E. JOSSE & W. GENSECKE.

MEANS FOR EVACUATING VACUUM APPARATUS.

APPLICATION FILED MAY 27, 1912.

1,046,304.

Patented Dec. 3, 1912.

2 SHEETS—SHEET 1.

Fig. 1.

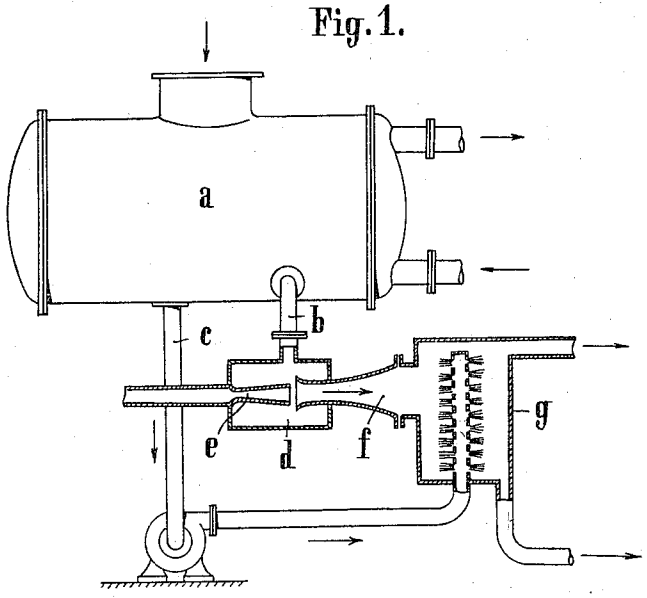
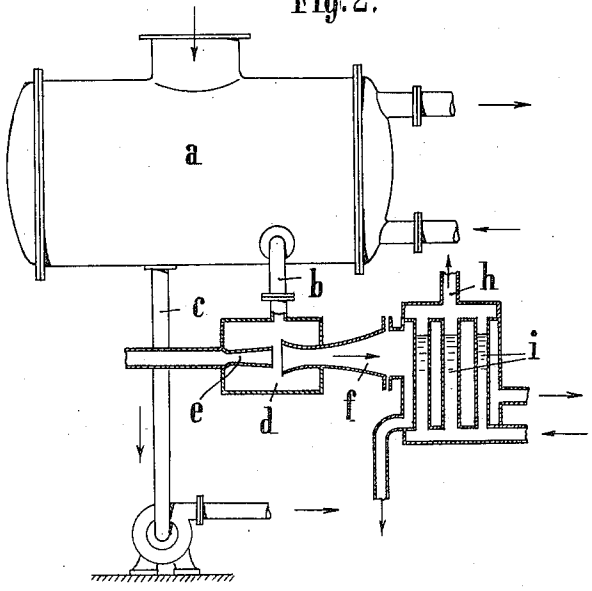


Fig. 2.



Witnesses:

Inventors

Emil Josse & Wilhelm Gensecke

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their Attorneys

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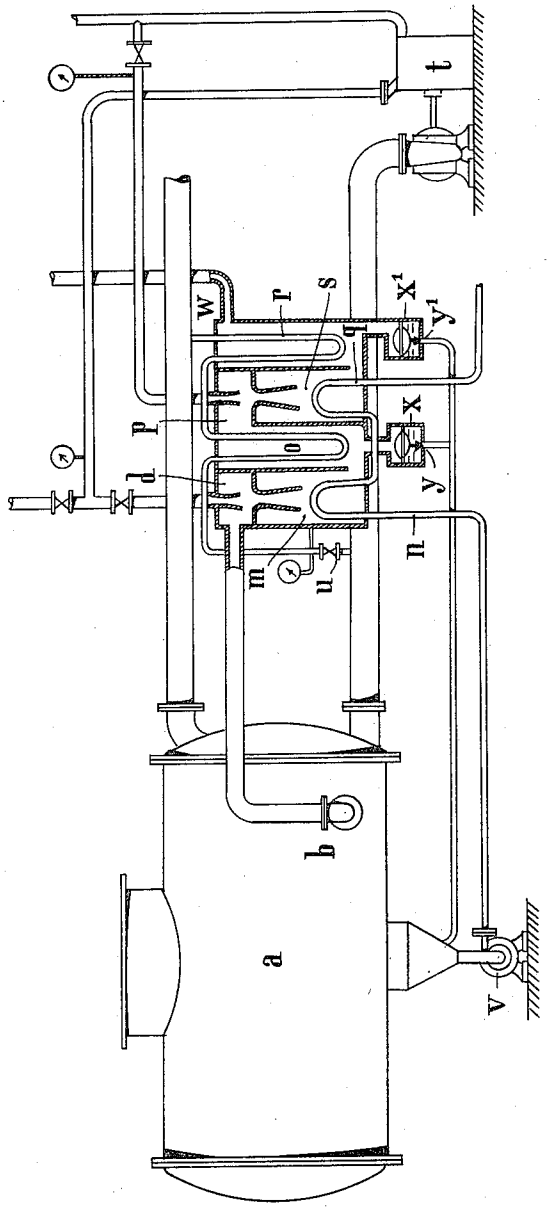

Fig. 3.

Witnesses:

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their Attorneys.

UNITED STATES PATENT OFFICE.

EMIL JOSSE AND WILHELM GENSECKE, OF CHARLOTTENBURG, GERMANY.

MEANS FOR EVACUATING VACUUM APPARATUS.

1,046,304. Specification of Letters Patent. Patented Dec. 3, 1912.

Application filed May 27, 1912. Serial No. 700,072.

To all whom it may concern:

Be it known that we, EMIL JOSSE and WILHELM GENSECKE, citizens of the Empire of Germany, and residing at Charlottenburg, near Berlin, Germany, have invented certain new and useful Improvements in Means for Evacuating Vacuum Apparatus, of which the following is a specification.

The subject-matter of our invention is means for removing the air from vacuum-apparatus of all kinds, such as surface condensers, injection condensers and the like, by means of a jet of steam.

Our invention substantially consists in not only the suction of the air and non-condensed vapors from the vacuum apparatus taking place owing to the action of a jet of steam, but the air and non-condensed vapors are raised to atmospheric pressure or to a still higher pressure solely by the action of a jet of steam, whereas heretofore piston-pumps or water-jet air-pumps were employed for this purpose.

It is true that it has heretofore been proposed to connect steam-jet apparatus in series with a piston-pump or other lifting apparatus. In contradistinction thereto, however, a characteristic feature of our invention is that the lifting takes place solely owing to the action of a jet of steam.

One advantage of this apparatus is that machines having movable parts are entirely obviated; as compared with water-jet air-pumps proposed heretofore it has the advantage of better, simpler and more economical running.

Several illustrative embodiments of our invention are represented by way of example in the accompanying drawings, wherein:—

Figure 1 is a vertical elevation, partly in section, showing the invention applied to a surface condenser, Fig. 2 is a like view showing a modified form of apparatus, and Fig. 3 is a like view of another form of apparatus.

Referring firstly to Fig. 1, *a* designates the surface condenser. Air and non-condensed steam are sucked away through the pipe *b*, while the water of condensation is sucked away and conveyed in known manner through the pipe *c* by means of any suitable pump. The air and non-condensed steam are conducted into a steam ejector apparatus *d* substantially consisting of a steam nozzle *e* and a diffuser *f* which is so designed that the substances sucked out of the pipe *b* are compressed to atmospheric or to a higher pressure. The substances passing out of the diffuser *f* may issue into the open air, but for the purpose of recovering the heat contained in the steam used for working the ejector or steam-jet apparatus it is preferable to condense the steam.

In the illustrative embodiment according to Fig. 1, therefore, we provide an exchange of heat apparatus *g* which may be formed as an injection or surface apparatus. The steam coming from the nozzle *e* is condensed in the apparatus *g*, the water of condensation from the main condenser being used as the cooling agent and thus absorbing the heat of this steam. In this manner it is possible to recover almost the entire heat of the steam requisite for sucking away and conveying the air and non-condensed steam, so that no material consumption of energy is required for this purpose.

Referring now to Fig. 2, instead of the intermediate condenser *g* shown in Fig. 1 we connect an evaporator *h* behind the steam-jet apparatus or ejector *d*. This evaporator *h* is a surface condenser. The air and non-condensed vapors issuing from the diffuser *f* of the steam-jet apparatus flow around a system of pipes *i*. The steam is precipitated and delivers its heat to the liquid, *e. g.* water, in the pipes. If the water in the pipes of the surface condenser *i* is at a less pressure than in the outer chamber in which the steam from the steam-jet apparatus is condensed, it can evaporate. This steam may be used elsewhere, if preferred, for example, for driving the low pressure stage of a steam turbine, or for like purposes.

If it is desired to increase the pressure of the sucked-away air and non-condensed steam, thus if a great difference of pressure has to be overcome, we prefer to use apparatus as shown in Fig. 3, in which two or more steam-jet apparatus or ejectors are connected in series, so that the compression takes place owing to compound action. The apparatus is designed so that the compression is brought about with as small a consumption of energy as possible.

In Fig. 3, *a* designates the surface condenser from which the air is sucked away through the pipe *b* and forced by the ejector *d* into the chamber *m*, in which there is a pressure higher than that in the condenser *a*. For example, if 95% of the air has been evacuated from the condenser there will be

a pressure of about 80% in the chamber *m*. The steam used for working the steam-jet apparatus is separated from the air in the chamber *m* by the steam being condensed. To this end, two cooling worms or coils *n* and *o* are provided in the illustrative embodiment according to Fig. 3. The air is then compressed further to atmospheric pressure by a second ejector *p*. The steam used for working this ejector can be separated from the air. To this end, we provide two cooling worms or coils *q* and *r*. The air and steam must be separated in the chamber *m;* this is preferable in the chamber *s* also, but not absolutely necessary. The advantages of this arrangement are, firstly, that the steam for the ejector *g* requires to have only a low pressure and, secondly, that the steam for the ejector *p* requires to be of only relatively low pressure, because the entire fall of pressure does not have to be overcome in the apparatus. According to tests which have been made, steam of atmospheric pressure suffices for the ejector *d*, and steam of a pressure of 3 to 5 atmospheres for the ejector *p*. The steam for working the ejector *p* can thus be taken in the form of steam of low pressure from a suitable part of the steam plant. In addition, the latent heat of the working steam for driving the ejectors can be recovered by connecting the worms *n* and *q* in series and conducting the water of condensation from the surface condenser *a* by means of the pump *v* through said worms, the water of condensation thus serving as cooling agent for the steam of the ejectors which is to be precipitated and absorbing its heat. In this manner it is possible to heat the water of condensation preliminarily to approximately 100° C. Fourthly, owing to the arrangement of two additional worms *o* and *r* we attain the advantage that the steam for the ejectors is precipitated even when the quantity of water of condensation delivered by the pump *v* is too small to precipitate the entire quantity of steam of the ejectors. Water is preferably allowed to flow through the pipes *o* and *r*, this water being taken from the cold water pipe at *u* and flowing back into the same at *w*. Lastly, in order that no special pump is required for removing the water of condensation from the chambers *m* and *s*, we may provide floats *x* and *x'* which allow the water of condensation to flow back through the valves *y* and *y'* into the main condenser.

We claim:—

1. The combination with a vapor condensing chamber provided with a conduit for the removal of air and vapor therefrom permanently open to the atmosphere, of steam jet apparatus located within said conduit and arranged to withdraw the air and vapor from the condensing chamber by an ejector action and discharge them against a pressure at least equal to one atmosphere, and a heat exchange apparatus located in said conduit on the discharge side of the jet for condensing the vapor from said chamber and said jet apparatus.

2. The combination with a vapor condensing chamber provided with a conduit for the removal of air and vapor therefrom permanently open to the atmosphere, of steam jet apparatus located within said conduit and arranged to withdraw the air and vapor from the condensing chamber by an ejector action and discharge them against a pressure at least equal to one atmosphere, and means for subjecting all the water of condensation from said chamber to the heating action of the air and steam discharged from said jet apparatus.

3. The combination with a vapor condensing chamber provided with a conduit for the removal of air and vapor therefrom permanently open to the atmosphere, of steam jet apparatus located within said conduit and arranged to withdraw the air and vapor from the condensing chamber by an ejector action and discharge them against a pressure at least equal to one atmosphere, and means for subjecting all the water of condensation from said chamber to the heating action of the air and steam discharged from said jet apparatus, together with a system of piping connected to the cooling water supply of said condensing chamber passing through said conduit also on the discharge side of the jet apparatus.

4. The combination with a vapor condensing chamber provided with a conduit for the removal of air and vapor therefrom permanently open to the atmosphere, of steam jet apparatus located within said conduit and arranged to withdraw the air and vapor from the condensing chamber by an ejector action and discharge them against a pressure at least equal to one atmosphere, and a system of piping connected to the cooling water supply of said condensing chamber passing through said conduit on the discharge side of the steam jet apparatus.

5. In combination with a condenser provided with a conduit for the removal of air and uncondensed vapor, steam jet apparatus within said conduit for withdrawing the air and vapor by an ejector action and discharging such ejected air and vapor from the conduit against atmospheric pressure, and means for subjecting such ejected air and vapor to the cooling action of the water of condensation of the condenser and of the cold-water supply of the condenser.

6. The combination with a vapor condensing chamber provided with a conduit for the removal of air and vapor therefrom permanently open to the atmosphere, of a plurality of steam jets located at different

points in said conduit and arranged to withdraw the air and vapor from the condensing chamber by an ejector action and discharge them against a pressure at least equal to one atmosphere, and connections for supplying steam of different pressures to the steam jet nozzles.

7. The combination with a vapor condensing chamber provided with a conduit for the removal of air and vapor therefrom permanently open to the atmosphere, of a plurality of steam jets located at different points in said conduit and arranged to withdraw the air and vapor from the condensing chamber by an ejector action and discharge them against a pressure at least equal to one atmosphere, and heat exchange apparatus located in said conduit on the discharge side of each steam jet apparatus.

8. The combination with a vapor condensing chamber provided with a conduit for the removal of air and vapor therefrom permanently open to the atmosphere, of a plurality of steam jets located at different points in said conduit and arranged to withdraw the air and vapor from the condensing chamber by an ejector action and discharge them against a pressure at least equal to one atmosphere, and heat exchange apparatus connected with the water of condensation discharge outlet of the condensing chamber located in said conduit on the discharge side of each steam jet apparatus.

9. The combination with a vapor condensing chamber provided with a conduit for the removal of air and vapor therefrom permanently open to the atmosphere, of steam jet apparatus located within said conduit and arranged to withdraw the air and vapor from the condensing chamber by an ejector action and discharge them against a pressure at least equal to one atmosphere, and a heat exchange apparatus located in said conduit on the discharge side of the jet for condensing the vapor from said chamber and said jet apparatus, together with means for returning the water of condensation so formed in the conduit to the hot well of the condensing chamber.

10. The combination with a vapor condensing chamber provided with a conduit for the removal of air and vapor therefrom, of a steam jet apparatus located in said conduit arranged to draw the air and vapor from the condensing chamber by an ejector action, a heat exchange apparatus connected to the water of condensation outlet of the condensing chamber located in the conduit at the discharge side of the steam jet apparatus, and a second heat exchange apparatus located in the conduit at a point farther removed from the steam jet apparatus.

11. The combination with a vapor condensing chamber provided with a conduit for the removal of air and vapor therefrom, of a plurality of steam jets located at different points in said conduit and arranged to withdraw the air and vapor from the condensing chamber by an ejector action and to discharge them against a pressure at least equal to one atmosphere, and connections for supplying steam of different pressures to the nozzles of said steam jet apparatus.

In testimony whereof, we affix our signatures in the presence of two witnesses.

EMIL JOSSE.
WILHELM GENSECKE

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.