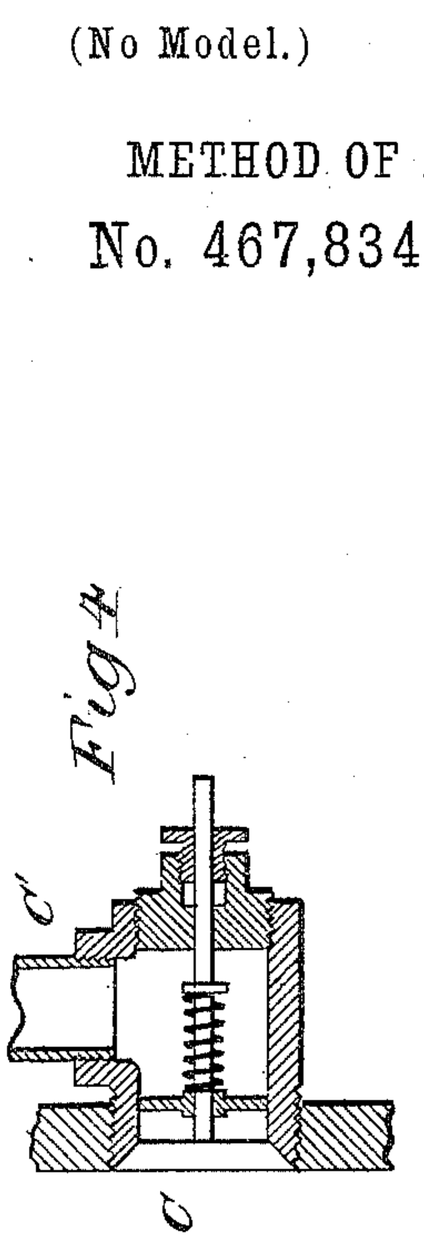

Fig 4.

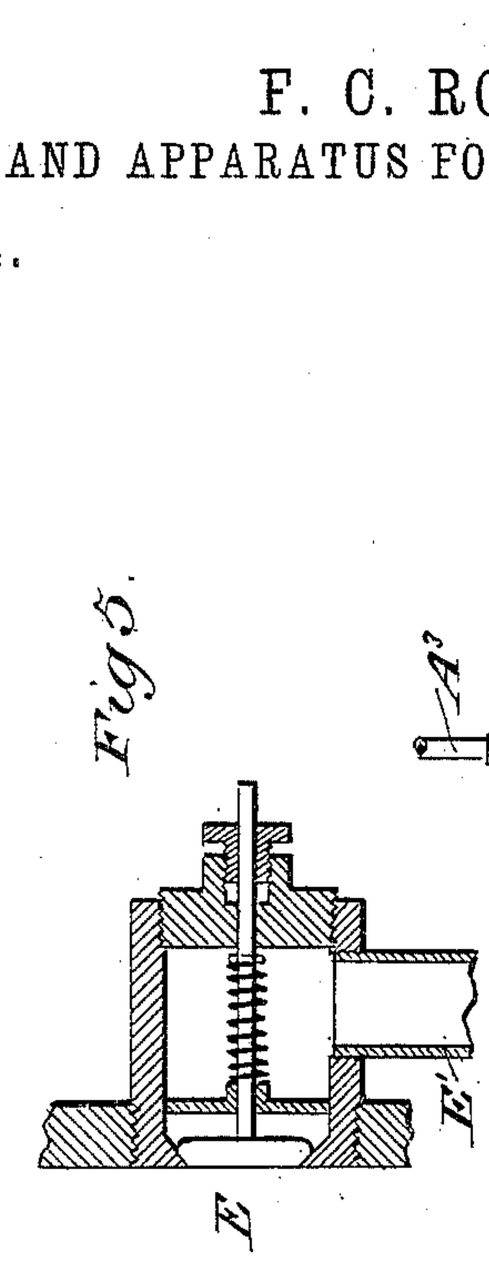

Fig 5.

Fig 1.

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Fig 10.

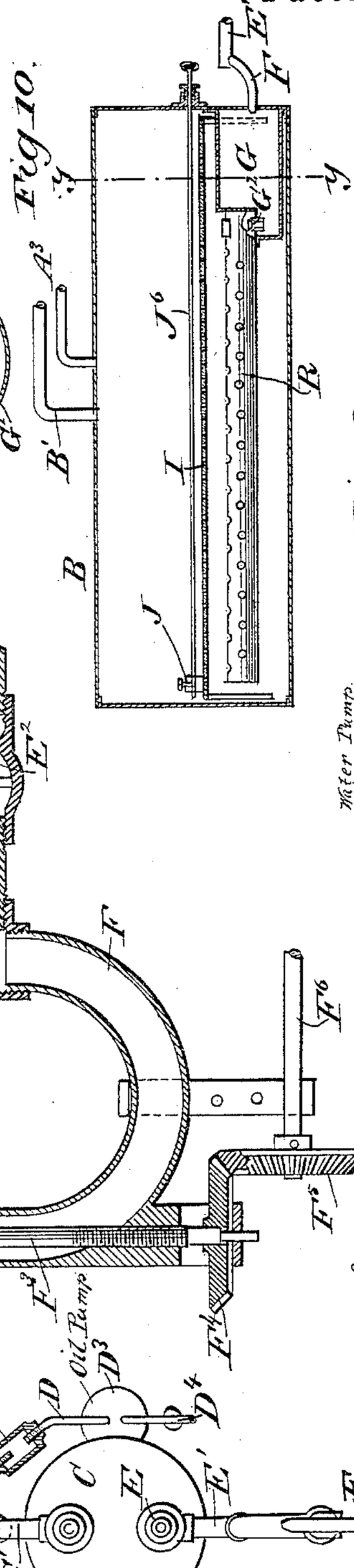


Fig 9.

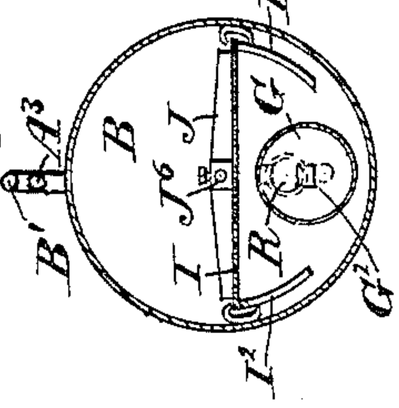


Fig 2. A

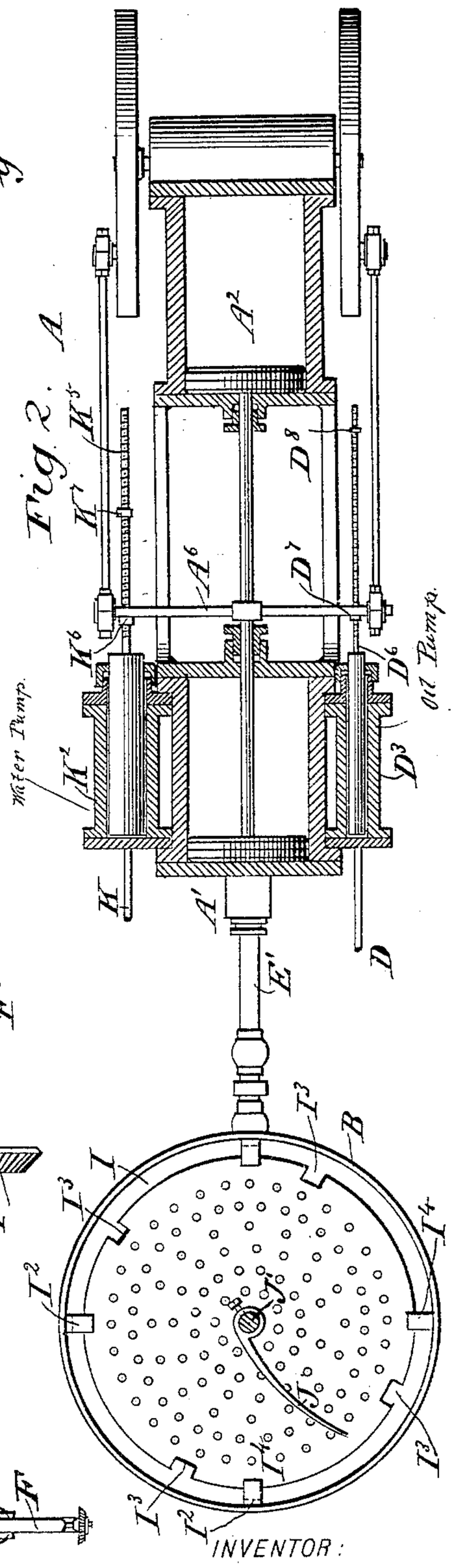


Fig 8.

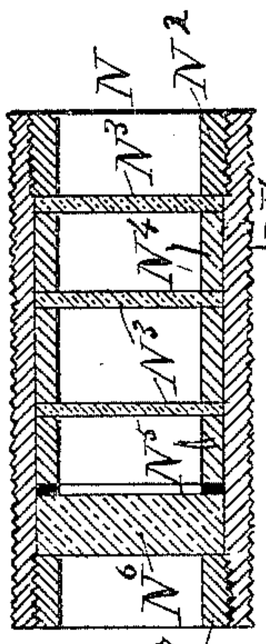


Fig 4.

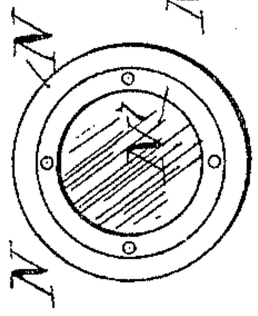
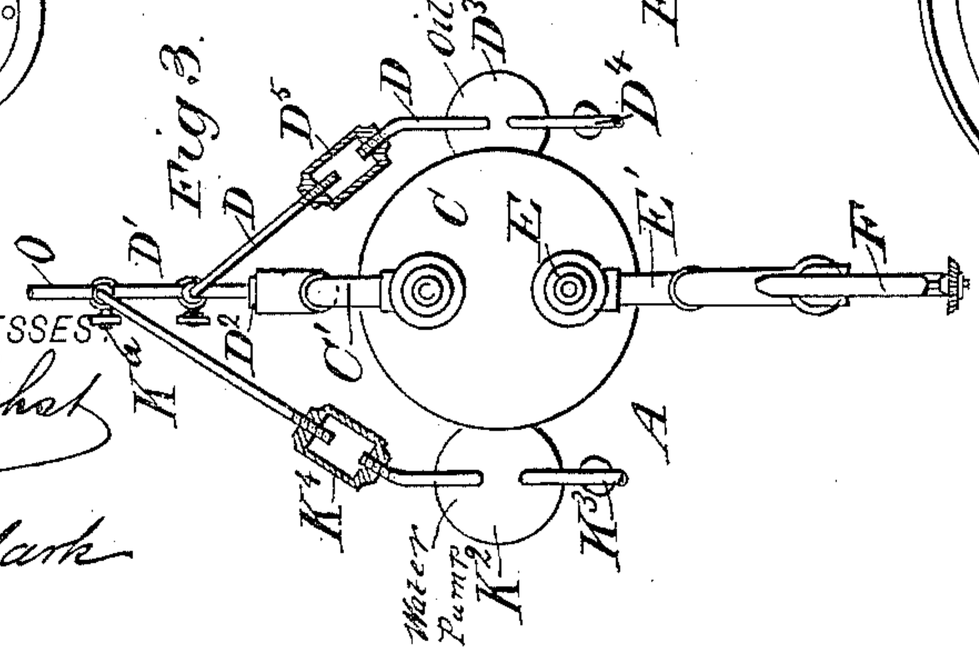


Fig 6.

Fig 3.



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UNITED STATES PATENT OFFICE.

FRANK C. ROMKEY, OF TOLEDO, OHIO.

METHOD OF AND APPARATUS FOR GENERATING MOTIVE POWER.

SPECIFICATION forming part of Letters Patent No. 467,834, dated January 26, 1892.

Application filed March 27, 1891. Serial No. 386,656. (No model.)

To all whom it may concern:

Be it known that I, FRANK C. ROMKEY, of Toledo, in the county of Lucas and State of Ohio, have invented a new and Improved Method and Apparatus for Generating Motive Power, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved method and apparatus for economically generating motive power from oil, gas, and water for driving engines or other motors, and also for other purposes.

The method consists in compressing and mixing air with a liquid fuel—such as oil—in an air-compressor, then forcing this mixture under pressure into a burner in which it is burned, then passing the products of combustion into water to generate steam, and to mix the latter with the products of combustion.

The apparatus consists, principally, of a boiler connected with a water-supply and a burner, and a compressor for forcing a mixture of air and oil or gas into the said burner to be burned, the products of combustion passing into the said boiler.

The invention also consists of certain parts and details and combinations of the same, as will be hereinafter fully described, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional side elevation of the improvement. Fig. 2 is a sectional plan view of the same on the line $x\,x$ of Fig. 1. Fig. 3 is an end elevation of the compressor with parts in section. Fig. 4 is an enlarged sectional side elevation of the inlet-valve for the compressor. Fig. 5 is an enlarged sectional side elevation of the outlet or discharge valve of the compressor. Fig. 6 is an enlarged sectional side elevation of the burner. Fig. 7 is an end elevation of the peep-hole of the furnace. Fig. 8 is a sectional side elevation of the same. Fig. 9 is a transverse section of the horizontal boiler on the line $y\,y$ of Fig. 10, and Fig. 10 is a longitudinal section of the horizontal boiler.

The improved apparatus for generating motive power is provided with an air-compressor A, having a compressor proper A′, actuated from the engine A^2, connected by a pipe A^3 with the boiler B, so that the motive power generated in the said boiler B is utilized for driving the engine A^2 of the said compressor. The upper end of the boiler is provided with the usual outlet-pipe B′ for conducting the generated motive power to the engine or other motor to be driven, or to conduct the motive power to other apparatus on which it may be used.

The compressor A′ proper is provided at each end with an inlet-valve C, held in the inlet-pipe C′, opening into the outer air by a branch pipe C^2, and into this branch pipe opens the oil-feed pipe D, provided with a valve D′ and supporting an adjustable collar D^2, arranged near the branch pipe C^2, so as to regulate the amount of air passing into the said branch pipe and inlet-pipe C′. The oil-feed pipe D connects with an oil-pump D^3, arranged at one side of the compressor A′, as is plainly shown in Fig. 2, the said oil-pump being connected by a suction-pipe D^4 with a suitable source of oil-supply. In the oil-feed pipe D is arranged an air-chamber D^5, as is plainly shown in Fig. 3, and serving to insure a regular feed in the pipe D. In the compressor A′ proper are also arranged the discharge-valves E, connected with a discharge-pipe E′, containing a check-valve E^2, (see Fig. 6,) and connected with the bent pipe F of the burner proper, the said bent pipe being formed with a contracted conical end F′, opening into the mouth-piece G′ of the furnace G, which latter is formed by a closed vessel arranged in or near the boiler B and containing in its upper end a valve G^2, opening into the said boiler.

The amount of the mixture of oil and air passing through the contracted end F′ of the burner is regulated by a valve F^2, conically shaped, as shown in Fig. 6, and formed on a valve-stem F^3, screwing in an offset in the bent pipe F. On the outer end of this valve-stem F^3 is held a bevel gear-wheel F^4, in mesh with a bevel gear-wheel F^5, secured on a shaft F^6, mounted to turn in suitable bearings secured on the pipes F and E′. (See Fig. 1.)

On the shaft F^6 is arranged a crank-disk F^7, connected by a pitman F^8 with the free end of the lever H′ of a diaphragm H, connected with the upper end of the boiler B. The said

lever H′ is also connected by a link H^2 with a crank-arm A^5, held on the stem of a valve A^4, located in the supply-pipe A^3 for the air-compressor engine A^2. The diaphragm H is actuated in the usual manner from the pressure within the boiler B to open or close the feed-valve A^4 to regulate the speed of the air-compressor. The said diaphragm H, by its connection with the shaft F^6, turns the latter so that a rotary motion is imparted to the valve-stem F^3, which thus screws in or out of the bent pipe F, so that the valve F^2 regulates the supply of the mixture of oil and air to the conical end F′ of the burner.

In the boiler B, directly above the furnace G, is arranged a distributing-disk I, formed with perforations and with downwardly-extending legs I′, supported on lugs I^2, secured on the inside of the boiler-shell. Lugs I^4 are adapted to engage the top of the distributing-disk I, so as to prevent displacement of the latter within the boiler.

In order to conveniently insert the distributing-disk I between the lugs I^2 and I^4, the said disk is formed with notches I^3 in its periphery, through which the lugs I^2 can pass in inserting the disk in its proper place, after which the disk is turned, as shown in Fig. 2, until the notches are out of register with said lugs and the legs I′ rest on the lugs I^2, as shown.

On the top of the disk I is arranged an agitator or scraper J, preferably curved, as indicated in Fig. 2, and held on a vertically-arranged shaft J′, having its lower bearing in the disk I and its upper bearing in a stuffing-box arranged in the top of the boiler B. The lower end of the shaft J′ limits the upward or opening movement of the valve G^2. The outer end of the shaft J′ is provided with a bevel gear-wheel J^2, in mesh with a bevel gear-wheel J^3, secured on a shaft J^4, mounted to turn in suitable bearings on the top of the boiler B, and provided with a hand-wheel J^5 for conveniently turning the said shaft J^4 so as to impart a rotary motion to the shaft J′ to move the agitator J over the distributing-disk I to remove any sediment or other impurities which may have settled on the said distributing-disk.

In one side of the boiler-shell of the boiler is arranged a hand-hole B^2 of any approved construction, serving to enable the operator to get at the disk I and the valve G^2 whenever necessary.

The boiler B is provided with a water-feed pipe K, containing a valve K′ and leading to a pump K^2, arranged on the compressor A′ opposite the oil-pump D^3. (See Fig. 2.) The pump K^2 is connected by a suction-pipe K^3 with a suitable source of water-supply. In the water-feed pipe K is arranged an air-chamber K^4, similar to the air-chamber D^5 in the oil-pipe D and serving the same purpose—that is, to insure a continuous flow of the water to the boiler B. The piston-rod K^5 of the pump K^2 is formed with a screw-thread, on which screw the nuts K^6 and K^7, adapted to be alternately engaged by the cross-head A^6 of the air-compressor A. The said cross-head A^6 is also adapted to engage alternately nuts D^7 and D^8, screwing on the threaded end of the piston-rod D^6 of the oil-pump D^3. By adjusting the nuts K^6 K^7 and D^7 D^8, more or less stroke can be given to the water-feed pump K^2 and the oil-pump D^3, respectively.

In order to conveniently ignite the gaseous mixture issuing from the contracted nozzle F′, an igniting-pipe L is provided extending through the shell of the boiler B into the furnace G, as is plainly shown in Fig. 1. The outer end of the pipe L is adapted to be closed by a plug L′, held on the end of a screw-rod L^2, provided with a hand-wheel L^3 for conveniently screwing the said screw-rod L^2 in the U-shaped frame L^4, pivoted on pivots L^5, secured on the outer end of the pipe L. By screwing the screw-rod L^2 outward until the plug L′ disengages the outer end of the pipe L, the frame L^4 is free to swing to one side, turning on the pivots L^5, so that the opening of the pipe L is clear, and a torch or other suitable ignitor may be inserted through the pipe L into the furnace G to ignite the gaseous mixture contained therein. When this has been accomplished, the pipe L is again closed by the plug L′.

In order to enable the operator to conveniently examine the burning of the fuel in the furnace G, a peep-hole N is provided, formed by a pipe N′, screwing in the shell of the boiler B and in the shell of the furnace G. (See Figs. 1, 7, and 8.) In the inner end of the pipe N′ screws a collar N^2, on which rests a transparent or a translucent plate N^3, formed of glass or mica, and on the outer edge of this plate abuts a collar N^4, also held in the pipe N′, and on this collar rests a second plate N^3, similar to the first-named plate N^3, and then another collar N^5 is applied, and so on, a series of transparent or translucent plates N^3 being arranged in the pipe N′. On the collar N^4 of the outermost or last transparent or translucent plate N^3 rests a flexible gasket N^5, on which abuts a thick glass disk N^6, held in place by a threaded collar N^7, screwing in the outer end of the pipe N′. The several disks N^3 in the pipe N′ are sufficiently strong to withstand all the heat from the burner F, at the same time enabling the operator to examine the burning of the fuel in the furnace G.

If it is desired to use gas instead of oil, a gas-supply pipe O is provided having a valve O′ and leading into the pipe D at or near the branch pipe C^2 of the air-compressor A. The valve D′ is then closed and the oil-pump D^3 is stopped, the nuts D^7 and D^8 being removed from the threaded end of the piston D^6 of the said oil-pump. If desired, the gas may also be directly introduced into the burner by a pipe P, leading into the pipe F and connected with a suitable source of gas-supply under pressure. The pipe P is provided with a valve

P′ for regulating the amount of gas permitted to pass under pressure to the burner. The oil may also be directly introduced from the pump D^3 into the burner by a branch pipe Q, leading from the pipe D into the bent pipe F, as is plainly indicated in Fig. 1. To regulate the amount of oil passing from the oil-pump to the burner, a valve Q′ is provided in the said pipe Q. In case a horizontal boiler is employed instead of the vertical boiler shown in Fig. 1, the boiler is made as illustrated in Figs. 9 and 10.

The furnace G is arranged either in or near the boiler B, and its valve G^2 opens into a pipe R, extending longitudinally in the lower part of the said boiler B. The pipe R is provided with perforations, through which the products of combustion pass into the boiler B underneath the perforated plate I, which is arranged longitudinally, as shown in Figs. 9 and 10. The scraper or agitator J is a transverse bar held on a rod J^6, passing through a stuffing-box in one end of the boiler, the outer end of the rod J^6, being formed with a handle to enable the operator to conveniently move the agitator J forward and backward over the perforated distributing-plate I.

The operation is as follows: In starting the generator the valves in the suction-pipes K^3 and D^4 (see Fig. 3) are closed, so that neither water nor oil is pumped into the air-compressor by the pumps K^2 and D^3, respectively. The valve A^7 in the supply-pipe A^3 of the engine of the air-compressor is then opened, so that the motive agent from the boiler B, which contains about, say, fifty pounds pressure, starts the air-compressor, whereby air is compressed and discharged into the boiler B to compensate for the amount of motive agent taken out for running the air-compressor A′. The valve in the suction-pipe D^4 is then opened, so that the oil-pump D^3 pumps oil into the pipe D, from which it passes into the inlet-pipe C′ of the compressor A′, the oil being completely atomized and mixed with the air drawn in through the branch C^2 of the said inlet-pipe C′. By the action of the compressor A′ the oil is completely atomized and evaporated by the heat of compression, so as to thoroughly mix with the air, the mixture being discharged through the valves E into outlet-pipe E′, from which the mixture passes past the check-valve E^2 into the bent pipe F of the branch tube to finally discharge through the nozzle F′ into the furnace G, in which the mixture is ignited by a suitable torch inserted through the open pipe L, as previously described. As soon as the mixture is ignited the pipe L is again closed. The valve A^7 in the inlet-pipe A^3 of the engine of the air-compressor is now fully opened, so that the air-compressor runs at full speed. As soon as the pressure of the products of combustion in the furnace G becomes greater than the pressure in the boiler the valve G^2 will open and allow the hot products of combustion to escape into the boiler directly into the water. In order to prevent the products of combustion from passing straight up into the water to the upper part of the boiler B, the distributing-disk I is provided, which divides the products of combustion so that the latter thoroughly mingle with the water in the boiler. As the distributing plate or disk I does not extend close to the inner surface of the boiler-shell, the water can freely pass down over the edge of the plate, so as to insure complete circulation of the water at the time the products of combustion pass through and mix with the water and thereby carry the water upward at or near the middle of the boiler B. By thus finally dividing the products of combustion by the plate I the water readily absorbs the heat and is thereby quickly turned into steam, the latter mixing with the remaining products of combustion. The motive agent thus generated can be drawn off from the boiler B through the pipe B′. The continuous stream of water is forced into the boiler B through the pipe K, connected with the pump K^2, actuated simultaneously with the compressor A′ and the oil-pump D^3. The correct proportion of the liquid fuel relative to the air pumped by the compressor and necessary for perfect combustion in the furnace G is regulated by the stroke of the oil-pump, which measures out the exact quantity required after each stroke of the air-compressor. As the air-compressor is double-acting and the oil-pump is single-acting, the latter has to pump a quantity sufficient for both strokes of the compressor. In order that each stroke of the compressor shall receive one-half of the oil pumped by each stroke of the pump, the chamber D^5 is provided, as previously described, and illustrated in Fig. 3, the said chamber containing compressed air, which forces the oil in a steady and equal stream into the branch pipe C^2 of the inlet-pipe C′. The stroke of the oil-pump D^3 is regulated by the nuts D^7 and D^8, as previously explained.

If it is desired not to pump the oil to the air-compressor inlet-pipe *c*′, then the valve D′ is closed and the valve Q′ in the branch pipe Q is opened. The oil now flows directly from the oil-pump D^3 through the branch pipe Q into the bent pipe F of the branch to be atomized therein by the compressed air passing through the said pipe. The water-pump K^2 is used for three purposes, the principal one being to supply water to the boiler B, as above described; but it is also used to reduce the heat of compression above that required to evaporate the fuel, and finally the pump serves for reducing the temperature of the furnace either by allowing the pump-water to go through the air-compressor by opening the valve K^9 in the branch pipe K or by throwing a spray of water directly into the furnace.

It is understood that whatever water is evaporated in the furnace need not be evaporated in the boiler, as the amount of water that goes into the boiler or air-compressor is

regulated by the valves K′ and K⁹. It is further understood that the stroke of the pump is regulated by adjusting the nuts K⁶ and K⁷, so as to throw the proper amount relative to the amount of the fuel. If the pressure in the boiler B rises above a normal pressure, then the diaphragm H causes a closing of the valve A⁴ and also a closing of the valve F², regulating the discharge of the gaseous mixture by the nozzle F′. The speed of the air-compressor A′ is thus reduced and a less quantity of gaseous mixture is passed into the furnace G, so that less motive power is generated until the amount of motive power used and drawn off by the pipe E′ has reduced the pressure in the boiler to a normal pressure.

In order to prevent a reaction of the pressure of the burning gases in the furnace G relative to the air-compressor, the check-valve E² is provided, which seats itself in case the pressure in the burner and furnace G is greater than the force of the air-compressor. I do not limit myself to any particular oil, as a fuel such as petroleum, crude oil, kerosene, gasoline, and all similar kinds of inflammable liquids may be used.

In case it is desired to operate the apparatus with gas instead of oil, the oil-pump is disconnected and the valves D′ and Q′ closed and the valve O′ opened, so that the gas passing through the pipe O passes into the air-inlet pipe C′ of the air-compressor to be mixed with the air, the mixture being forced under pressure by the compressor to the burner to be burned in the furnace G in the manner above described.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. The method of generating motive power, consisting in first introducing air and hydrocarbon or liquid fuel into a compressor together, mixing the same therein by compression, then discharging the compressed mixture to a point of combustion and burning the same, and finally discharging the products of combustion into water to generate steam, substantially as set forth.

2. In an apparatus for generating motive power, the combination, with a boiler, of a furnace provided with a valve adapted to open into the said boiler, a hydrocarbon-burner connected with the said furnace, a compressor for forcing a combustible mixture into the said burner and provided with an air-inlet, and an oil-pump operating with the said compressor and serving to discharge the oil into the air-inlet of the said compressor for mixture with the air by compression, substantially as shown and described.

3. In an apparatus for generating motive power, the combination, with a boiler, of a furnace provided with a valve adapted to open into the said boiler, a hydrocarbon-burner connected with the said furnace, a compressor for forcing a combustible mixture into the said burner and provided with an air-inlet, an oil-pump operating with the said compressor and serving to discharge the oil into the air-inlet of the said compressor for mixture with the air by compression, and a pump also operating simultaneously with the said compressor and serving to discharge water into the said boiler, substantially as shown and described.

4. In an apparatus for generating motive power, the combination, with a boiler, of a furnace containing a valve adapted to open into the said boiler, a burner for burning a combustible mixture in the said furnace, a compressor for forcing the said combustible mixture into the said burner to be burned in the said furnace, and a valve in the outlet end of the burner for regulating the amount of combustible mixture burned in the said burner, said valve being controlled by the pressure of the motive agent in the said boiler, substantially as shown and described.

5. In an apparatus for generating motive power, the combination, with a boiler, of a furnace containing a valve adapted to open into the said boiler, a burner for burning a combustible mixture in the said furnace, a compressor for forcing the said combustible mixture into the said burner to be burned in the said furnace, a diaphragm connected with the said boiler, a valve held in the said burner, and a second valve held in the inlet-pipe of the said compressor, the said valves being automatically controlled from the said diaphragm, substantially as shown and described.

6. In an apparatus for generating motive power, the combination, with a boiler, of a furnace containing a valve adapted to open into the said boiler, a burner for burning a combustible mixture in the said furnace, a compressor for forcing the said combustible mixture into the said burner to be burned in the said furnace, a diaphragm connected with the said boiler, a valve held in the said burner, a second valve held in the inlet-pipe of the said compressor, the said valves being automatically controlled from the said diaphragm, and check-valves held in said burner, substantially as described.

7. In an apparatus for generating motive power, the combination, with a boiler, of a furnace provided with an outlet-valve opening into the said boiler, and a perforated distributing plate or disk held in the said boiler above the said valve, substantially as shown and described.

8. In an apparatus for generating motive power, the combination, with a boiler, of a furnace provided with an outlet-valve opening into the said boiler, a perforated distributing plate or disk held in the said boiler above the said valve, and an agitator or scraper arranged on top of the said distributing-plate and adapted to be moved thereon, substantially as shown and described.

9. In an apparatus for generating motive power, the combination, with a boiler, of a furnace in the bottom thereof provided with

an outlet-valve opening into the said boiler, a hydrocarbon-burner connected with the bottom of the said furnace, and a peep-hole opening extending through the boiler into the said furnace above the burner and comprising a pipe, and a series of spaced translucent or transparent disks or plates held in the said pipe between spacing and retaining collars, substantially as shown and described.

10. The combination, with the boiler having a valved combustion-chamber discharging therein, of series of upper and lower lugs on the inner side walls of the boiler, and a perforated plate having notches in its edges, the lower lugs supporting the plate when its notches are out of register therewith, substantially as set forth.

11. The combination, with the boiler and the combustion chamber or furnace having a valve opening into the boiler to discharge the products of combustion therein, of a burner-tube entering said chamber or furnace, a compression-cylinder provided with a piston and having its outlet connected with the burner-tube, and means for supplying oil to the compression-cylinder for vaporization and mixture with the air by said piston before being delivered to the burner-tube, substantially as set forth.

12. In an apparatus of the character described, the combination, with the compressor-cylinder provided with a piston, inlet-valves at the ends of the cylinder, a pipe connecting said valves and provided with a central air-inlet, and the outlet-valves at the ends of the cylinder having a connecting-tube, of an oil-supply pipe discharging into the said central air-inlet, substantially as set forth.

13. The combination, with the boiler, the combustion chamber or furnace provided with a valve opening into the boiler and a burner-tube entering the said chamber or furnace, of a compression-cylinder provided with outlets in its ends discharging into the burner-tube, inlet-valves in the cylinder ends, a tube connecting said inlet-valves and having a central air-inlet, an oil and a water pump at the sides of the compressor and operated from its piston-rod, a pipe leading from the oil-pump to the said air-inlet, and a water-pipe leading from the other pump to the boiler, substantially as set forth.

14. The combination, with the boiler, the valved combustion-chamber, and the burner, of the compressor delivering to the burner-tube and having an air-inlet, a pipe O, entering said air-inlet and having a valve O′, a pump having a water-pipe K, leading to the boiler and having a valve K′, a valved branch pipe K^8, leading to the pipe O, and the valved oil-supply pipe D, leading from an oil-pump to the pipe O, substantially as set forth.

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