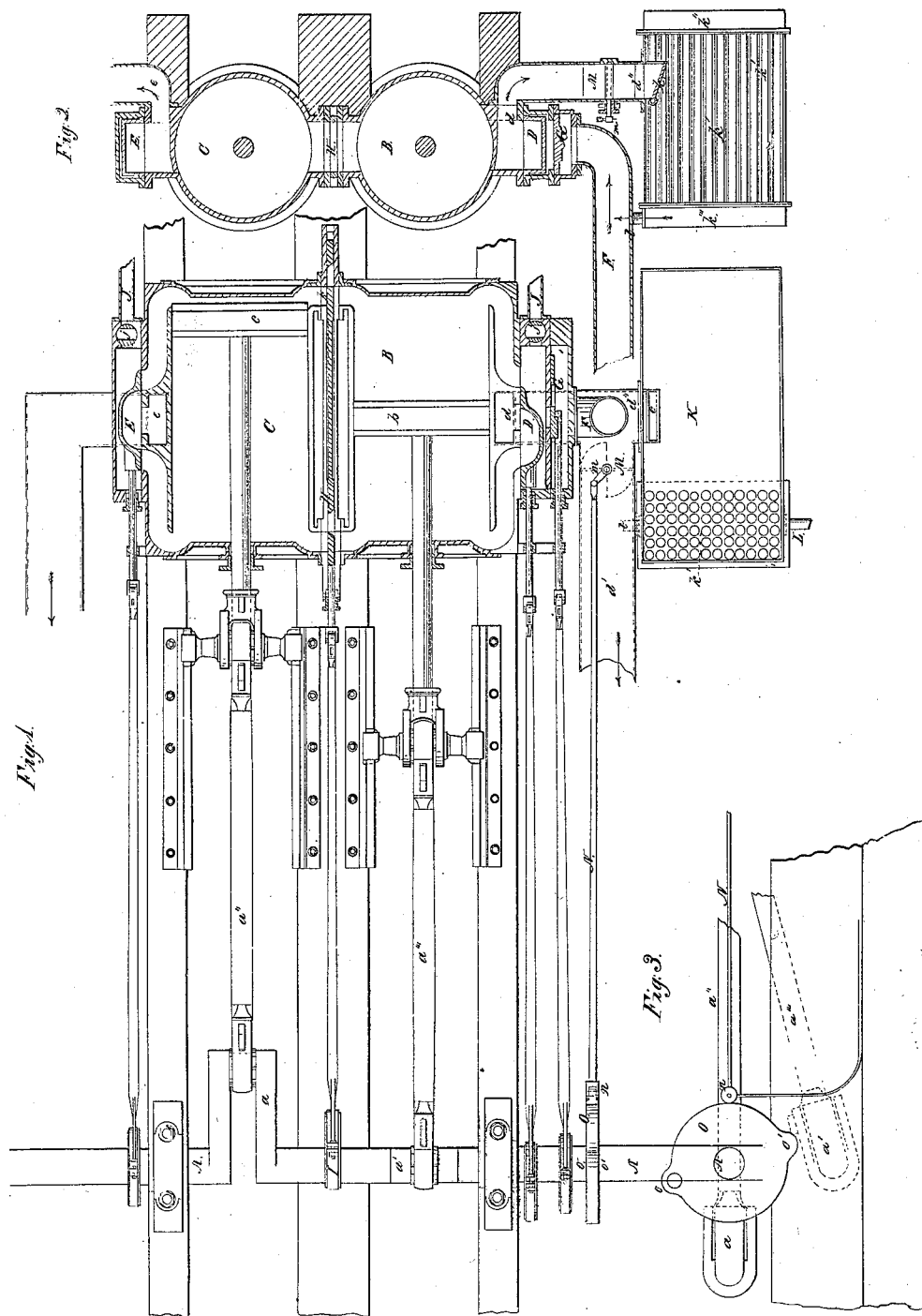


*J. Ericsson.*  
*Compound Steam Engine.*  
*N<sup>o</sup> 4,311.      Patented Dec. 20, 1845.*



# UNITED STATES PATENT OFFICE.

JOHN ERICSSON, OF NEW YORK, N. Y.

## IMPROVEMENT IN STEAM-ENGINES.

Specification forming part of Letters Patent No. 4,317, dated December 20, 1845.

*To all whom it may concern:*

Be it known that I, JOHN ERICSSON, an alien, who have been residing in the United States for five years and upward next preceding the date hereof, and now reside in the city, county, and State of New York, and have made oath of my intention to become a citizen of the United States, have invented a certain new and useful Improvement in Steam-Engines; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings and the letters marked thereon, that is to say:

My said improvement consists, first, in two cylinders, into only one of which steam is admitted directly from the boiler, the pistons of these cylinders being connected to cranks placed at right angles, and the steam being made to act simultaneously on both pistons during half the stroke by keeping a free communication open during that half-stroke between the said two cylinders, there being a vacuum constantly kept up in the cylinders (on the opposite side of their pistons to that on which the steam acts) during the entire stroke of each piston; and, secondly, in introducing a valve into the exhaust-pipe of that cylinder which receives the steam directly from the boiler, said valve being made to close momentarily at the termination of each stroke of the piston, while the steam from the cylinder thereby prevented from escaping into the condenser is made to pass through a self-acting valve or trap into a capacious steam-receiver partially filled with small tubes, through which the feed-water is made to pass on its way from the ordinary hot-water cistern of the air-pump to the boiler.

In the drawings accompanying this specification and making part of the same, Figure I represents a top view, and Fig. II an end view, of a steam-engine exhibiting my said improvement.

A A is the crank-shaft; *a a'*, cranks placed at right angles; *a'' a'''*, connecting-rods for communicating the force of the pistons to the said cranks in the usual manner; B, cylinder connected to the crank *a'* and which receives the steam directly from the boiler; *b*, its piston; C, cylinder connected to the crank *a*; *c*, its piston; D E, ordinary slide-valves worked in the usual manner for conveying the steam

to and from said cylinders; *d e*, exhaust-pipes for conveying the steam into ordinary condensers; F, main steam-pipe for conducting the steam from the boiler to cylinder B; G, a cut-off valve worked in the ordinary manner, to be opened when the piston *b* commences its stroke, and to be closed when the same has traveled one-half the length of the cylinder B; *h*, slide-valves which open or close a communication between the cylinders B C, these valves to be worked by an eccentric I, fixed on the crank-shaft in such a position that when the piston *c* commences its movement from right to left the slide-valves H *h* will commence to open by a left-handed movement, and will close when said piston shall have performed half its stroke, and again open by a right-handed movement when said piston *c* commences its movement from left to right, and again close when said piston shall have performed half its stroke; J J, small steam-pipes communicating with the boiler; *j j*, stop-cocks in said pipes for shutting off such communication; *d'*, continuation of the exhaust-pipe *d* of the cylinder B, communicating with an ordinary condenser, as before stated; *d''*, a branch of said exhaust-pipe *d*, attached to a capacious steam-receiver K; *k*, a self-acting valve or trap applied to the end of the branch exhaust-pipe *d''*, permitting the steam to enter the receiver freely, but preventing its return; *k'*, a series of small tubes inserted through the top and bottom of the steam-receiver K; *k'' k'''*, boxes covering the apertures of said tubes and forming a free communication between the whole series; L, feed-pipe attached to box *k''*, communicating with an ordinary force-pump; *l*, feed-pipe communicating with the box *k'''* and the boiler; M, a throttle-valve placed in the exhaust-pipe *d'* and worked by means of the lever *m* and the rod N and the tappet-wheel O, fixed to the crank-shaft; *n*, a spring attached to the end of the rod N for pressing the same against the circumference of the tappet-wheel O; *o o'*, lugs or projections formed on the circumference of said tappet-wheel on opposite sides and so placed that when the piston *b* shall have arrived at the termination of its stroke either way one of these lugs shall commence to bear against the end of the rod N, so that when the crank *a'* shall have passed the center either way the said rod N, by means of

the lever *m*, shall cause the throttle-valve *M* to close, and thus cut off the communication between the exhaust-pipe *d* and the ordinary condenser.

Having thus particularly described my said improvement, I will proceed to explain the manner in which the same is to be put into operation. On starting the engine the cocks *j j* should be opened in order to admit steam from the boiler through the steam-pipes *J J*. The slide-valves *D E* being adjusted and connected with the crank-shaft in the ordinary manner, the steam thus admitted will cause the engine to work. As soon as motion is thus obtained the cocks *j j* should be closed. The cylinder *B* will then be supplied with steam expansively through the steam-pipe *F*, the cut-off valve *G* being worked upon the ordinary plan. As the slide-valve *h* will commence opening when the piston *c* commences its left-hand movement, the steam in the cylinder *B* will pass into the cylinder *C* and the pressure will act simultaneously on both pistons until the piston *b* shall have arrived at the termination of its stroke and the piston *c* shall have performed half its stroke. The slide-valve *h* being then closed, the steam thus admitted into the cylinder *C* from the cylinder *B* will by its expansive force cause the piston *c* to perform its full left-handed stroke. In the mean time the piston *b*, by means of the steam admitted through the valves *G* and *D*, will have performed half of its retrograde or right-handed movement and again occupy the position marked on the drawings, at which moment the slide-valve *H* will commence opening with a right-hand movement and the steam on the left side of the piston *b* pass into the cylinder *C*, thereby causing the same simultaneous pressure on the two pistons in the opposite direction to that before described, and thus a continuous movement will be kept up in both engines, the cylinder *C* obtaining its supply of steam solely from the cylinder *B*, while at each stroke the steam from the cylinder *C*, having performed its office, will pass off through the exhaust-pipe *e* into an ordinary condenser, while that portion of the steam from the cylinder *B* which has not passed through the valves *H h* will escape through the exhaust-pipe *d* partially into the steam-receiver *K* and partially through the exhaust-pipe *d'* into an ordinary condenser. By inspecting the form of the lugs *o o* (see Fig. III, which is a section in elevation) on the

tappet-wheel *O* it will be seen that the throttle-valve *M* is closed only for a moment at each termination of the stroke of the piston *b*, and that during this momentary stoppage of the exhaust-pipe *d'* the escaping steam from the cylinder *B* will pass through the self-acting valve or trap *k* into the steam-receiver *K*. The steam which in this manner is admitted into said steam-receiver will act upon the series of small tubes *k' k'*, whereby the feed-water on its passage to the boiler, as before described, will become heated. The condensed water formed by the steam in the receiver in giving out its heat to the said tubes should be carried off from the bottom of said receiver by means of a small pipe into the condenser, or it may be drawn out by suitable pumps and forced directly into the boilers.

I do not claim as my invention the pistons, valves, or any other known part of the engine hereinbefore described; nor do I claim the passing the steam from one cylinder to another, (that having been done by Wolf and others;) but

I claim as my invention, and desire to secure by Letters Patent—

1. The connecting the pistons of the two cylinders to cranks placed at right angles, in combination with the admitting the steam directly from the boiler into one cylinder only and the working the steam expansively in said cylinder, together with the employing the steam to act simultaneously on both pistons during half the stroke, as hereinbefore described, by opening a communication alternately and keeping the same open during only half the stroke between the two cylinders, while at all times a vacuum is kept up during the entire stroke in both cylinders on the opposite sides of each of the pistons to that on which the steam acts.

2. The momentary stoppage of the exhaust-pipe of that cylinder which receives the steam directly from the boiler, and the conveying a portion of the steam from that cylinder into a receiver partially filled with tubes, through which the feed-water is passed on its way to the boiler, in the manner hereinbefore described.

J. ERICSSON.

Witnesses:

JOHN O. SARGENT,  
JAMES O. SARGENT.