

J. ERICSSON.
Air-Engine.

No. 226,052

Patented Mar. 30, 1880.

Fig. 1.

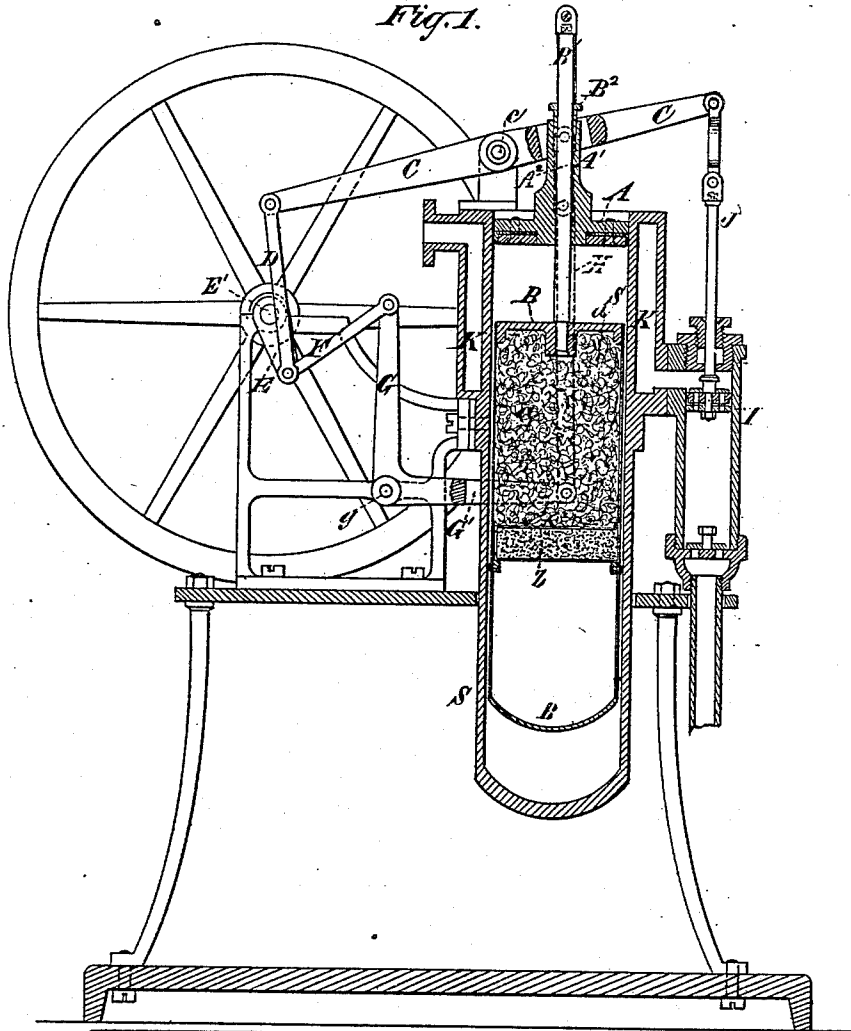
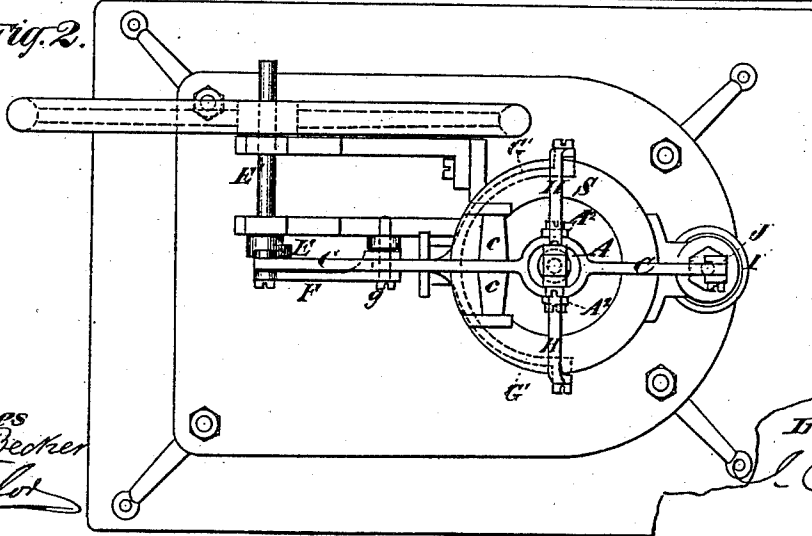


Fig. 2.



Witnesses
John Becker
S. W. Taylor

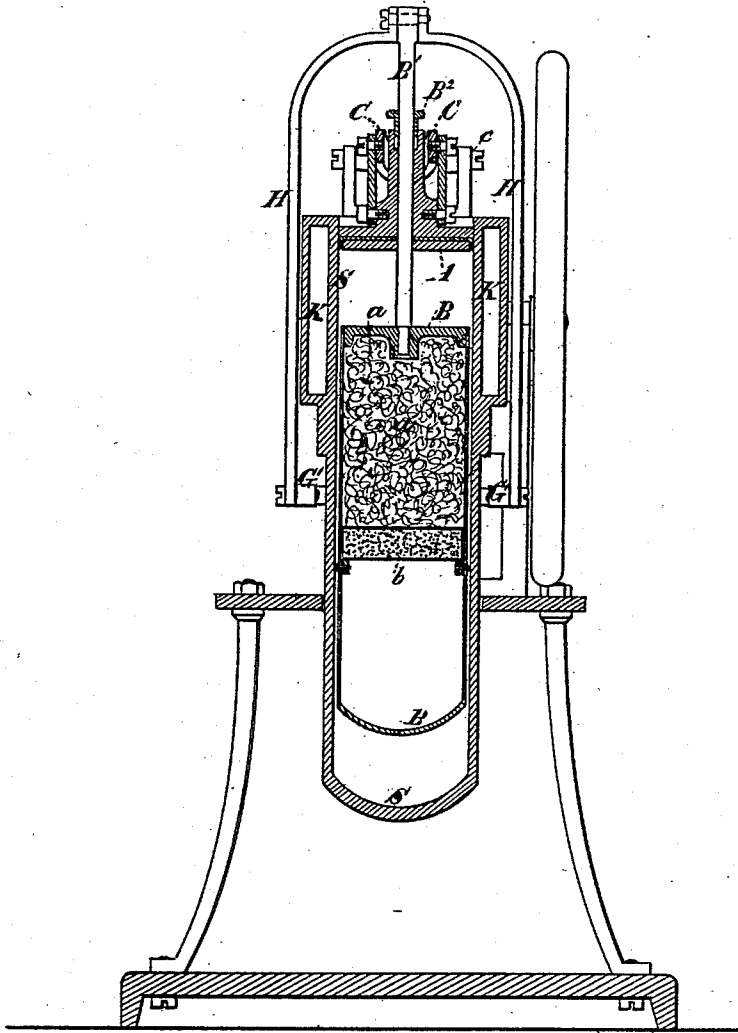
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Fig. 3.



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UNITED STATES PATENT OFFICE.

JOHN ERICSSON, OF NEW YORK, N. Y., ASSIGNOR TO CORNELIUS H. DELAMATER AND GEORGE H. ROBINSON, OF SAME PLACE.

AIR-ENGINE.

SPECIFICATION forming part of Letters Patent No. 226,052, dated March 30, 1880.

Application filed February 19, 1880.

To all whom it may concern:

Be it known that I, JOHN ERICSSON, of the city, county, and State of New York, have invented certain new and useful Improvements in Air-Engines, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to that class of air-engines in which, by the action of a piston, which may be termed the "exchange-piston," working in a cylinder, at or near one end of which is the working-piston and at the other end of which is the fire-place, the same air is over and over again transferred from each end of the said cylinder to the other alternately, being heated and expanded during its transference in one direction, and being cooled and contracted during its transference in the other direction, the said piston also performing the office of a regenerator.

One part of my invention consists in a novel system of mechanism for transmitting motion from the working-piston to a crank and to the exchange-piston, whereby with a short stroke of the working-piston I obtain both a long crank and a long movement of the exchange-piston, and the movements of the two pistons relatively to each other are so timed as to obtain the most effective action.

Another part of my invention consists in a novel arrangement of a pump and its connections with an air-engine, whereby I obtain a very effective pumping-engine with a short stroke of the engine-piston and a very long proportionate stroke of the pump plunger or piston.

In the accompanying drawings, Figure 1 is a vertical section of an upright engine constructed according to my invention, especially adapted for pumping, but also capable of use for other purposes. Fig. 2 is a plan of the same, and Fig. 3 a transverse vertical section.

S is the cylinder of the engine, open at the upper end, and containing two pistons—viz., the working-piston A and the exchange-piston B. The lower part of the said cylinder is closed and intended to be heated by gas, coal, or other fuel, with a burner or fire-place of any suitable construction. The working-piston A, which is

in the upper part of this cylinder, is packed in any suitable manner to work air-tight therein.

The exchange-piston B, which is of considerable length in an axial direction, is so much smaller than the cylinder that an annular space for free passage of air is left between its exterior and the interior of the cylinder. The said piston is represented as hollow and having its upper part, which is farthest from the fire or heat, partly filled with cotton or other fibrous material; *a a*, below which, inclosed, is a stratum, *b*, of powdered charcoal or other such non-conducting material as will protect the fibrous material from taking fire by the heat to which the bottom part of the piston is subjected.

The working-piston A is connected by a hollow rod or trunk, A', and short side links, A², with a beam, C, above the cylinder, the connection being at a short distance from the fixed center of oscillation *c* of the beam. This beam is connected at a much greater distance from the other side of the said center *c* by a connecting-rod, D, with the crank E on the main shaft E' of the engine, which is arranged on one side of the cylinder. This crank is also connected by a rod, F, with one arm, G, of a bell-crank lever, G G', which has a fixed center of oscillation at *g*, and the other forked arm, G', is connected by arched side rods, H, on opposite sides of the cylinder, by an arched yoke, with the head *g*. The piston-rod B' of the exchange-piston B passes through the hollow rod or trunk A' of the working-piston, and is packed air-tight by a stuffing-box, B², in the top of said hollow rod or trunk.

The center of oscillation of the bell-crank is arranged on the same side of the cylinder as the crank-shaft, but nearer to the side of the cylinder and farther from the upper part, in which the working-piston works.

By means of this system of connections the beam, receiving motion from the working-piston, is caused to transmit motion through the rod D to the crank E, which is caused to transmit motion through the rod F, the bell-crank lever G G', and the rods or yoke H to the exchange-piston.

The movements of the pistons are as fol-

lows: During the upward movement of the exchange-piston the cool air from the upper part of the cylinder will be transferred by the said piston through the annular space between it and the cylinder to the bottom and lower part of the latter, which is heated, as hereinabove described. The air so transferred, becoming heated, expands in the lower part of the cylinder, and its expansion causes it to force the working-piston upward. This movement of the exchange-piston is about three-fourths completed before the working-piston commences its upward movement by which its work is done, and when the working-piston has nearly completed the upward or working stroke the exchange-piston begins to descend and force the hot air back from the lower heated to the upper cool part of the cylinder, completing its stroke by the time the working-piston has made about one-third of its return stroke.

It will be understood that with such a movement of the piston as above described the working-piston is actuated by the air which is confined in the cylinder, and which is caused to be heated and cooled alternately by the peculiar motion of the exchange-piston, which transfers it from the heated to the cool and from the cool to the heated part of the cylinder.

It will be evident that the large surface presented by the outside of the long exchange-piston and inside of the long cylinder will cause a rapid change of temperature of the latter, the exchange-piston thus performing the office of what has been termed in air-engines a "regenerator."

By the arrangement of the crank-shaft, the centers of motion of the beam and bell-crank lever and of the connections, I obtain a long crank with a short stroke of the working-piston, and obtain a long stroke of the exchange-piston with such long side rods or yoke for working the latter piston and such slight deviation from a right line in the movement of the said side rods or yoke that guides for the said rods or yoke are unnecessary.

I is a pump arranged on the opposite side

of the cylinder S to the crank-shaft. The piston or plunger rod J of this pump is connected with the beam C on the same side of the center of oscillation of the latter as the engine-piston connections, the beam being prolonged beyond the cylinder S for the purpose of making this connection, and so obtaining the well-understood advantage of a long stroke for the pump with a short stroke of the working-piston of the engine. This pump is represented as delivering its water through a jacket, K, which surrounds the upper part of the engine-cylinder, for the purpose of cooling that part of the said cylinder, and so effecting a more rapid cooling of the air on its transference from the lower to the upper part of the said cylinder. This jacket is not, however, necessary to the successful cooling of the air in the cylinder itself. Being very long, it presents a large radiating-surface, which may be further increased by corrugating the external surface of its upper part.

What I claim as my invention is—

1. The combination, with the cylinder, crank-shaft, and crank of an air-engine, of a working-piston and an exchange-piston in the said cylinder, a beam and connecting-rod connecting the working-piston with the crank, and a bell-crank lever and connections connecting the crank with the exchange-piston, substantially as herein described.

2. The combination of the working-pistons A B, beam C, connecting-rod D, crank E, connecting-rod F, bell-crank lever G, and rods or yoke H, all substantially as herein described.

3. The combination, with the working cylinder and piston of an air-engine and a beam with which the said piston is connected, of a pump having its piston or plunger connected with the said beam at a greater distance from the center of oscillation thereof than the connection of the working-piston, substantially as and for the purpose herein described.

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Witnesses:

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FREDK. HAYNES.