L. A. L. SÖDERSTRÖM.

HOT AIR ENGINE.

No. 92,117. Patented June 29, 1869.

Fig. 3.

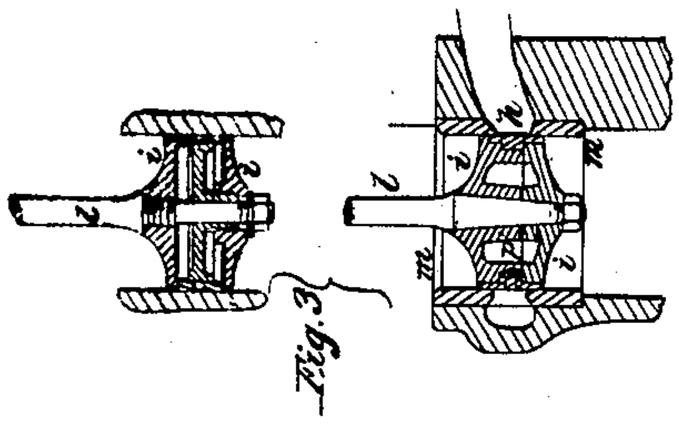


Fig. 4.

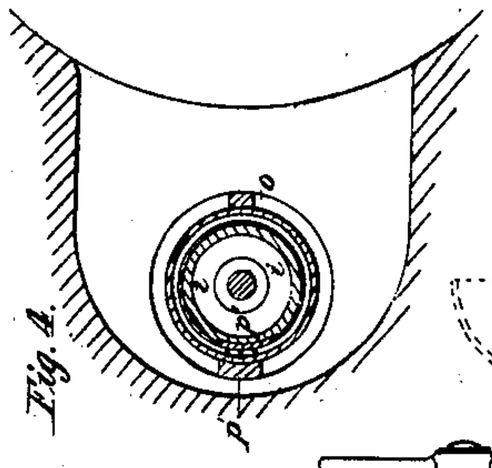


Fig. 5.

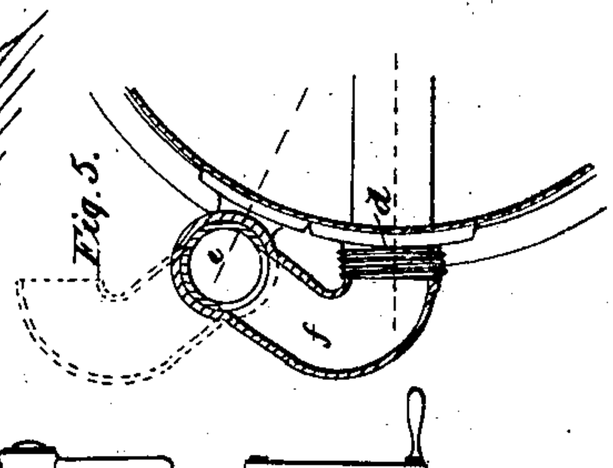


Fig. 1.

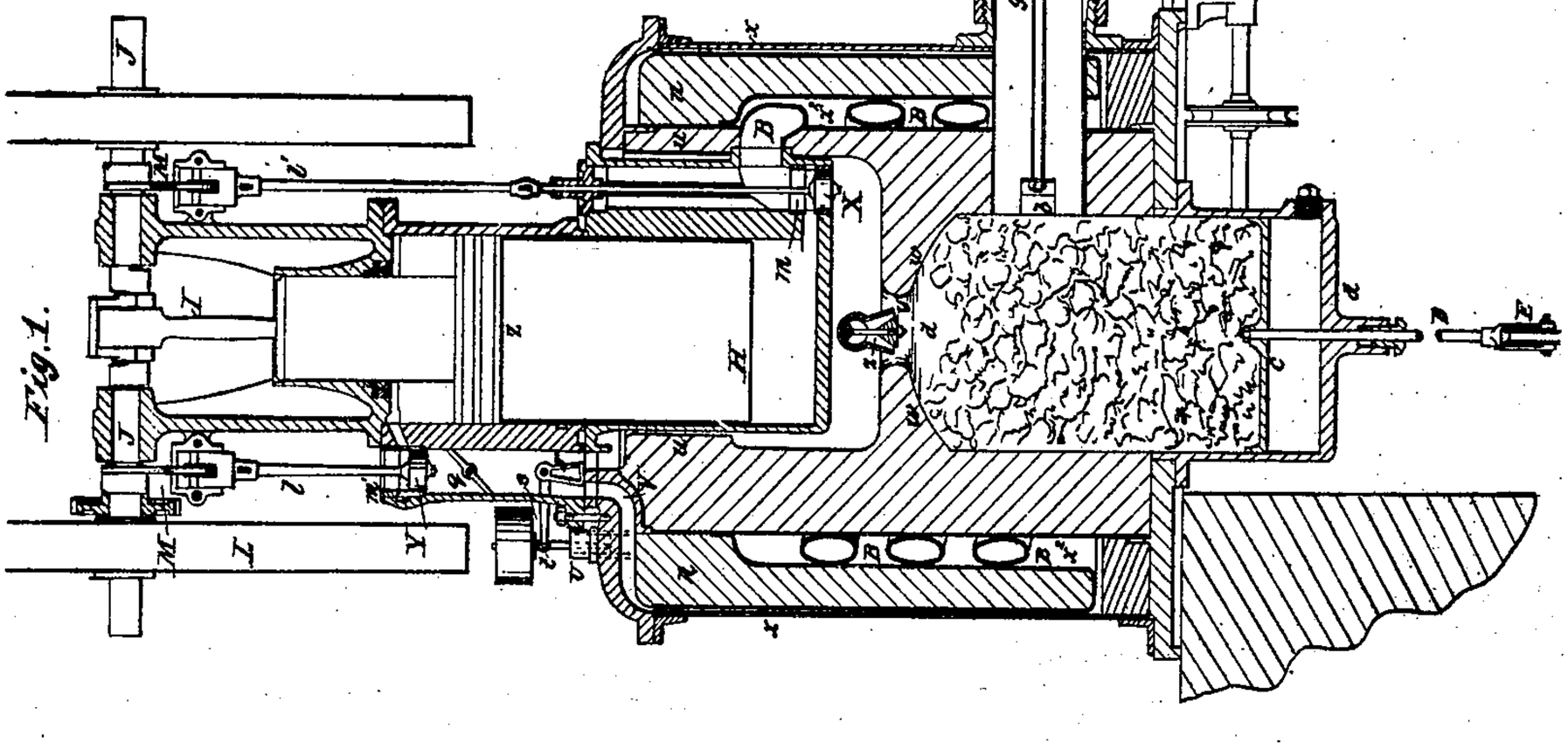
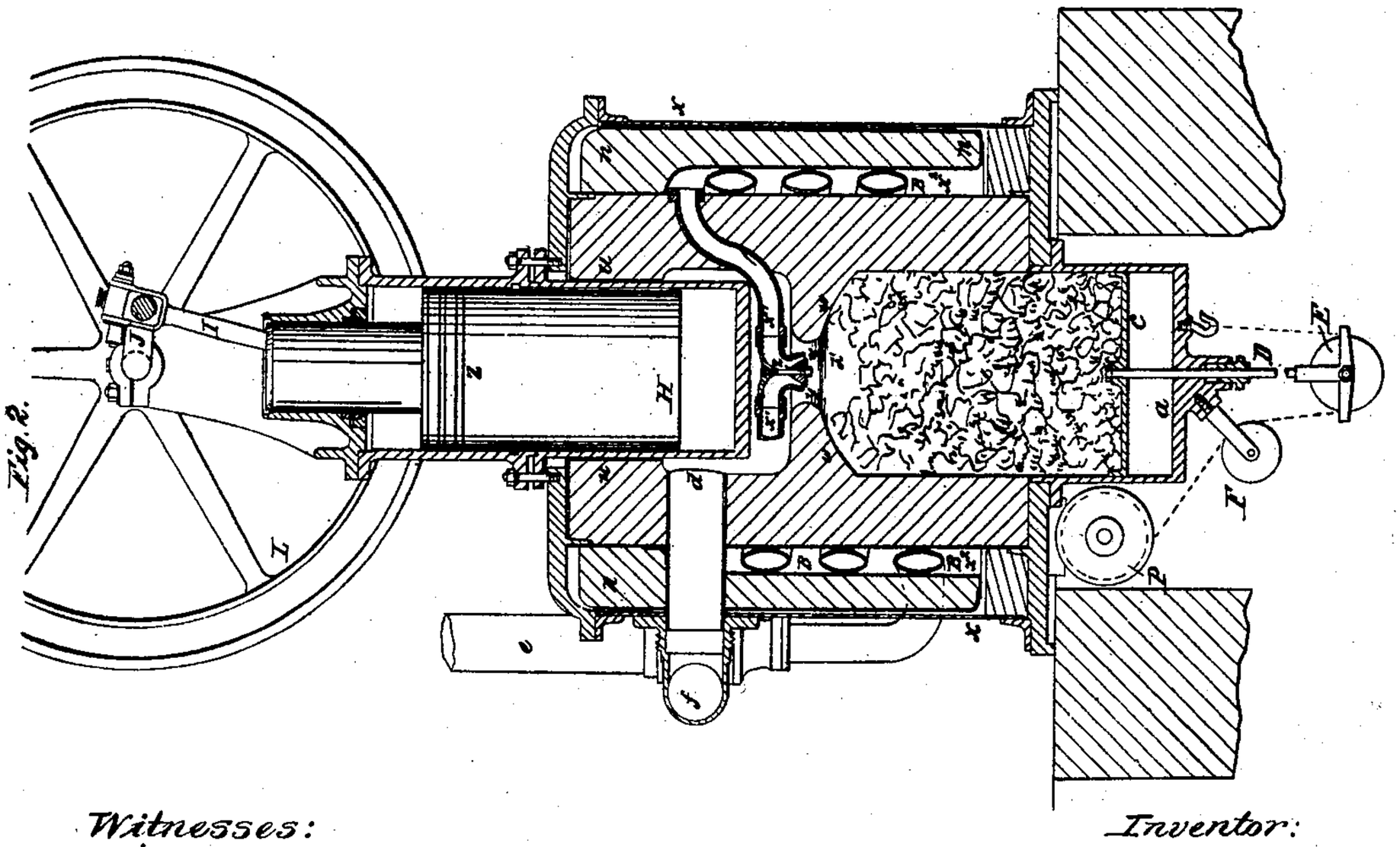


Fig. 2.



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LARS ALBERT LEONARD SÖDERSTRÖM, OF PARIS, FRANCE.

Letters Patent No. 92,117, *dated June* 29, 1869.

IMPROVEMENT IN HOT-AIR ENGINE.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, LARS ALBERT LEONARD SÖDERSTRÖM, of Paris, in the Empire of France, have invented a new and useful Improvement in Hot-Air Engines with Closed Furnaces; and I do hereby declare the following to be a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which drawing—

Figure 1 is a vertical section of the apparatus in motion.

Figure 2 is a vertical section, in a plane perpendicular to the axis of the distributing-pistons.

Figure 3 is a view, partly in section, of one of the distributing-pistons, on a larger scale.

Figure 4 is a horizontal section thereof.

Figure 5 is a horizontal section of the chimney junction-pipe.

Similar letters indicate corresponding parts.

This invention relates to improvements in the application of heated compressed air to the production of motive power, and in the apparatus by means of which this power is developed and rendered available for general purposes.

The main feature of this improved air-tight apparatus consists essentially—

First, in dispensing with the ordinary distributing-valves of such apparatus, and substituting pistons;

Second, in the devices for distributing and heating the air;

Third, in the devices for introducing the air through the upper part of the furnace;

Fourth, in the devices for feeding the said furnace with fuel;

Fifth, in the combination of organs or devices, which allow of regulating the said apparatus automatically, and of increasing or diminishing, at will, the combustion, in order to obtain this regulation;

Sixth, the peculiar arrangement of the furnace; and

Seventh, the facility with which oxide of carbon, burnt in the recipient intended for the coal, which may be used as fuel, this mode of heating being of great importance in large-sized machines, wherein may be used the gases proceeding from any gas-stove disposed to that effect, and which may receive all sorts of fuel, of whatever nature it may be.

The projection of the air by the upper part of the furnace, and above the ignited fuel, prevents the formation of smoke and gases, which absorb to no purpose a large amount of caloric; as, by forcing the air into the upper part of the furnace, the ascending gases are of necessity entirely consumed, by keeping them in contact with the burning fuel.

The high speed of the apparatus allows of using one cylinder only, the upper part of which answers the purpose of a force-pump for compressing the air into the furnace, and the lower part serves as a driving-cylinder.

By reason of the manner in which the machine is disposed, the upper air remains always cold, whilst that which acts under the pistons is constantly heated, the lower part of the cylinder plunging directly into the furnace, in which it is half enclosed.

In order more fully to appreciate the chief characteristics of the said improvements, the working of the machine will now be described.

The coal is first fed into the furnace *a* by an aperture, *b*, which is made at the lower part of the apparatus. This coal falls on to a movable cast-iron platform, *c*.

When the furnace is replenished with coal, the fire is lighted at the upper part, and the draught required for the lighting up takes place through an aperture, *d*, fig. 2, communicating with a chimney, *e*, by means of a junction-pipe, *f*, fig. 5. This junction-pipe is movable around the chimney.

When the coal is thoroughly lighted, and when the walls of the cylinder and furnace are sufficiently heated for operating, the junction-pipe *f* is turned off from the mouth of aperture *d*, as represented in dotted line in fig. 5, and it then serves as a stop-cock to close the orifice in the chimney, which then serves as an escapement-pipe.

The two apertures, *b* and *d*, are next closed, by means of plugs furnished with handles, like that shown at *g*, fig. 1. These plugs are by preference made of cast-iron, slightly tapering, and they are lined with refractory clay, to intercept the heat.

When the apparatus is set in motion, the air heated in the furnace circulates first in a space surrounding the lower part of the cylinder, which it previously warms, then meets with the lower orifice of a piston-valve, X, which in due time opens to let the heated air penetrate into the lower part, below the driving-piston Z.

The air, on expanding, drives the piston Z upward, and compels it to compress the cold air enclosed in the upper part of the cylinder, which cold air is driven by a piston-valve, Y, into a conduit furnished with a throttle-valve, *q*, serving to regulate the speed of the apparatus. This compressed air is heated to any required degree, by passing, in greater or smaller quantity, into the furnace, through another valve, *r*, situate a little below the first.

Moreover, to regulate the temperature, and maintain automatically a uniform pressure, this second valve *r* is actuated by a lever, *s*, connected with a small piston working in a hollow cylinder, U, screwed on to the lid of the furnace, and by a connecting-rod, *t*, carrying directly the counterweights to equilibrate the action of the piston in the cylinder U.

The air required to keep up the combustion comes down through the conduit *v* into an annular space, *x*,

furnished underneath the top of the outer jacket of the furnace, and then descends between the cylindrical portion of the said jacket, as shown in figs. 1 and 2, and a lining of masonry, *n*, consolidated with thin sheet-iron. It then rises into a second annular space, x^2, between the lining of masonry *n* and the furnace, where it is heated by the spiral pipe B, through which the heated air escapes, and by the outer side of the furnace, consolidated with thin sheet-iron, the air being allowed to enter only by the cast-iron pipe x^1, fig. 2, which, by one or more branch-pipes, communicates with the tuyere *y*.

In this tuyere, in order to regulate the quantity of air, and to throw it properly on to the furnace, is a cone, *z*, movable on its rod by means of a nut, which raises or lowers it at will.

The volume of air which does not come in contact with the furnace circulates in a conduit, *u*, which surrounds the cylinder, and descends between this latter and the masonry, to prevent the heat rising into the upper part.

The pistons, at the head-plate of the cylinder, are actuated by the rods *l l'*, impelled by the crank-shaft J of the apparatus, by means of two cams M M on the said shaft, and which act on friction-rollers carried by the rods *l l'*. The motion of these pistons takes place at the same time as that of the driving-piston Z. By the disposition of these pistons, the internal pressure compels them to cause the rollers of the rod to press against the cams of the crank-shaft J.

The driving-piston Z is furnished with a trunk above, and with an extension-piece, H, below, filled with coal-dust, to obviate the upper parts of the cylinder from getting overheated. It actuates the connecting-rod I, fixed at the bottom of the trunk, and which transmits its motion to the crank-shaft J, carrying the fly-wheels L L. This shaft is supported by two brackets K, cast solid with the lid of the cylinder.

The small distributing-pistons, represented in detached views in figs. 3 and 4, are packed with a segmental ring, *h*, having a central rib, and confined between both the head-plates *i*, which, by means of a nut, are fixed to their rod.

Moreover, two rings *m m'*, figs. 1 and 3, which are fitted into the inlet-conduits of the cylinder, and in which these pistons work, are furnished with a slot for the air to pass, said slot being provided with two abutments, *o* and *p*. (See fig 4.) These abutments serve to prevent the air passing through the slot, if the same is covered by the piston.

The cams M are so disposed as to admit the air when necessary, and also to obtain the degree of expansion required. Thus, when the driving-piston Z descends, the outer air penetrates into the upper part of the cylinder, through the upper distributing-piston Y, which is then at its lowest point.

As soon as the piston Z rises toward the middle of its course, the distributing-piston Y has also risen, and has intercepted the entrance of the outer air, and all further communication, until the cold air, at that moment shut up in the upper part of the working-cylinder, has acquired the same pressure as that of the furnace. Then the piston Y rises completely, together with the large piston Z, and the compressed air is forced through the valves *q* and into the interior of the furnace, as has been hereinbefore related.

The working of piston X, which distributes the heated air on issuing from the lower part of the cylinder, is the same as the preceding one, said air being allowed to escape through the spiral pipe B, so as to obtain the triple process of introduction, expansion, and escapement.

The disposition and the working of the furnace are as follows:

The upper part is arched in the shape of a vaulted roof, *w*, pierced in the centre with a circular aperture, immediately beneath the tuyere *y*. The object of this refractory roof, so arched, is to retain the heat as much as possible at the centre of the furnace, and thoroughly to consume the smoke and gases by the action of the draught of heated air introduced by the tuyere *y*.

The lower part of the furnace is hermetically closed, and furnished with a cast-iron platform, *c*, for the fuel, said platform being constantly rising toward the roof *w*. The furnace is fed for a whole day's work, or for any required length of time, the platform being at that stage completely lowered, and the fuel being made to reach the roof *w*.

As the fuel is by degrees consumed, the platform *c* rises gradually, by means of its central rod D, which carries at its lower extremity a roller, E, under which passes a chain fixed by one end to the lower part of the furnace, and by the other end to a counterweight, having a chain and a pulley, F G P, (see fig. 2,) which lowers as the fuel on the platform is gradually consumed. This counterweight is actuated, if needs be, with the hand, by means of a handle and a chain, as represented by the dotted lines in fig. 2.

What I claim as new, and desire to secure by Letters Patent, is—

1. The arrangement of devices for distributing the air throughout the apparatus, and for heating the same, consisting of main pistons Z, piston-valves X Y, valves *q r*, and annular chambers $x\ x^2$, substantially as described.

2. The arrangement of the furnace, with its peculiar closing-piece *g*, its vaulted roof *w*, and ascending platform *c*, substantially as set forth.

3. The arrangement of the valve *q*, for regulating the pressure, and of the double-conduit *x u*, for the passage of the compressed air, substantially as set forth.

4. The escapement air-pipe B, arranged in a spiral around the furnace, in combination with chimney *e*, provided with the junction-piece, constructed and operating substantially as described.

5. The combination and arrangement of the various devices constituting the apparatus, substantially as hereinbefore fully set forth and illustrated in the accompanying drawings.

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Witnesses:

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