

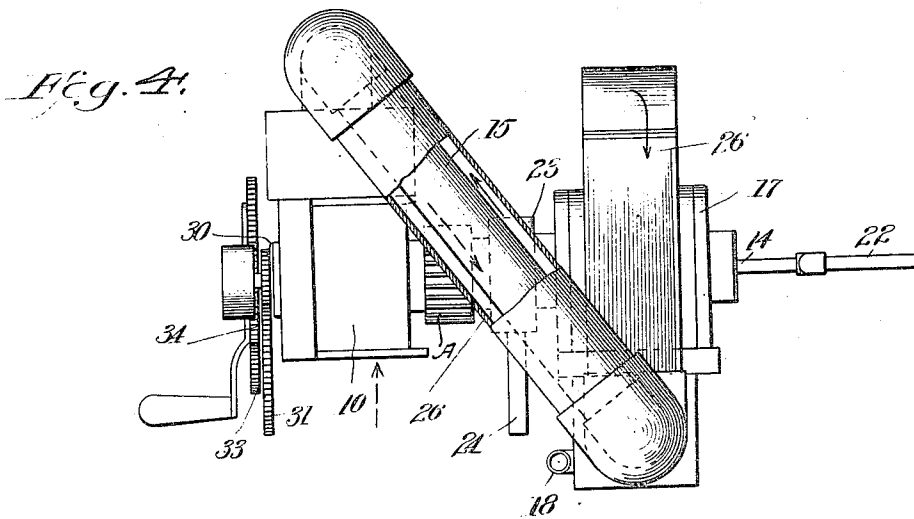
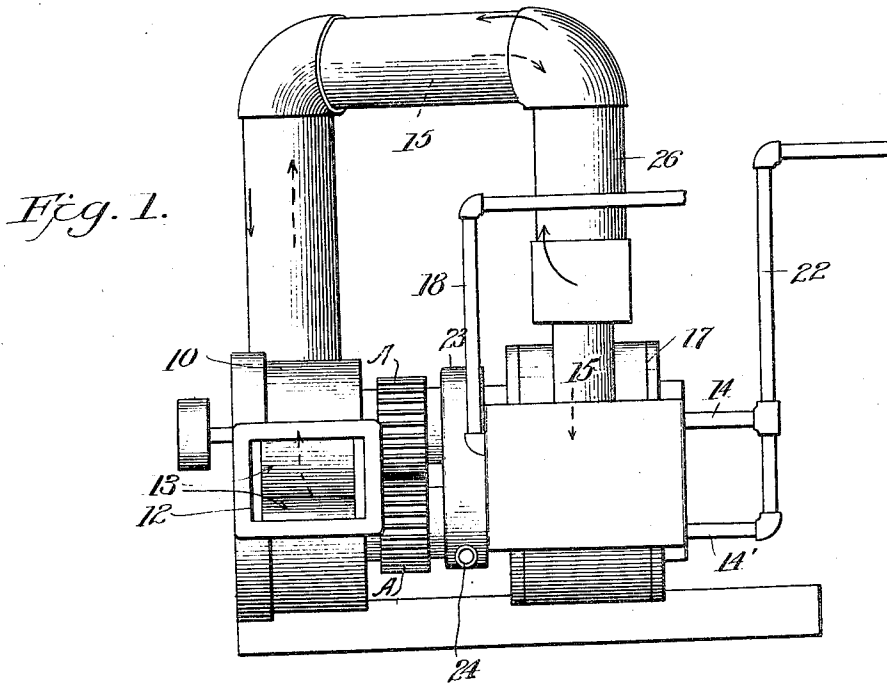
E. M. FRASER.
HOT AIR ENGINE.

APPLICATION FILED SEPT. 12, 1907. RENEWED OCT. 24, 1908.

Patented May 25, 1909.

3 SHEETS—SHEET 1.

922,875.



Inventor

Ethelbert M. Fraser

Witnesses

C. H. Walker.
Ab. Ernst

By J. D. Walter Fowler
his Attorney

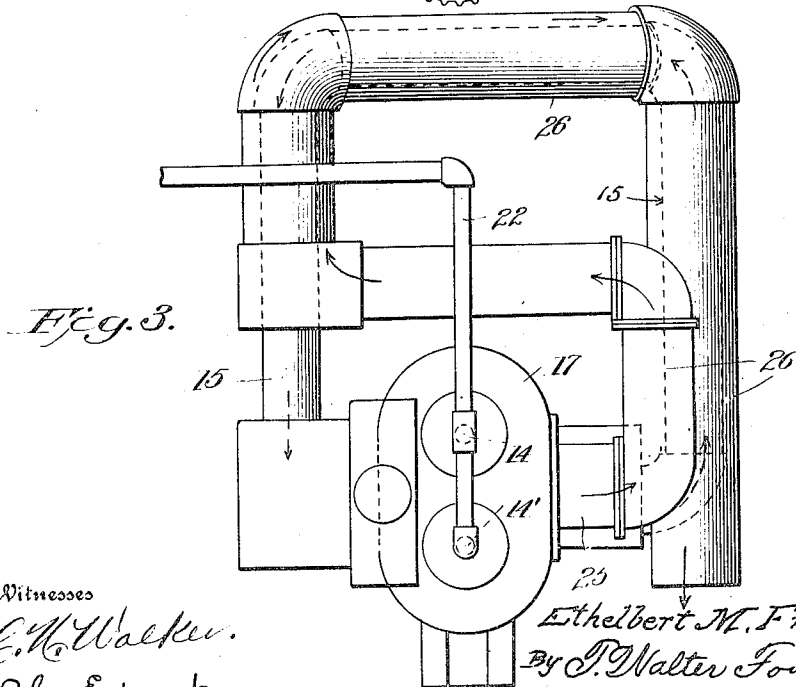
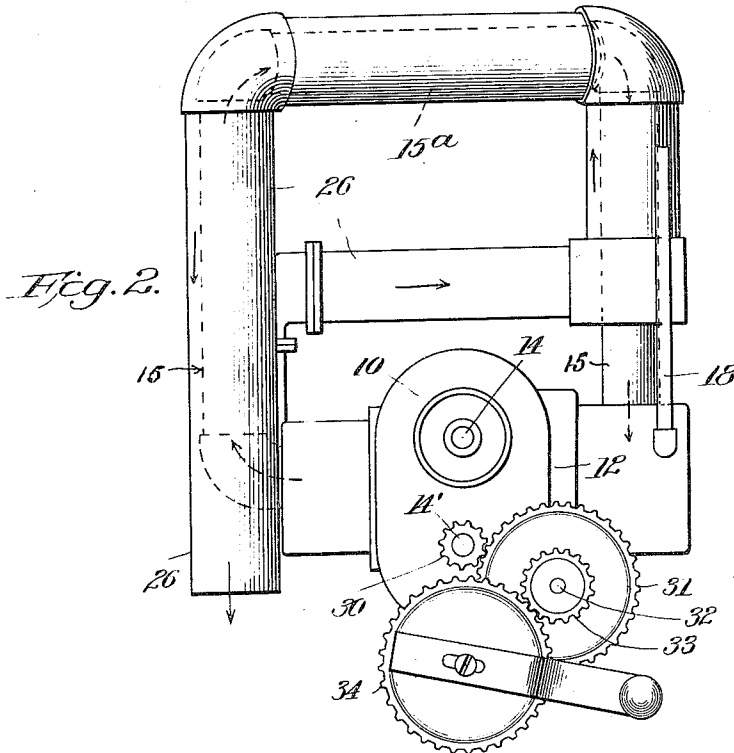
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3 SHEETS—SHEET 3.

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Fig. 5.

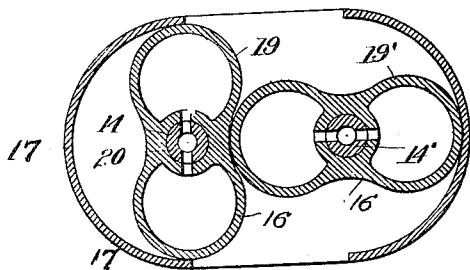


Fig. 6.

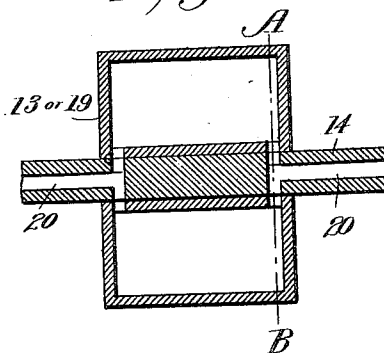


Fig. 7.

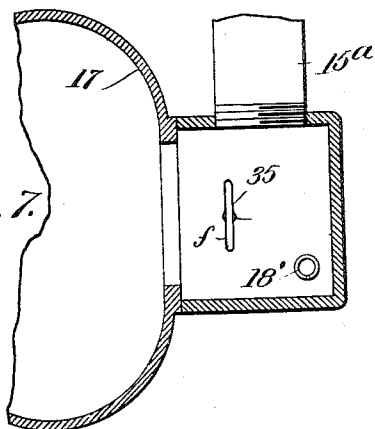


Fig. 8.

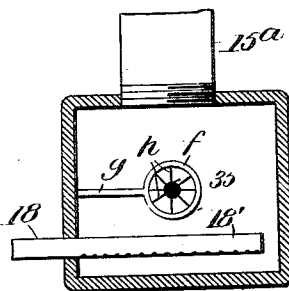


Fig. 9.

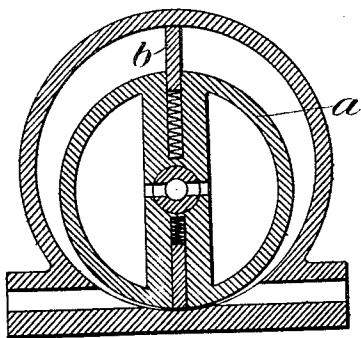
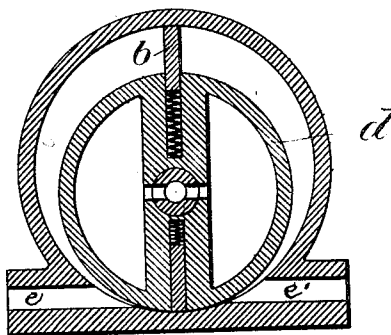


Fig. 10.



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UNITED STATES PATENT OFFICE.

ETHELBERT M. FRASER, OF YONKERS, NEW YORK, ASSIGNOR OF SIXTY-ONE ONE-HUNDREDTHS TO JOSEPH D. GRANT, OF SAN FRANCISCO, CALIFORNIA.

HOT-AIR ENGINE.

No. 922,875.

Specification of Letters Patent.

Patented May 25, 1909.

Application filed September 12, 1907, Serial No. 392,501. Renewed October 24, 1908. Serial No. 459,371.

To all whom it may concern:

Be it known that I, ETHELBERT M. FRASER, a citizen of Canada, residing at Yonkers, in the county of Westchester and State of New York, have invented new and useful Improvements in Hot-Air Engines, of which the following is a specification.

This invention relates to certain new and useful improvements in hot-air engines of the rotary type employing in combination an air-pump and a motor connected thereto, the said engine comprehending the principle of producing motive power by the application of caloric to atmospheric air or other permanent gases or fluids susceptible of considerable expansion by increase of temperature, the mode of applying the caloric being such that after having caused the expansion or dilation which produces the motive power, the waste products, or exhaust, are utilized to heat the atmospheric air before the same is delivered to the motor, whereby said air is delivered to the combustion chamber of the motor in its most efficient state.

The invention consists of the parts and the constructions, arrangements and combinations of parts which I will hereinafter describe and claim.

In the accompanying drawings forming part of this specification, and in which similar reference characters indicate like parts in the several views:—Figure 1 is a side elevation of a hot-air-motor embodying my invention; Fig. 2 is an end view looking toward the pump-end of the apparatus; Fig. 3 is a similar view looking toward the motor-end of the apparatus; Fig. 4 is a top plan view. Fig. 5 is a sectional view on the line A—B of Fig. 6 of motor impellers of cycloidal form and the casing therefor, showing means for circulating a cooling medium through the impellers; Fig. 6 is a horizontal section showing an impeller and shaft and showing means for admitting the cooling medium into one end of the shaft and discharging the medium through the other end of said shaft. Figs. 7 and 8 are sectional details showing the jet-nozzle and initial igniter. Figs. 9 and 10 are modifications to be referred to.

In carrying out my invention I may support the pump and the connected hot-air motor and the coöperating parts in any appropriate manner, this depending largely

upon the purposes for which the engine is intended to be used. The pump which supplies the air to the motor may have any desired capacity, and kind of impeller, and its casing, 10, is open at one side to provide an air-inlet, 12, for the free admission of atmospheric air. The kind of pump used as a part of this engine may also vary within more or less wide limits. For instance, I may use a pump like the one shown in Figs. 1 and 2 and which pump comprises the aforesaid casing and two coöperative impellers, 13, mounted on shafts 14, 14', respectively, said shafts being parallel with each other and connected together by gear wheels A. This pump is of itself of well known form and construction and further detailed description of it seems unnecessary, except to say that the impellers with which the shafts 14, 14', are provided, are preferably of the equally well known cycloidal outline, adapted to pump a definite volume of atmospheric air to the combustion chamber of the companion hot-air-motor, as I will presently describe. The impellers 14, 14' are herein shown of the balanced type, that is the weight of each impeller is equally distributed upon each side of the axis about which the impeller rotates.

Instead of using the aforesaid pump with its plurality of impellers of cycloidal outline, I may use some other form of pump, as for instance, one of the well known type shown in Fig. 9 wherein the casing contains a revolvable drum or cylinder *a* that is journaled eccentric to the axis of the shell or casing and carries one or more slidable vanes or pistons *b*, which may be spring-pressed, against which pistons the hot-air, or burning fluid, operates. While a pump of the single impeller type will be found useful, I consider the pump shown in Fig. 2, with its cycloidal impellers, as possessing the greatest efficiency.

The pump and hot-air motor may connect by a single head, or otherwise, and the discharge end, or side, of the pump casing is connected to the casing of the hot-air-motor by means of a pipe or connection 15, thereby leading the air discharged from the pump into the combustion chamber of the hot-air-motor in which chamber the air is mixed with an inflammable vapor and ignited to cause it to expand or increase in volume, and

thereby actuate the impeller, or impellers, 16, of the hot-air-motor, as I will presently disclose.

The casing, 17, of the hot-air-motor has a combustion chamber in which the air and vapor are mixed and consumed, this chamber connecting directly with the air-pipe, 15, leading from the pump; the vapor, which may be alcohol or like volatile fluid or the product of a solid fuel, as coal, coke, etc., is delivered into the combustion chamber through a pipe, 18, and jet, 18'. All of the air delivered by the pump passes through the pipe, 15, into the combustion chamber of the hot-air-motor where it meets and ignites the vapor of the alcohol, if alcohol is used, supplied in jet form through the pipe, 18, and jet nozzle, 18', and heats and expands the air in direct proportion to the amount of alcohol vapor, and causes the impeller, or impellers, to rotate. These impellers, 16 and 16 are, in Fig. 5, also preferably of cycloidal outline and are each mounted on one of the parallel shafts on which the pump impellers are also mounted. The impellers, 16 and 16, are also preferably longer than the pump impellers, and the corresponding impellers on the pump and motor have their major axis on the same plane. It will be understood that the motor impellers, as well as those of the pump, are not limited to a cycloidal form but said motor-impeller may be of the slidable-vane or piston order similar to that shown in Fig. 10, or they may be of any well known and appropriate character.

Owing to the intense heat to which the motor-impellers are subjected by reason of the burning of the vapors in the combustion chamber, I show the motor-impellers of Fig. 5, and the drum or cylinder *d* of Fig. 10, hollow, and I provide means for circulating water or a cooling medium through the impellers to prevent their burning out. That this object may be satisfactorily attained, I construct the shafts, 14, 14' (Fig. 6) hollow or with a passage 20, one end of the passage connecting with a water supply pipe, 22, and the other end of said passage connecting with a casing, 23, or receiver into which the water flows from the impellers and from which casing the water is delivered by any suitable means, as by the pipe, 24. In Fig. 10 the hollow drum has equivalent passages, as shown at *e*, *e'*.

The spent products of combustion are exhausted from the combustion chamber through a port 25 and enter a pipe or passage 26 and are finally delivered into the atmosphere through the open end of this pipe or passage, the exhaust being muffled or not as desired. The pipe, 26, is of such diameter as to receive and inclose the air-delivery pipe, 15, leading from the pump casing to the combustion chamber of the hot-air-motor, the two pipes, 15 and 26, being spaced from

each other whereby the hot gases or products of combustion exhausted from the combustion chamber pass in contact with the air-pipe and heat the air which is being delivered to the combustion chamber of the motor for mixture with the alcohol or other vapor to form therewith the inflammable vapor which constitutes one form of fuel for the hot-air-motor. The exhaust pipe of the hot-air motor, therefore, constitutes a reheater for the air delivered by the rotary pump and thus heats the air and delivers it for admixture with the vapors of the alcohol or other volatile fluid, or other fuel, in its most efficient state.

On the shaft of one of the impellers of the pump shown in Fig. 2, is a pinion, 30, which meshes with a gear-wheel, 31, mounted on a shaft, 32, said shaft, 32, carrying a second gear-wheel, 33, which meshes with a large gear, 34, to which power may be applied for starting the pump and impellers in operation.

Any desired form of device may be used as a means for igniting the inflammable fluid; an efficient means for this purpose may include a small piece of spongy platinum placed in front of the jet-nozzle, 18', and adapted to be heated by the vapors to incandescence and thereby ignite the mixture of say air and alcohol to start and also in case the flame in the combustion chamber should be extinguished from any cause. The jet in this case may be only a straight piece of pipe closed at the end and having a series or row of small holes in one side furnishing outlets for the fluid; and the igniter may take the form of a metal ring, *f*, secured to a rod, *g*, which is anchored to the side of the combustion chamber. Stretched across this ring may be fine platinum wires, *h*, and in the center of the ring where the wires cross, is placed the lump of black platinum, which platinum has the greatest affinity for the gas consequently it will heat up first, heating the wire at the same time. The wire when heated has a much greater affinity for gas and heats to incandescence much quicker when black platinum is used in combination.

From the foregoing description it will be apparent that the invention comprises an organized machine having a rotary-pump directly connected to a rotary motor, a vapor-burner placed in the intake of the motor, and a reheater whereby the exhaust of the motor is utilized to heat the fresh air admitted to said motor for admixture with fuel, say the alcohol or other vapors, and a means for circulating water through the hollow impellers, or impeller, of the motor to better prepare the same to resist the intense heat to which they are subjected.

It is not essential that the fuel used in this engine should be confined to one of a liquid or volatile character, as solid fuel, such as

coal, coke, charcoal, etc., will answer as a satisfactory substitute for the alcohol vapors, especially when the combustion chamber of the hot-air-motor is constructed of increased dimensions.

Briefly stated, the operation of the engine is substantially as follows:—The gear-wheel 34 is rotated by hand or otherwise, thus revolving the impellers of the pump and motor. As the pump rotates, it draws air from the atmosphere through the intake of the pump casing, and the impeller or impellers force this air into the pipe, 15, which pipe passes through the reheater, or pipe for conducting the exhaust from the motor, whereby said air is highly heated when it reaches the combustion chamber of the motor. The heated air when delivered into the intake of the motor meets and ignites alcohol vapor, when this is used, delivered by the jet, 18', the heating and expansion of the air being in direct proportion to the amount of alcohol vapor. The impellers or rotating pistons of the motor being longer, or larger, than those of the pump, said motor is capable of running itself and also the connected pump. The extra quantity of air required over that furnished by the pump is made up by the expansion of the air due to heating; and the hot-air discharged as exhaust into the pipe, 26, is carried through this pipe or heater, to raise the temperature of the air supply to the motor and to extract all the heat from the exhausted air before being discharged again into the atmosphere. The alcohol jet is only required to add the amount of heat lost and used up in the form of power and friction. Any means may be employed to vaporize the alcohol or other volatile fluid before admitting the vapor thereof to the jet-nozzle for admixture with the air. In practice, enough heat has been found to be stored in the motor to vaporize the alcohol for several hours after running.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. A positive-pressure engine for converting heat into mechanical power, said engine having in combination a rotary-pump and a rotary-motor, said pump and motor being directly connected and each being provided with a pair of coacting intergeared impellers, said pump having an air-intake and said motor having a combustion chamber, an air conductor connecting at one end with the discharge of the pump and having its opposite end leading into the combustion chamber of the motor, a fuel conductor independent of the air conductor and also leading into the combustion chamber of the motor, and means for jacketing the air conductor from the pump by the hot exhaust from the motor whereby the air is heated to a high degree by the hot exhaust of the motor before reaching

the combustion chamber of the latter and before mixing with the fuel.

2. A heat-engine comprising parallel intergeared shafts and pairs of coacting impellers thereon forming an air-pump and a rotary-motor, at opposite ends of the engine, said pump and motor having inlets and outlets; means for conducting the air delivered from the pump to the motor into the field of the exhaust of said motor whereby the fresh charge of air will be highly heated by the spent products of the preceding charge before being delivered into said motor; and fuel-feeding means connecting with the motor.

3. A heat-engine comprising parallel shafts and pairs of coacting impellers thereon forming two rotors connected to operate in unison, one of said rotors being a pump and having an air inlet and outlet, and the other rotor having a combustion chamber, a fuel-supply and an exhaust opening; an air-conductor connecting the outlet of the pumping-rotor directly with the combustion chamber of the other rotor, and a conductor encompassing the air-conductor and leading the exhaust of said other rotor thereagainst to highly heat the air before it reaches the combustion chamber.

4. A heat-engine comprising parallel shafts and pairs of coacting impellers thereon forming two rotors connected to operate in unison, one of said rotors being a pump and having an air inlet and outlet, and the other rotor having a combustion chamber, a fuel-supply and an exhaust opening; an air conductor connecting the outlet of the pumping-rotor directly with the combustion chamber of the other rotor, and a conductor extending parallel with and incasing the air conductor and leading the exhaust of said rotor thereagainst to highly heat the air before it reaches the combustion chamber.

5. A heat-engine comprising parallel shafts and pairs of coacting impellers thereon forming a rotary pump and a rotary motor, at opposite ends of the engine, said pump and motor each having an inlet and outlet, and said pump having an air conductor leading to the motor and said motor having a combustion chamber and an exhaust pipe or passage through which latter the air-conductor of the pump passes on its way to the motor, whereby the air is heated to a high degree by the exhaust of the motor before being delivered to said motor, and fuel-feeding means delivering into the motor in the presence of the heated air.

6. A heat-engine having in combination parallel shafts and pairs of coacting impellers thereon forming a rotary-pump and a rotary-motor, at opposite ends of the engine; means connecting the pump and motor shafts so that they will operate in unison; an air-conductor connecting the outlet of the

pump with the inlet of the motor; a fuel-supply means; and a receiver connecting with the exhaust of the motor; said air-conductor being inclosed for the greater portion 5 of its length by the exhaust receiver whereby the heat of the exhaust is utilized to raise the temperature of the air to a high degree before said air is delivered into the motor in the presence of the fuel.

10 7. A heat-engine comprising parallel shafts and pairs of coaxing impellers thereon forming an air-pump and a rotary motor, at opposite ends of the engine, said pump and motor having inlets and outlets; means 15 for conducting the air delivered from the pump to the motor into the field of the exhaust of said motor whereby the fresh charge of air will be highly heated by the spent products of the preceding charge before being delivered into said motor, and fuel-feeding 20 means connecting with the motor, said motor impellers being hollow and the shafts thereof having longitudinal and lateral passages connecting with the interior of the impellers and affording circulation for a cooling fluid.

25 8. A heat engine having in combination

two rotors connected to operate in unison, one of said rotors being a pump and the other rotor having a combustion chamber, 30 each of said rotors having a pair of coaxing impellers and each impeller having its weight equally distributed upon each side of its axis, whereby said impeller is balanced, an air conductor connecting the outlet of the 35 pump with said combustion chamber, and a fuel supply independent of the air conductor and leading into said combustion chamber.

9. A heat engine comprising a rotary 40 pump and a rotary motor, connected to operate in unison, coaxing intergeared impellers, said motor impellers being of greater length than the impellers of the pump, and said motor having a combustion chamber in 45 which a fuel is burned.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ETHELBERT M. FRASER.

Witnesses:

WILLIAM GAUL,
NETTIE GAUL.