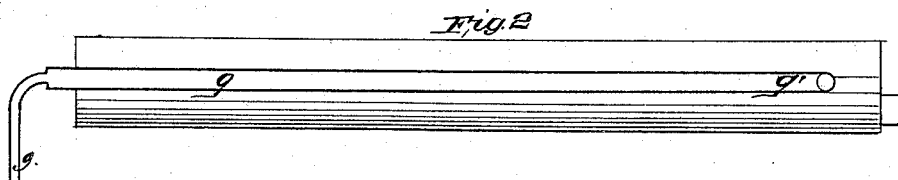
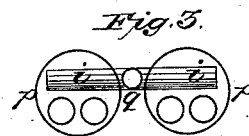
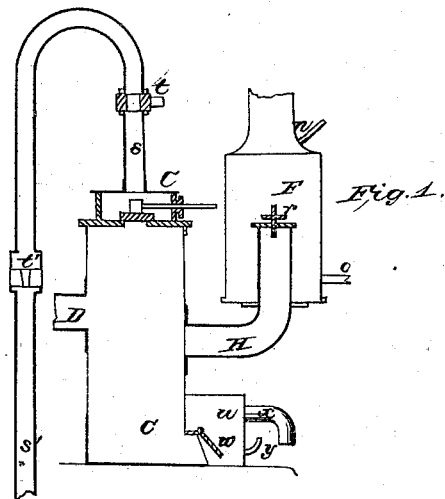


B. CRAWFORD.  
STEAM ENGINE.

No. 3,732.

Patented Sept. 7, 1844.



# UNITED STATES PATENT OFFICE.

BENJN. CRAWFORD, OF ALLEGHENY, PENNSYLVANIA.

## CONDENSER AND BOILER OF STEAM-ENGINES.

Specification of Letters Patent No. 3,732, dated September 7, 1844.

*To all whom it may concern:*

Be it known that I, BENJAMIN CRAWFORD, of the city of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Engines; and I do hereby declare that the following is a full and exact description thereof.

My first improvement consists in combining a water heater from which the boilers to be supplied, with a condenser provided with a foot valve opening into the atmosphere or a reservoir of water by means of an ejection pipe and valve, so that the exhaust steam that enters the condenser shall escape into the heater until its elastic force is reduced to the atmospheric pressure; and then to be condensed by a jet of water—the water and air of the previous condensation being discharged by the same steam without an air pump.

My second improvement consists in the manner in which I prevent the water from flowing from one boiler into another when the boat careens.

In the accompanying drawing Figure 1, is a heater such as are generally used on high pressure engines, C, being the condenser, and F the heater. Into the condenser C, cold water may be conducted through a pipe S, which may be recurved, and its end S', may dip into the river, or other reservoir of water the water will then rise—by the pressure of the atmosphere—through this tube when a vacuum is produced in the condenser. When the tube is thus recurved a valve *t'* may be placed in it which opening upward in its descending part will allow water to flow into the condenser; but will prevent the steam from throwing it out again at the time of escape.

I usually place a slide valve *v*, working in a box over an opening on the top of the condenser, in order to let on and shut off the water at the proper intervals; this valve may be worked by a cam that will shut off the water at the end of the stroke of the engine, and let it on again immediately after the escape of the steam from the cylinder. D is the pipe that connects the condenser with the cylinder. H, is an escape pipe by which the steam passes off into the heater F. Upon the escape pipe H, I place a valve *r*, which serves to prevent the entrance of the air into the condenser C, while it allows the escape of the steam and of any air which

may be mixed with it. The condenser C, stands in a cistern *u*, and *w*, is a foot valve opening outward, *x* is a waste pipe from the cistern *y*, is a pipe leading to a pump by which the water is to be pumped from the cistern *u*, into the heater, *n*, represents the pipe by which it is to be conducted in, and *v*, is a pipe leading from the heater to the force pump for the supply of the boilers.

From the manner of arranging the apparatus it will be seen that I permit a portion of the steam which may be above atmospheric pressure to escape from the condenser through the valve *r*, into the heater F which escape steam may be used for heating the water for the supply of the boilers. By allowing the steam to escape as above described, the condenser may be made much smaller than would otherwise be required. The quantity of cold water used will also be much diminished and a great saving will be effected in the weight and material of the condenser. In the arrangement of the respective parts of the condenser and heater the main working parts differ in their combination from such as have been heretofore employed. The foot valve *w*, is a common device, but the valve *r*, within the heater, the slide valve *v*, the cold water pipe S, with its valve *t*, enables me by their action to heat the water preparatory to the supply of the boilers, and to produce a vacuum in the condenser without the aid of a cold water pump for supplying the jet, or the air pump for the purpose of exhausting air and water from the condenser.

My second improvement consists in the manner by which I prevent the water from flowing from one boiler into another when the boat careens; this I am enabled to do by means of tubes attached to the openings and reaching nearly across the boilers, which will extend the openings to the opposite side from which they are connected as shown at *i, i* in Fig. 3. These tubes will be placed about an inch or an inch and a half above the flues of the boilers, so that when the boilers stand level the water will flow through the tubes from one boiler to the other; but when the boat careens and throws the boilers out of level the end of the tube in the boiler which stands highest will lift out of the water thereby preventing the water in it from flowing into the lowermost boiler.

Having thus fully described the nature of

my improvement in the steam engine what I claim as my invention and desire to secure by Letters Patent, is—

1. The method of working the condenser  
5 of a steam engine without the aid of an air pump, by so combining it with a valve which opens from an escape pipe into a water heater, and with a foot valve which discharges into the open air or into a reser-  
10 voir of water—by which combination the steam which enters the condenser escapes partly through the upper valve into the heater to heat the water for the boilers and carrying with it a portion of the air from  
15 the condenser, and partly through the foot

valve carrying with it the water and air of the previous condensation, and when by these operations the elastic force of the steam is reduced below the atmospheric pressure the valves are closed and the remaining  
20 steam condensed—all as described.

2. I likewise claim the manner of preventing the water from flowing from one boiler into another when the boat careens by means of the tubes as above described and repre-  
25 sented.

BENJN. CRAWFORD.

Witnesses:

ABRAHAM BUTLER,  
THOS. J. EARHART.