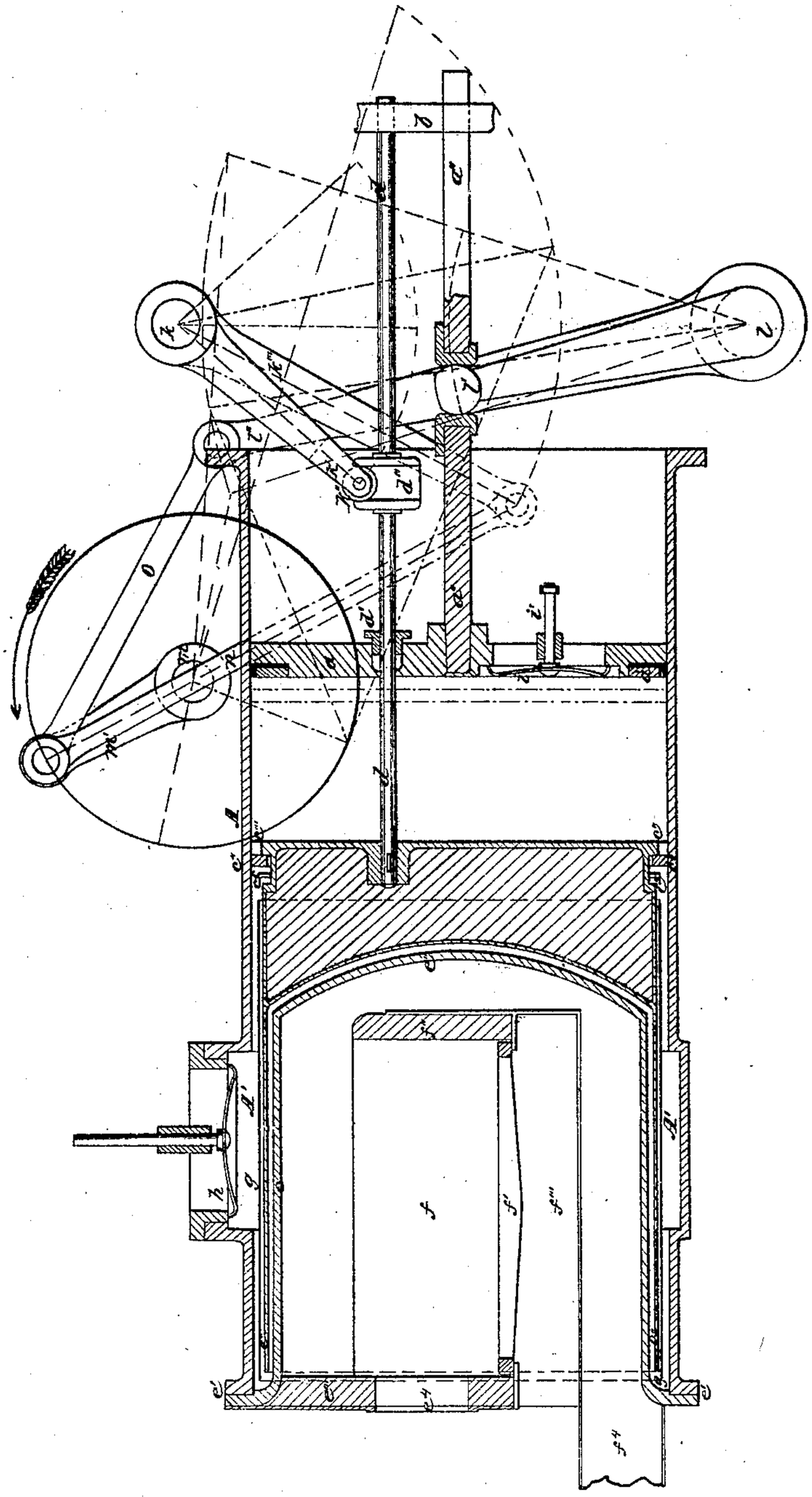
J. ERICSSON.

AIR ENGINE.

No. 22,281. Patented Dec. 14, 1858.



UNITED STATES PATENT OFFICE.

JOHN ERICSSON, OF NEW YORK, N. Y.

AIR-ENGINE.

Specification of Letters Patent No. 22,281, dated December 14, 1858.

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; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, making a part of this specification.

My invention consists in so constructing, arranging, and actuating the supply and working pistons within a single cylinder, that the cold supply air in being transferred to the heater for the purpose of having its tension augmented, shall cool that portion of the cylinder in which the working piston moves and keep it at so low a temperature that any kind of metal or any other suitable material, such as leather, may be employed for rendering the piston air-tight. In order to effect this, I connect the working and supply pistons to the crank of a fly-wheel shaft by a system of levers, rock-shafts and connecting rods of such a nature that an alternating accelerated and retarded reciprocating movement will be imparted to the two pistons, capable of effecting the desired transfer of the air and cooling of the working cylinder and at the same time to produce motive power.

My invention also consists in conveying the supply air from the cold end of the cylinder to the opposite end by such means that every particle of the air to be heated is made to traverse the entire length of the heater; all of which will be shown by the following description, reference being had to the drawing, which represents a longitudinal section of an air-engine with a single cylinder.

To enable others to apply my invention to use, I will proceed to describe its construction and operation.

A, is an open working cylinder.

a, is a working piston.

a', is an air-tight leather packing secured to the piston by means of a follower.

a'', *a''*, is the piston-rod, composed of a broad flat bar kept in a parallel position by a guide-piece *b*.

c, is the supply piston made hollow with a concave head *c'*. This piston is elongated toward the heater, the elongation forming an open cylinder as shown at *c''*, *c''*; the hollow part between the two heads *c* and *c'* is to be filled with pounded charcoal or other nonconducting substance. The circumference of the supply piston *c* is notched all around as shown at *c'''*, the notches resembling the spaces between the cogs of a spur wheel. The supply piston is also provided with a metallic packing ring c^4, which fits the bore of the working cylinder and forms an airtight joint when pressed against the back face of the supply piston-head during the inward motion of the supply piston. During the outward motion of the piston, the ring is permitted to move back against the cheek-pins c^5, a communication being thereby established which allows the air to pass freely through the notches and behind the packing ring toward the heater.

d, is the piston-rod of the supply piston, made to pass through a stuffing box *d'* in the main piston and held in parallel position by the guide piece *b*.

e, is the heater, consisting of an open cylinder with a spherical head *c''*, the open end being secured to the flange of the working cylinder or to its prolongation as shown at *e'*. The said open end of the heater is provided with a brick front *e'''*, and fire-door e^4.

f, is the fireplace; *f'*, the grate; *f''*, brick lining placed a short distance from the heater to allow the heat after leaving the fireplace to act properly on the inside of the heater.

f''' is the ashpit, and f^4 the flue for carrying off the products of combustion. In engines of small power, I carry this flue directly to the chimney; but in engines of greater power, I first pass the products of combustion through the annular space formed between the working cylinder or its prolongation and a surrounding jacket composed of some non-conducting substance.

g, is a cylindrical casing, open at both ends, resembling a telescopic tube large enough to allow the supply piston to work freely within. This tube is secured to the inside of the working cylinder or its prolongation by small socket bolts passing through the space between the cylinder and the tube, or by other methods that do not interfere with the free passage of the air through this space.

A' is a cavity formed on the inside of the working cylinder or its prolongation for conveying the air readily from every part of the circumference to the exhaust valve *h*. This valve is to be actuated by suitable valve

gear connected to the fly-wheel shaft in such a manner that the valve will open when the supply piston has performed the outward stroke, and close somewhat in advance of the completion of the inward stroke of that piston.

i, is the inlet valve inserted in the main piston, guided by the stem *i'*, and held against the valve seat by a spring or balance weight.

K, is the rockshaft extending across the cylinder, terminating a short distance behind it and supported at each end by pillow blocks secured to the flange of the open end of the working cylinder or otherwise supported by appropriate side frames.

k', is a lever attached to said rockshaft for moving the supply piston by means of friction rollers *k''*, and a crosshead *d''*.

k''' is another lever, also attached to said rockshaft, outside of the cylinder.

l, is another rockshaft extending across the cylinder and supported by pillow blocks as before stated.

l', is a lever attached to rockshaft *l*, for transmitting the motive power of the working piston. The upper end of this lever is inserted into the main piston rod, appropriate bearing brasses being applied in the rod for receiving the thrust of the lever. *l''* is another lever also attached to the rockshaft *l*, close by the side of the lever *k'''*.

m, is the fly-wheel shaft; *m'*, the crank attached thereto, connected to the levers *k'''*, and *l''*, by means of connecting rods *n*, and *o*.

It will be evident on examining the drawing and the relative position and movement of the crank, connecting rods and levers described, that the two pistons will complete the outward stroke nearly at the same time; and that during the inward stroke, the supply piston not only performs a much longer movement than the working piston, but also that the former completes its movement before the latter. It has been stated that the exhaust valve *h* opens at the termination of the outward stroke of the supply piston. It will therefore be seen that as this piston moves away from the working piston during the inward movement, fresh cold air will be drawn in through the self-acting valve *i*, filling the space formed between the two pistons; at the same time the heated air behind the supply piston will pass off through the exhaust valve *h*. It will further be seen that during the outward motion of the supply piston, its packing ring will be drawn back and thereby allow the air to pass through the notches *c'''*, from the cold to the hot end of the cylinder. Further examination of the crank and lever movement will show that when the working piston has performed a very small portion of the outward stroke, the supply piston is far advanced, and that it soon overtakes the former and moves with it to the end of the stroke. The cold air drawn in and confined between the two pistons during their inward movement will consequently be transferred to the space between the heater and supply piston. The pressure produced by the increase of temperature during this transfer will propel the working piston through the outward stroke and thus supply motive force. The return stroke is effected by various means, such as the momentum of the fly wheel alone,—the momentum together with a balance weight placed in the rim of the wheel;—the coupling of two similar engines together, with their driving cranks placed in opposite directions;—or by atmospheric pressure acting on an air-tight piston connected to the engine, a vacuum being formed during the outward stroke of the working piston.

I have now particularly to describe the telescopic tube or casing *g*. This tube as before stated is secured to the inside of the working cylinder or its prolongation, the diameter being sufficient only to admit the supply piston to pass through, but having ample space outside to admit a free passage of the air to and from the heater. It will be seen that when the supply piston moves outward, the air, during its transfer and after its passage through the notches, must traverse the whole distance outside of the tube until it reaches its extreme end, after which it must also traverse the entire length of the heater, as well as the interior of the tube; consequently every particle of air must pass over the entire heating surface, during the transfer from the cold to the hot end of the cylinder. I have further to notice that during the discharge of the hot air through the exhaust valve, heat is all the while being imparted to the tube and cylinder by the escaping air. The heat thus imparted is in due course given out again to the cold air in the passage to the heater. The hot air escaping from the exhaust valve I employ for various purposes, such as warming buildings and boiling liquids. In cases where the draft of the chimney is insufficient to keep up the combustion in the fireplace, I carry the escape air into the center of the chimney, on the principle of the steam blast of a locomotive engine. I likewise, in some cases, carry a portion of the escape air under the grate in order to stimulate the combustion.

In relation to the packing ring of the supply piston, I have to state that it serves the two-fold purpose of packing and valve, and that it is instrumental in cooling that end of the cylinder in which the working piston moves by permitting the cold air to pass simultaneously through all the notches and thereby to sweep the entire inside of the cylinder during the time that the supply piston is moving out; while it effectually

shuts off the return of hot air during the inward movement. It is proper further to state that the cooling process here described, besides its other advantages, is instrumental in imparting considerable heat to the air during the transfer, since the cooling of the cylinder is effected by the air to be heated.

What I claim as my invention, and desire to secure by Letters-Patent, is:—

1. The within-described system of levers, rockshafts, and connecting rods, or its equivalent, for combining the supply and working pistons with the crankshaft of the engine to produce the operation herein specified.

2. The ring c^4, the notches c''', check pins c^5, and the elongation c'', of the supply piston, or their equivalents, for effecting the required transfer of the air to and from the heater and the cooling of the cylinder and preservation of the packing of the working piston.

3. The telescopic tube g, applied within the working cylinder and its prolongation, by means of which tube the air is brought in proper contact with the heating surfaces, substantially as herein set forth.

J. ERICSSON.

Witnesses:
HENRY T. BROWN,
WM. TUSCH.