N. W. ERICSON.

Apparatus for Utilizing Exhaust Steam.

No. 217,785. Patented July 22, 1879.

FIG. 1.

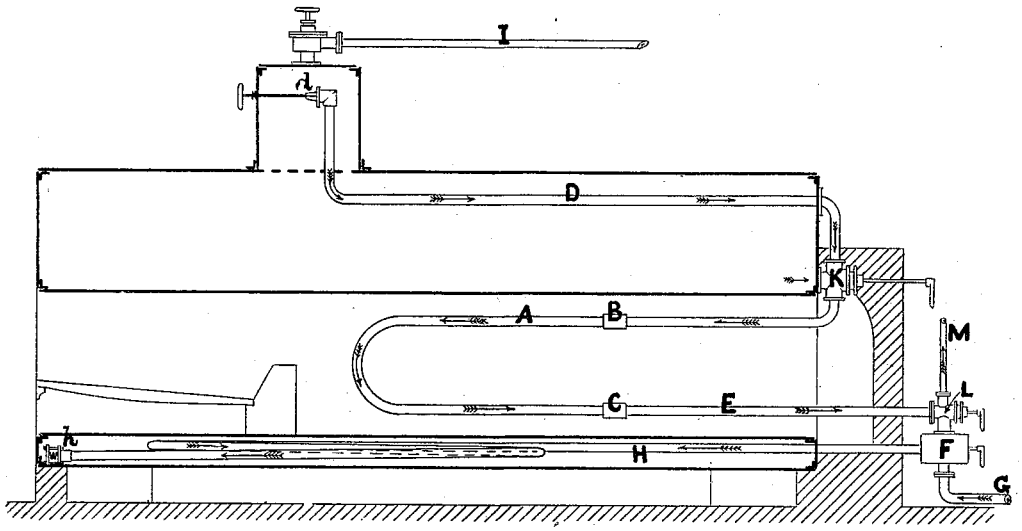


FIG. 2.

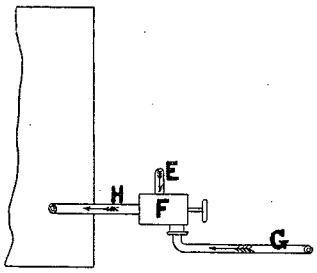
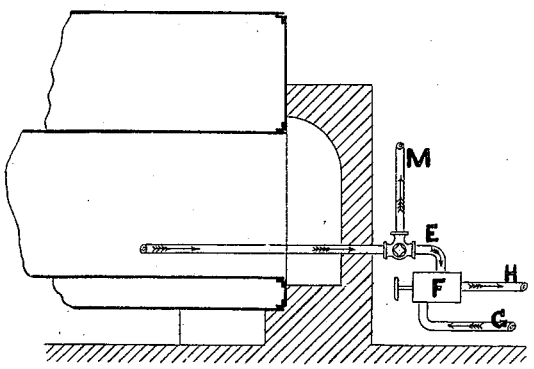


FIG. 3.



Witnesses

Chas. H. Smith
Harold Serrell

Inventor

Nils Werner Ericson
by Samuel W. Serrell
Atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

NILS WERNER ERICSON, OF STOCKHOLM, SWEDEN.

IMPROVEMENT IN APPARATUS FOR UTILIZING EXHAUST-STEAM.

Specification forming part of Letters Patent No. **217,785**, dated July 22, 1879; application filed December 30, 1878.

To all whom it may concern:

Be it known that I, NILS WERNER ERICSON, of Stockholm, Sweden, but at present of 33 Chancery Lane, in the county of Middlesex, England, have invented Improvements in Apparatus for Utilizing Exhaust or other Used or Spent Steam, and in apparatus therefor; which improvements are fully set forth in the following specification, reference being had to the accompanying drawings.

According to this invention I let steam, be it superheated or not, of higher pressure or higher temperature, or both higher pressure and temperature, than the pressure or temperature, or both, of the steam which is to be used in a steam-engine, or for any other purpose, pass into an apparatus for the suction and compression of elastic fluid, in order that the said higher or stronger steam may in such apparatus act as the suction fluid to the said spent steam. This suction and compression apparatus is further connected with the apparatus wherein steam is to be used, in order that the spent steam may, to a greater or less extent, be drawn into the suction and compression apparatus when the acting or higher steam passes through it. The mixture of the acting or drawing steam and the spent steam passes through the delivery-pipe of the suction and compression apparatus (and its continuation, as required) either to the place where the thus compressed steam is to be used or else first through an apparatus containing saturated steam or water, or in so near connection with water that the steam, if in a superheated state, becomes saturated, or lowered in temperature, or else into an apparatus wherein the steam, by cooling, is rendered liquid, and the heat thereby given out is used for generation of fresh steam. This latter apparatus may be the steam-boiler in which the acting superheated steam is generated or another steam boiler or vessel.

As to the pipe or other conductor through which the steam after compression is led directly to where it is used, (if the method be so adapted,) or the apparatus where the steam is saturated, (if the method be so adapted,) I do not lay particular stress upon its form or nature; but, as regards the apparatus which I shall call the "receiving-vessel," whereinto (if the method be so adapted) the steam is condensed, and the heat thereby given out is used for the generation of fresh steam, I shall farther on describe some of its features, which may vary.

The receiving-vessel is so divided into two parts that their steam-spaces are separated from each other, while the water-spaces wholly or partly are connected; or, instead of such a partitioned receiving-vessel, I may use two apparatus, but so that their water-spaces communicate, and the heat communication may take place between both apparatus without loss of heat. When new steam enters the one compartment, which I shall call the "first," it passes into the liquid state in that measure, as its temperature, through the higher pressure being kept constant, is higher than that of the water in the same compartment. This water cools again in that measure, as heat is carried over to what I call the "second compartment." The temperature of the water in the second compartment is lowered in the measure it gives up heat for the formation of steam, which is led away for application to a steam-engine, or to some other useful purpose. The heat communication between the water-compartments may be arranged in various ways. The water-compartments may thus communicate completely, or the partition between the steam-spaces may be continued into the water-space and an opening only left. The heat communication may only be through the water and the partition without any intervention of special means; or it may be furthered by the application of any suitably-formed metallic strongly-conducting bodies or appliances; or one compartment may be partially extended into or wholly contained in the other, in order to afford a greater contact area between the compartments, this area being formed in any convenient manner; or the pipe through which the steam is led into the first compartment may be first passed through the water-space of the one compartment, or both, in order that the steam may thereby give up heat; or two or more of these various arrangements may be combined or applied simultaneously.

The simplest is to lead the pipe in the water-space of the second compartment, and quite shut out the first compartment. As the pipe enters the said water-space the steam is, by compression, brought to a higher temperature than that of the surrounding water, and consequently gives off heat through the metal wall of the pipe. By continued compression this high temperature of the steam is retained, and when in this manner a certain amount of heat has been given off the steam already in the pipe will, if this latter be of sufficient dimensions, be rendered partly or wholly liquid. The same, of course, takes place, if instead of one pipe a system of same be applied, and this pipe or pipe system thus answers to the first compartment, which, as before stated, is placed in the other.

In general, as regards these arrangements, it must be observed that it is possible, to a great extent, to determine the temperature (corresponding to the pressure, and depending upon the amount of heat then existing in the steam) at the place of entry in the space, which may be of any form suiting the first compartment, thereby that against the entry of this steam be opposed a certain resistance—for instance, in the form of a valve, (loaded by spring or otherwise,) which opens in toward the said compartment. In the same way one may influence the pressure and temperature of the steam in several places in this first compartment, where its form admits it as well as where the compartments directly communicate with one another, which may take place in one or more places. On the other hand, such resistance appliance or valves may be left out; but an unloaded valve should be used in order to prevent the flow of steam from the receiving-vessel to the suction apparatus when the steam-entry from some cause stops. When, as described with the first alternative, the receiving-vessel is made with a partition with an aperture through in the water-space, this aperture may be provided with a valve for keeping the water in the other compartment at a certain height, this valve closing in the measure as the pressure might rise in the first compartment, or it may be so arranged that by an automatic appliance it is put in connection with the water-surface in one or both compartments, and so that as the water rises or falls it may open or close, and thus regulate the communication between the water-spaces and the position of the water-surfaces.

By means of a valve in the wall between the steam-compartments the pressure in each compartment may be influenced. All this valve-regulation is, however, not an indispensable feature in all my arrangements, according to my method, but depends upon such adaptations as may have to be made in some cases.

In order that any surplus of the spent steam passing to the suction apparatus may have liberty to escape, a valve or opening should be provided in a pipe or part in connection with the said apparatus.

It would be inconvenient and useless to illustrate the application of my invention to all the numerous constructions of steam-boilers or other receiving-vessels or generators, or even to the more important or typical constructions of steam-boilers; but to enable a practical engineer to carry out my invention I will, by outline diagrams, illustrate three modes of carrying it into effect.

Figure 1 is a longitudinal section through an ordinary cylindrical boiler constructed with one or two fire-places, and acting also as a receiving-vessel.

D is a steam-pipe, fitted with admission-valve or regulator *d*, and leading to a superheating-pipe system, A, connected at each end to the boxes B and C. E is a pipe conveying the superheated steam to a jet apparatus, F, which may be of any suitable construction. G is a pipe conveying used or other spent steam—say, the exhaust-steam from a steam-engine. The high-pressure steam from E draws on the exhaust-steam from G, and forces it into the pipe-system H, which passes through the water-space of the boiler, and is compressed while giving off heat to same. The pipe-system H terminates in a valve, *h*, which can be set to any required extent, so as to regulate the pressure, the more or less condensed steam escaping there into any part of the boiler—as here shown, into the water-space. I is the steam-pipe leading to the steam-engine. K is a three-way cock, which can be turned so as to constantly admit a very small quantity of water, for the purpose of preventing the superheater A from being burned while the steam is being got up in the boiler before the engine and the whole apparatus are at work, or during any other stoppage of work. L is a three-way cock for letting the steam generated by such water-admission escape into the chimney or other place, and for shutting off the connection with the jet apparatus F.

In Fig. 2 is shown a similar arrangement, only that the acting or superheated steam in this case comes by the pipe E from another or separate steam-boiler.

Fig. 3 shows an arrangement with one boiler in which the acting or superheated steam is generated and passes by the pipe E into the apparatus F, and there draws the exhaust or spent steam from the pipe G and forces it directly to the steam-engine or other apparatus where it is to be applied by the pipe H in a compressed state instead of carrying it into a boiler for being therein condensed.

I will add that my method does not depend upon and is not distinguished by the construction or arrangement of the generator or generators used, if two generators are used; nor in any greater measure than hereinbefore indicated on the arrangement of the receiving-vessel; nor on the means for the superheating of the sucking steam; nor on the amount of

heat carried with the compressed steam into the boiler or receiving-vessel or such apparatus which may be used for equalizing or lowering the temperature of the compressed steam or for saturating the same; nor on the manner in which the surplus is applied or the deficiency supplied, as this depends upon the various adaptations of my method; nor on the means for equalizing the delivery of spent steam to the suction apparatus, if it, for example, comes stroke by stroke from a steam-engine; nor on the means for equalizing the temperature of the compressed steam, if conducted in a superheated state to any place where it is to work; nor on the construction of the suction and compression apparatus; nor on the arrangement of the pipes, the steam-boilers, or the other apparatus, although it is of course important that loss of heat be as much as possible avoided; nor do I lay any stress on any other arrangements or details which do not alter the essential features of the invention.

I am aware that an injector has been employed to force the feed-water into a boiler, both alone and in connection with the exhaust-steam from an engine; and I am also aware that a peculiar jet apparatus has been used in connection with a jet-condenser, which it is claimed condenses the water out of the exhaust-steam, feeds water to the boiler, and so restores the life of the steam, which, after passing through a reduction-nozzle, is fitted for reuse in an engine; but I distinctly disclaim any such means or apparatus.

I claim as my invention—

1. The combination, with a steam-boiler, of a steam-pipe passing through the flue-space of said boiler, whereby the steam becomes superheated, an injector operated by the superheated steam, a feed-water pipe and a pipe in the lower part of the boiler through which the superheated steam and feed-water pass, and a check-valve at the end of said pipe, substantially as and for the purpose set forth.

2. A steam-pipe from a boiler passing through the flue-space, whereby the steam becomes superheated, a pipe leading from an engine in which steam has been employed, and an injector, substantially as specified, whereby the superheated steam and the injector are made to exhaust the spent steam, and the superheated steam, commingling with the exhaust-steam, vitalizes the same for use, substantially as set forth.

NILS WERNER ERICSON.

Witnesses:

PETER JENSEN,
33 *Chancery Lane.*

EDWIN PLANTA,
33 *Chancery Lane.*