E. S. G. REES.

EVACUATION AND COMPRESSION OF GASES.

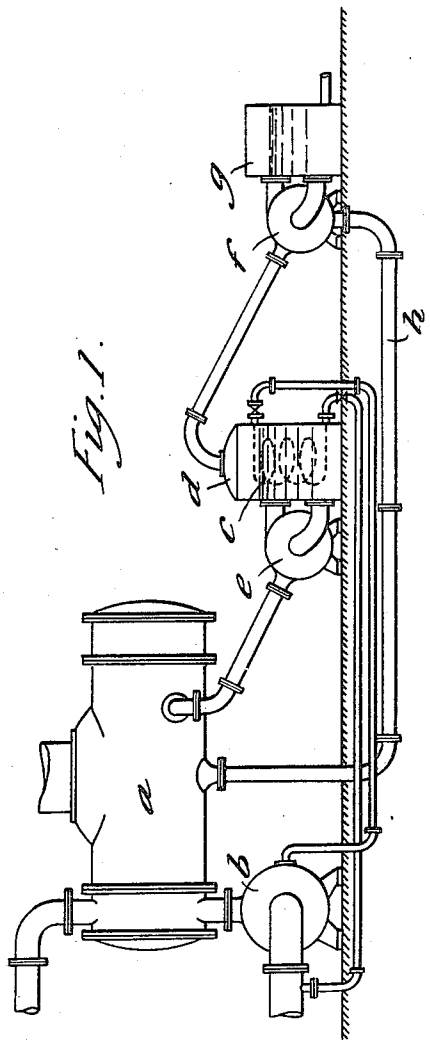
APPLICATION FILED MAY 17, 1915.

1,252,178.

Patented Jan. 1, 1918.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses
M. E. McDade.

Inventor
Edmund S. G. Rees
by James L. Norris
Attorney.

E. S. G. REES.

EVACUATION AND COMPRESSION OF GASES.

APPLICATION FILED MAY 17, 1915.

1,252,178.

Patented Jan. 1, 1918.

2 SHEETS—SHEET 2.

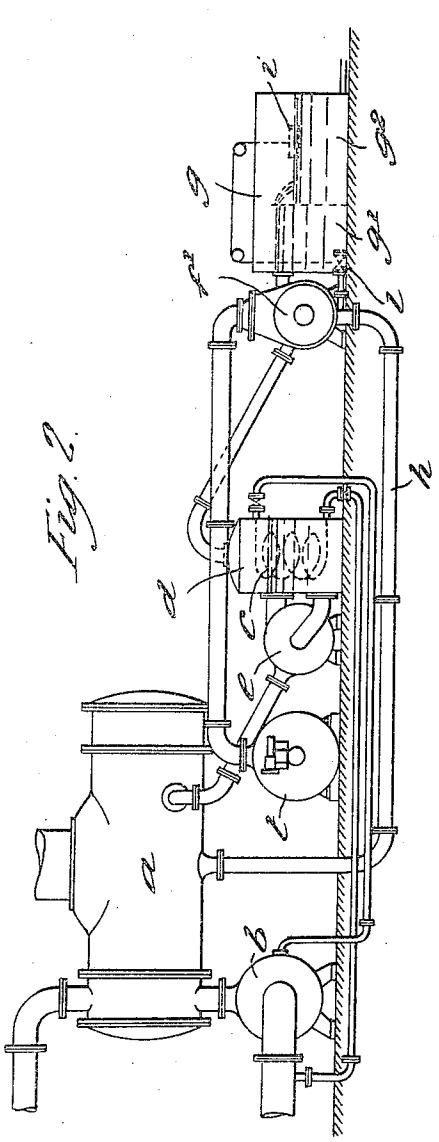


Fig. 2.

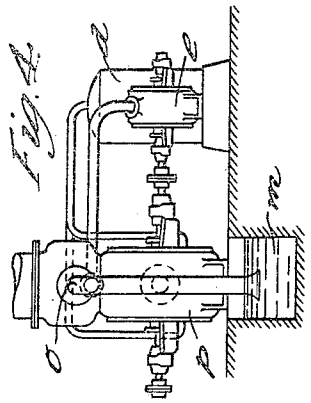


Fig. 4.

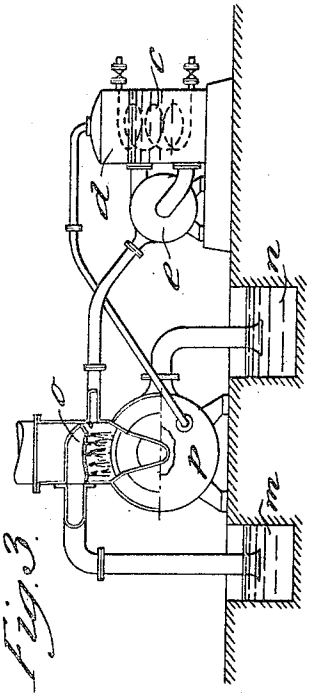


Fig. 3.

Witnesses:

W. E. McDade.

Inventor

Edmund S. G. Rees

by

James L. Norris,

Attorney

UNITED STATES PATENT OFFICE.

EDMUND SCOTT GUSTAVE REES, OF STAFFORD, ENGLAND.

EVACUATION AND COMPRESSION OF GASES.

1,252,178. Specification of Letters Patent. Patented Jan. 1, 1918.

Application filed May 17, 1915. Serial No. 28,794.

To all whom it may concern:

Be it known that I, EDMUND SCOTT GUSTAVE REES, a subject of the King of Great Britain, residing in Stafford, England, have invented certain new and useful Improvements in the Evacuation and Compression of Gases, of which the following is a specification.

The present invention relates to means for establishing and maintaining vacua in steam condensers or other spaces from which air or vapors are to be exhausted.

In the method of exhaustion employed the vacuum is produced and compression effected in part by means of a comparatively small quantity of relatively cold water and in part by a further supply of hotter water, and the principal feature of novelty of the present invention consists in the separation of the water circuits of the pumps used in the successive stages of compression.

Thus, in the case of surface condensation, assuming a two-stage compression between the condenser or other space to be evacuated and the atmosphere, the first air pump may be connected with the air and vapor space of the condenser and deliver to the upper part of a sealed tank which in turn is connected with a second air pump. The suction side of the first pump draws water from the lower part of the sealed tank, while the second air pump normally draws its entraining water from the condenser, but this supply may be assisted by water from the hotwell or a tank connected with the hotwell.

Substantially the same arrangement holds in the case of a jet condenser, the air being withdrawn from the coldest part of the condenser by a rotary air pump and delivered to a sealed tank containing comparatively cold water, whence it is extracted by a second rotary pump and further compressed to atmospheric pressure.

Heat may be extracted from the entraining water of the pump or pumps working on high vacua and transferred to the water used in the pump or pumps working on comparatively low vacua or to the boiler feed water tank, and if a steam turbine be used to drive the pumps the exhaust steam from the turbine may be conveyed to a rotary air pump and its heat utilized to raise the temperature of the feed water.

These and other features of the invention will be more specifically described with reference to the accompanying drawings, wherein Figure 1 shows diagrammatically the application of the invention to a surface condenser; Fig. 2 is a modification wherein the second air pump acts also as a condenser for the steam turbine driving the pumps; and Figs. 3 and 4 are, respectively, a side view and an end view illustrating the application of the invention to the case of a jet condenser.

Referring to Fig. 1, *a* is a surface condenser, *b* a main circulating pump from which a branch pipe leads to the coils *c* for cooling the water in the sealed tank *d*. A rotary air pump *e*, preferably of the Rees roturbo type, is supplied with water from the tank *d*, entrains the air and vapor drawn off from the coolest part of the condenser *a* and returns the water and air at a somewhat higher pressure than that of the condenser into the said tank. A second rotary air pump *f*, preferably of the double impeller type, as described in my British patent specification No. 26,307 of 1912, compresses the air into the open tank *g*, which communicates with the hotwell or boiler feed water supply. Since the pump is only required to maintain a comparatively low vacuum in the sealed tank *d*, it may use hot water. In the double impeller pump *f*, the eye of one impeller communicates with a pipe *h* which leads to a water space at the bottom of the condenser *a*, and the eye of the second impeller communicates with the water in the tank *g*.

The water in the sealed tank *d* may be sea water, the temperature of which is kept down to the required degree by the means described or by any other suitable means, for example, by the continuous extraction of part of the water from the tank by means of a small pump, and the provision of a ball float valve enabling the quantity of cold water necessary to maintain the required temperature and level to flow into the tank from an outside source.

In the modification shown in Fig. 2, the cooling arrangements are shown as in Fig. 1. To insure a full water supply to the second air pump, any loss of water in the tank *d* can be compensated for from an external source by a pump operated automatically in accordance with the level of a float in the tank, which float is not shown in the drawing, but which might be mounted in any appropriate manner in the tank *d*. The various pumps are assumed to be driven by a

steam turbine t, the exhaust steam from which is led into the pump f', in which it is condensed and the heat energy utilized in the feed water.

In Fig. 2 the tank g is shown as divided by a partition into two compartments g^1 and g^2 to form a weir. The compartment g^2 is in communication with the hotwell. At low loads the supply through the pipe h will be small, but the water will rise in the compartment g^2 and a float i in this compartment will regulate the opening of a valve l in the inlet from the compartment g^1 to the pump f^1 and thereby compensate for the deficiency in the water supply through the pipe h.

In the arrangement shown in Figs. 3 and 4 which is adapted for jet condensers, the air is withdrawn from the coolest part of the condenser by a rotary pump e and is compressed into the sealed tank d, which is cooled by liquid circulating in the coils c as in the arrangement shown in Fig. 1. The vacuum produced in the condenser draws water from a supply m, which entrains vapor from the condenser by means of a static ejector o, preferably of the type shown in United States Letters Patent No. 975,997 of 1910, and comprising a number of jet nozzles. The energy of the ejector water jets effects initial compression of the condensate before this mixes with the air coming from the sealed tank d for final compression. The initial compression effected by the static ejector is continued to atmospheric pressure by a rotary air pump p, preferably of the Rees roturbo type, which delivers the condensing water and condensate, for example, into a receptacle n. The final compression of the air from the tank d is completed by the same pump p.

It will be understood that what may be regarded as the accessory devices of the water circuits, although described with reference to particular figures of the drawings, are in general applicable to all the modifications. Thus the accessories of tank g shown in Fig. 2 for insuring a full supply of water to the second air pump may be applied to the apparatus of Fig. 1.

It is obvious that any other closed space, such as a brine evaporating chamber, can be exhausted in the same way as a steam condenser, any suitable supply of water being used for the primary air pump.

Having thus described the nature of the said invention and the best means I know of carrying the same into practical effect, I claim:—

1. Multi-stage apparatus for the production of vacua comprising a rotary air pump connected with the space to be evacuated, a sealed receptacle containing water, means for maintaining said water at a comparatively low temperature, a second rotary air pump connected with the air space of the sealed receptacle, a water circuit for the first pump fed from the sealed receptacle and a separate water circuit for the second pump.

2. Apparatus for the production of vacua comprising a sealed receptacle containing water, means for maintaining said water at a comparatively low temperature, a rotary air pump, connections to the suction side of the pump from the water in the sealed receptacle and from the space to be evacuated, a second rotary air pump delivering to the atmosphere, connections to the suction side of said pump from the air space of the sealed receptacle and from a water supply.

3. Apparatus for the production of vacua comprising a sealed receptacle containing water, means for maintaining said water at a comparatively low temperature, a rotary air pump, connections to the suction side of the pump from the water in the sealed receptacle and from the space to be evacuated, an open receptacle containing water, a second rotary air pump delivering to said open receptacle, connections to the suction side of the second air pump from the air space of the closed receptacle, from the water space of the vessel to be evacuated and from the water space of the open receptacle.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDMUND SCOTT GUSTAVE REES.

Witnesses:
J. G. NUDULULE,
HAROLD V. PEDLEY.