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E. KEHLBERGER & L. FOUQUE.

ENGINE.

No. 510,480. Patented Dec. 12, 1893.

Fig. 1.

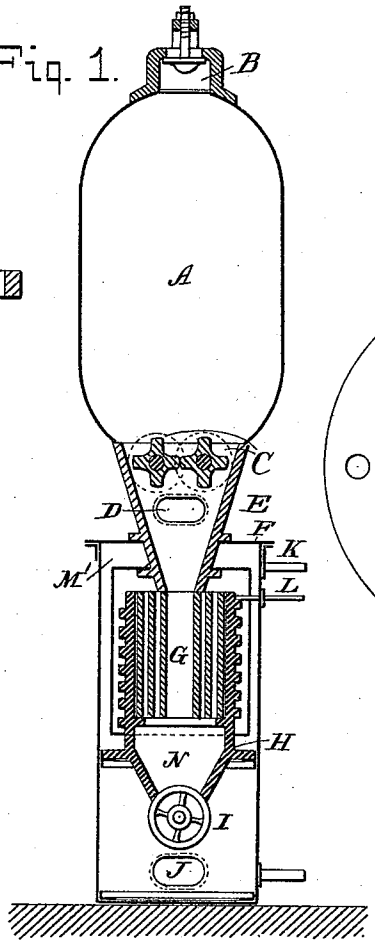

Fig. 2.

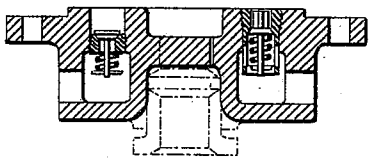

Fig. 3.

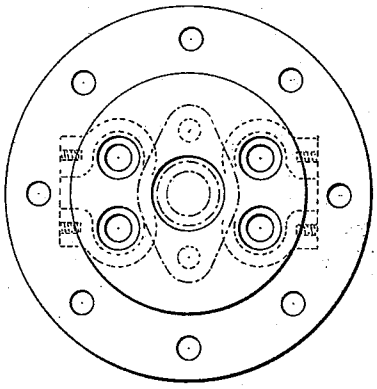

Fig. 5.

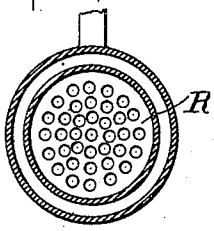

Fig. 4.

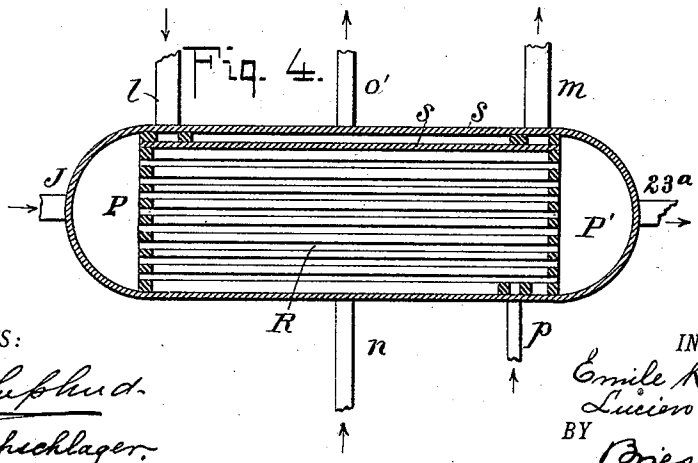

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FIG. 6.

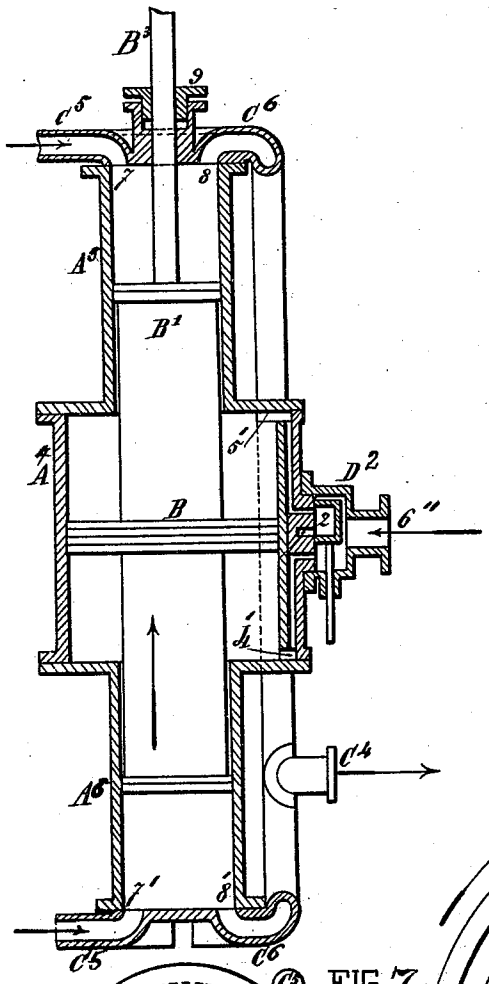


FIG. 7.

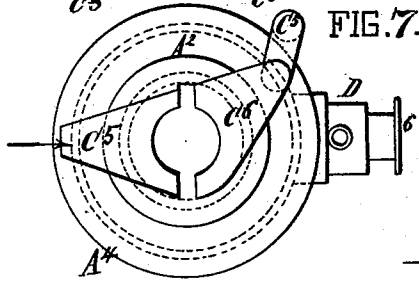
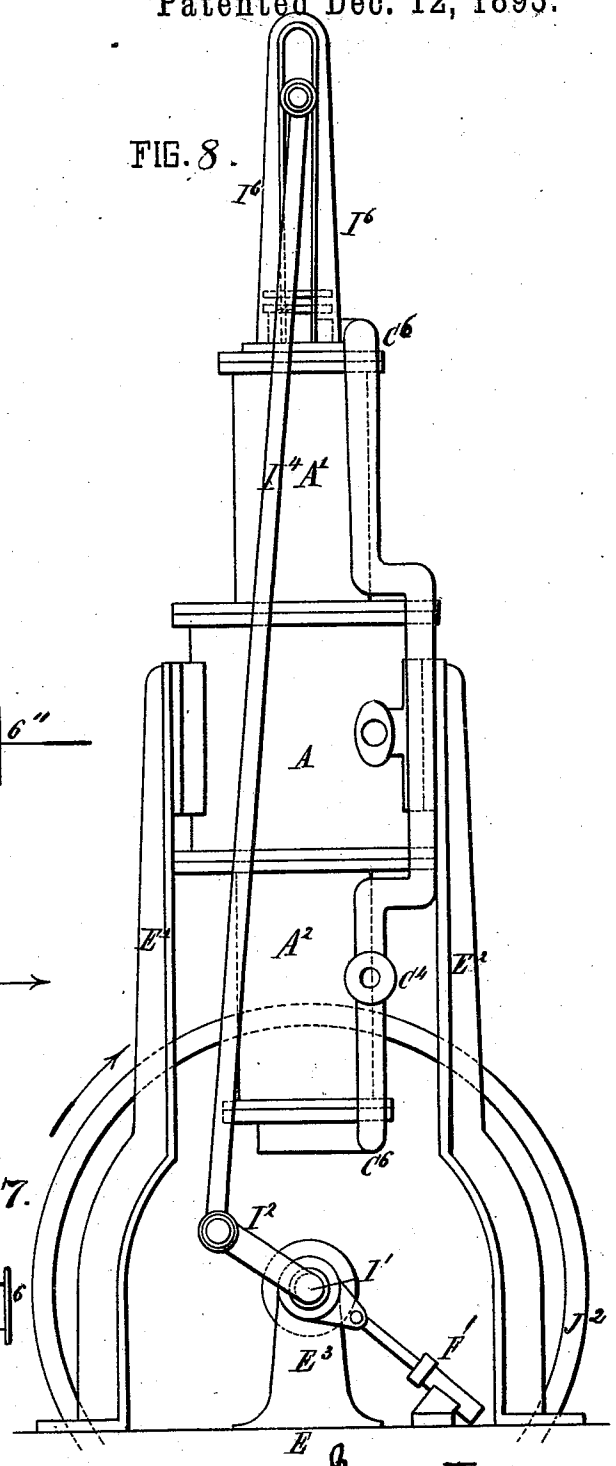


FIG. 8.



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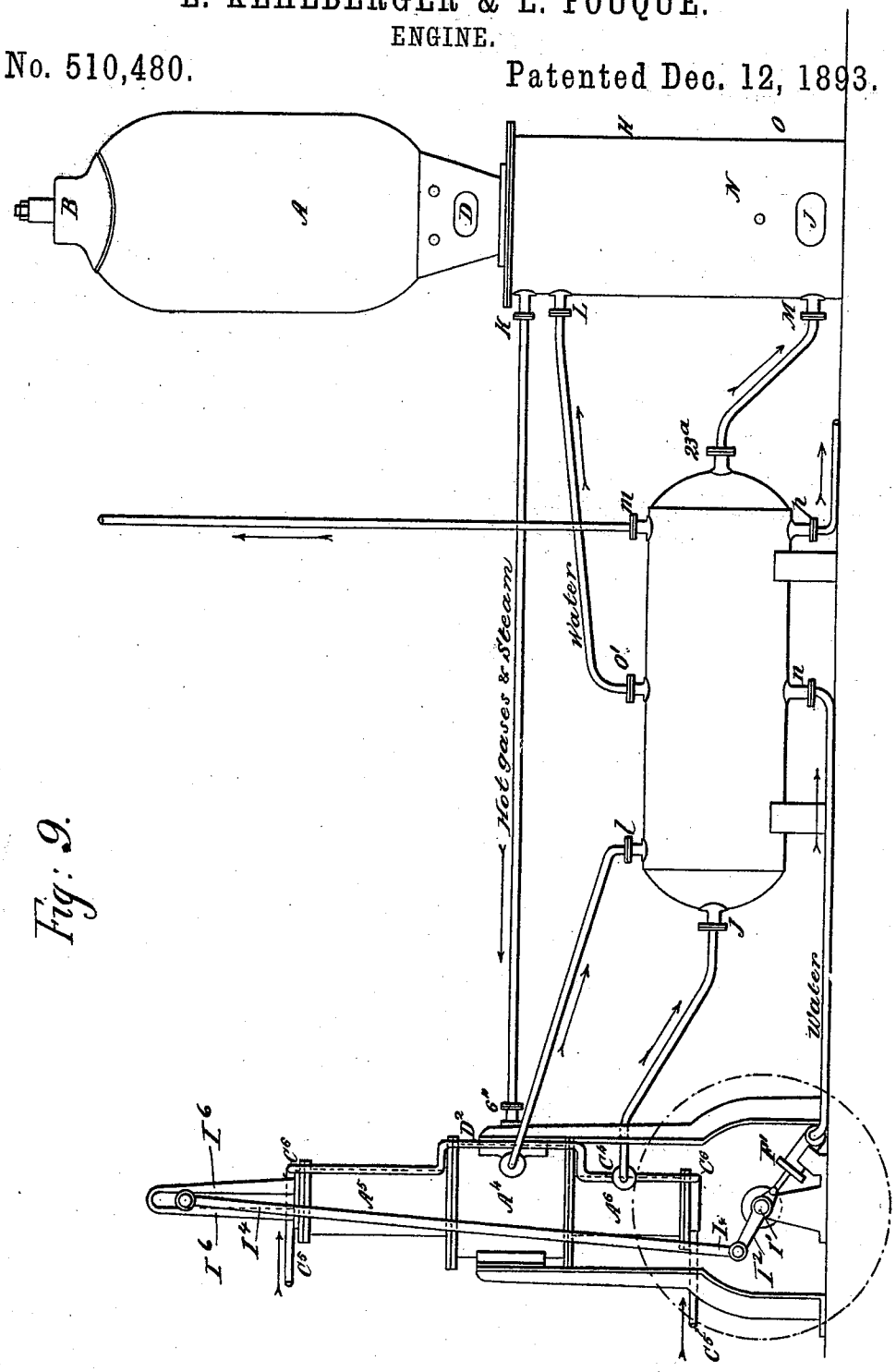

Fig. 9.

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UNITED STATES PATENT OFFICE.

EMILE KEHLBERGER AND LUCIEN FOUQUE, OF PARIS, FRANCE.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 510,480, dated December 12, 1893.

Application filed March 18, 1891. Serial No. 385,483. (No model.) Patented in France June 4, 1890, No. 206,126; in Belgium January 2, 1891, No. 93,307; in England January 9, 1891, No. 458; in Germany January 12, 1891, No. 57,904; in Switzerland February 24, 1891, No. 3,476, and in Spain April 30, 1891, No. 11,864.

To all whom it may concern:

Be it known that we, EMILE KEHLBERGER and LUCIEN FOUQUE, of the city of Paris, France, have invented Improvements in Aero-Hydro-Thermal Motors, (for which we have obtained Letters Patent in France for fifteen years, dated June 4, 1890, No. 206,126; in Belgium, January 2, 1891, No. 93,307; in Germany January 12, 1891, No. 57,904; in England January 9, 1891, No. 458; in Switzerland February 24, 1891, No. 3,476, and in Spain April 30, 1891, No. 11,864,) of which the following is a full, clear, and exact description.

Our invention relates to an aero-hydro-thermal engine operated by compressed air heated to a temperature of 250° centigrade and saturated with steam; also to a generator for the gaseous mixtures employed; and also to a recuperator connected with the motor of the engine and the generator. As the motor is completely separated from the furnace of the generator, it is not liable to rapid destruction. The pressure to which the gaseous mixture may be raised is unlimited, and very powerful engines may be constructed with very limited dimensions.

Referring to the accompanying drawings in which like letters and figures indicate corresponding parts, Figure 1 is a vertical elevation, partly in section, of a generator used in connection with our motor. Figs. 2 and 3 are detail views of the valves placed at the ends of the compressing cylinders of the motor. Fig. 4 represents a longitudinal section through the axis of the recuperator. Fig. 5 is a transverse section of the same. Fig. 6 is a central vertical section taken through the three cylinders of the motor. Fig. 7 is an under side plan view of the same. Fig. 8 is a side elevation of the motor, and Fig. 9 is a side elevation showing the various parts in operative relation to each other.

The generator shown in Fig. 1 consists of a storage chamber A for combustibles, hermetically sealed, made of strong metal, and provided at its upper portion with a stopper B and at its lower portion with a funnel-shaped spout E in the upper part of which is mounted a pair of feed drums C. The feed drums are driven in any desired manner and the fuel is thereby supplied into a furnace chamber through a central vertical opening made in a block G made of cast iron or fireclay and provided with vertical passages of small diameter around the central opening for the passage of the products of combustion and the compressed air, the block also serving as a heat accumulator for heating the gaseous mixture. The furnace N is of truncated conical form and provided with a rotary drum-shaped grate I turning on a suitable axis through which the ashes fall into the closed ash pit at the bottom of the outer casing O from whence they are withdrawn at the door J. The furnace chamber extends upward in the form of a cylinder H in which the perforated block G is supported and terminates at its bottom in a flange dividing the upper part of the casing O from the ash pit.

The cylinder H is provided with an external helical rib extending vertically and to within a certain distance of the bottom flange, and is inclosed in a sheet iron hood M′ open at bottom and serving to produce a circulation of the hot gases and also to throw down the ashes carried off therewith. Water is injected from the recuperator through a pipe L onto the upper end of the spiral ribs of the cylinder H down which it flows until it becomes vaporized. Compressed air is introduced from the recuperator into the ash pit through pipe M and the gaseous mixture escapes under pressure, through pipe K to the motor.

Figs. 4 and 5 show respectively a central longitudinal section and transverse section of the compressed air and water recuperator. It is constructed of a double metallic casing S, capable of resisting pressures, between the walls of which the water, supplied by a feed pump or other convenient pressure, circulates from the inlet at *n* to the outlet at *o′* to the generator. The compressed air from the compressing cylinders of the motor enters at J into the space P of the recuperator and passes through the tubes R to the space P′, and then through pipe 23^a to the ash pit of the generator at M. The exhaust enters at *l*, the space

surrounding the tubes and escapes at *m* into the atmosphere. The recuperator is provided with a purge cock *p*.

Figs. 6, 7 and 8 show our improved motor as provided with two cylinder air-compressors for the purpose of throwing continuously the compressed air into the heated generator.

In these figures, A^4 represents the working cylinder of the motor and A^5 and A^6 the two air compressing cylinders with piston B, B^6 common to both, the compressing cylinder A^5 being located above the working cylinder and the compressing cylinder A^6 below it, and B, B^6 being the piston common to all of them. The gaseous mixture at a high temperature and under pressure passes by the pipe 6″ into the chamber D^2 having an ordinary slide valve 2″ as shown in Fig. 6. In the position shown in Fig. 6, 4′ is the admission port and 5′ is the discharge port. The piston in its upward movement draws air into the lower cylinder A^6 through the pipe C^5 provided with a valve 7′ while at the same time the air compressed in the cylinder A^5 is driven out toward the generator through pipe C^6 connecting with pipe C^4 and provided at its lower end with valve 8′ as shown in Fig. 6. When the piston has reached its extreme upper movement, the slide valve 2″ receives a reverse motion and the gaseous mixture will be admitted through port 5′ and the pistons will be caused to descend drawing air into the cylinder A^5 through pipe C^5 and driving out the compressed air in the cylinder A^6 through pipe C^4 to the recuperator. This operation can be carried on continuously. Upon the top of the cylinder A^5 is arranged a stuffing box 9′ in which the piston rod B^7 works.

The three cylinders are firmly secured in any desired manner, and to the top of the upper cylinder are secured guides or ways I^6 in which reciprocates a cross bar to which the piston rod B^7 is connected. To this cross bar are also connected rods I^4, the lower ends of said rods being pivotally connected to the outer end of a crank arm I^2 secured to a motor shaft I′. Upon this shaft I′ is another crank arm connecting with and operating a feed pump F′ for supplying water to the recuperator as shown in Fig. 9. Two fly wheels or pulleys J^2 are mounted on the shaft I′.

The difference between the force exerted on the large piston by the gaseous mixture under pressure, and the resistance which it encounters through the compression of air in one or the other compressing cylinders, represents the available power upon the pulleys and fly wheels on the main shaft.

Having thus described our invention, what we claim is—

1. The combination with an aero-motor as described, of a recuperator consisting of a double casing S, tubes R, chamber P open to one end of said tubes and connected by pipe J to the motor, chamber P′ open to the other end of said tubes and connected by pipe 23^a with a thermal generator, water inlet pipe *n* and outlet pipe *o′*, and exhaust pipes *l* and *m*, all substantially as described.

2. The combination with a recuperator as described of a thermal generator consisting of a storage chamber A, furnace N connected with said storage chamber, feed drums C interposed between said chamber and furnace, perforated ribbed cylinder H above said furnace, casing O surrounding said cylinder and furnace, and means for connecting said generator with said recuperator and an aero-motor, substantially as described.

The foregoing specification of our improvements in engines signed by us this 13th day of February, 1891.

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