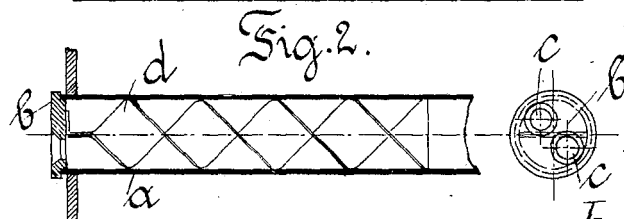
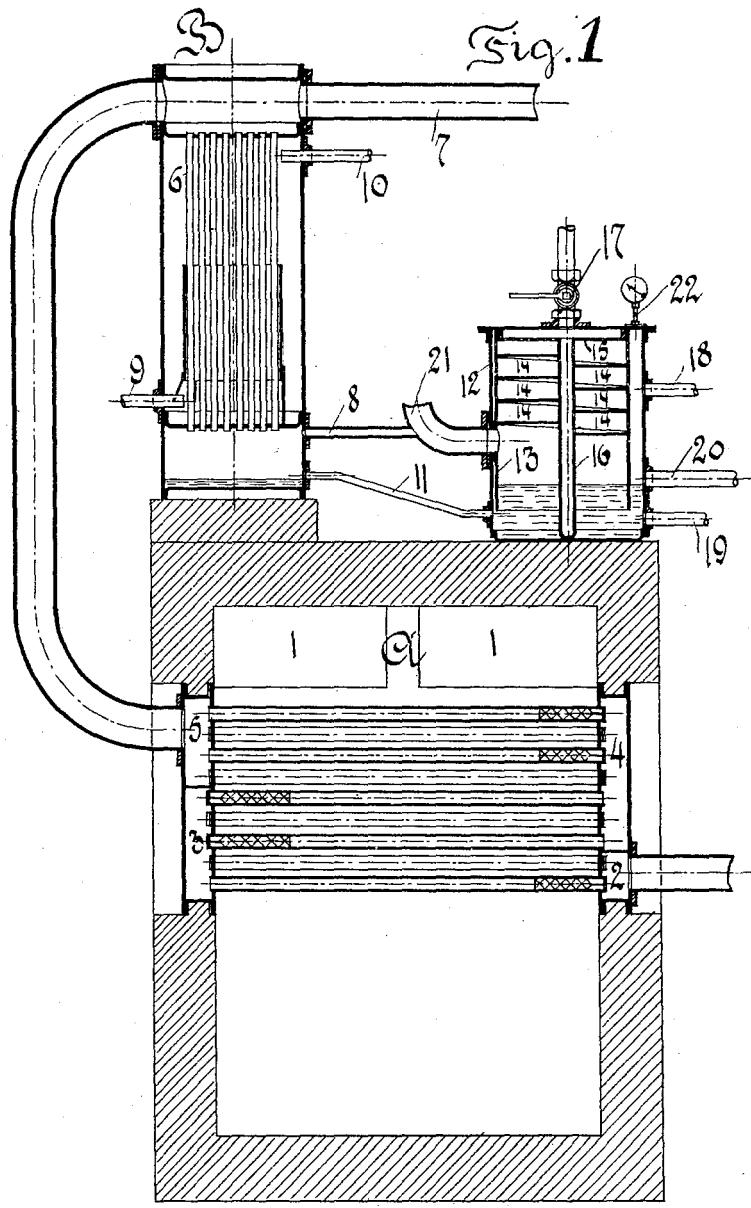


J. F. A. BRUUN.
APPARATUS FOR UTILIZING EXHAUST STEAM.
APPLICATION FILED MAR. 5, 1903.



Witnesses:
Gustave R. Thompson.
Wm. B. Kerkham

Inventor:
John F. A. Bruun,
by Maurice Cameron Lewis,
Attorneys.

UNITED STATES PATENT OFFICE.

JOHAN FREDERIK ADOLPH BRUUN, OF COPENHAGEN, DENMARK.

APPARATUS FOR UTILIZING EXHAUST-STEAM.

No. 805,340.

Specification of Letters Patent.

Patented Nov. 21, 1905.

Application filed March 5, 1903. Serial No. 146,382.

To all whom it may concern.

Be it known that I, JOHAN FREDERIK ADOLPH BRUUN, of Copenhagen, Denmark, have invented a new and useful Improvement in Methods and Apparatus for Utilizing Exhaust-Steam and for Utilizing the Steam for Superheating the Feed-Water, which invention is fully set forth in the following specification.

My invention relates to an apparatus for utilizing the latent heat contained in exhaust-steam by superheating the exhaust-steam under vacuum and then using it to raise the temperature of the feed-water above 100° centigrade and at the same time to allow it to work in a low-pressure cylinder or use it for boiling, heating, or like purposes.

In the accompanying drawings, wherein is illustrated one embodiment of the inventive idea, Figure 1 is a vertical sectional view of my device. Fig. 2 is a longitudinal section of part of one of the tubes, and Fig. 3 is an end view of one of the tubes.

Referring to the drawings, A is a heating-chamber, which is entered by the hot smoke through the openings 1 at the top. In the chamber is placed a superheater consisting, in the form of apparatus herein illustrated, of three groups of pipes 2, 3, and 4, to be traversed in succession by the exhaust-steam which comes from the engine, entering at 2 and leaving at 5. Having left the superheater part, the steam is led through the tube 7 to the place where it is to be employed in a low-pressure cylinder or for boiling, heating, or other purposes, while another part finds its way through the tubes 6 of the pressure-feed-water heater B. This is of the well-known type, the feed-water entering through the tube 9 from the feed-pump and leaving for the boiler through the tube 10. Having acted in the feed-heater, this part of the steam passes through the tube 8 and enters a condenser C, which also receives through the tube 11 the condensed water from the feed-heater.

In the condenser passes a cooling-water pipe with a cock 17, and from the condenser leads the tube 18 to the air-pump, (or an ejector.) Through a pipe 19 the condensed water is led to the feed-pump. Another pipe 20, placed at the level of the water in the condenser, together with tube 18, leads to the air-pump, carrying off the superfluous water. Pipe 21 leads the steam from its place of consumption to the condenser.

22 is a vacuum-meter.

One of the main features of my invention is that the exhaust-steam passes the superheater at a very small and constant speed, about thirteen or sixteen feet a second; further, that the tubes of the superheater are constructed in such a way that the heaviest particles of the steam, first of all the water particles, are forced out against the inner surface of the tubes, thus being most intensely heated. This arrangement, in combination with a small speed, makes it possible to obtain a relatively considerable superheating with a small heating-surface.

In the drawings, therefore, the superheater is so arranged that any tube *a*, Fig. 2, has its entrance provided with a plug or disk *b*, having two holes *c*, whose area is, say, one-fifth of that of the tube. Further, a winding way *d* is arranged in every tube, filling this out in its entirety. The narrowing of the inlet-opening causes the steam to enter all of the tubes, whereas without narrowing the inlet-openings the steam would find its way through some of the tubes only and at a considerable speed. Thus, for instance, if the speed in the inlet-holes *c* be seventy-five feet a second it will be fifteen feet in the tubes, provided that a ratio of one-fifth is adopted between the area of the openings to that of the tube. Further, the winding way causes by centrifugal force the water particles and the heaviest less-heated steam particles to fly out to the highly-heated tube-walls. In order, moreover, to keep the speed of the steam almost constant at any point of the superheater in spite of the steam expanding, (sixty to one hundred per cent.,) owing to the superheating and to the evaporation of the water particles, the number of the tubes increases as the steam gets hotter. Thus in the drawings the first group of tubes contains two series of tubes, the next three, and the last four series. During the superheating the hot smoke and the exhaust-steam are moving in opposite directions.

As mentioned above, the superheated steam is used for boiling, heating, or other purposes or to impart motive power in a low-pressure cylinder. Therefore a part of it must be condensed in order to maintain the vacuum on the outlet side of the low-pressure cylinder or in the case of boiling arrangement for counteracting the resistance that otherwise would arise in the high-pressure cylinders on their discharge side. This is obtained, as described above, by allowing a part of the superheated

steam to pass through the pressure-feed heater B, in which the feed-water is heated to some 130° to 140° centigrade, the steam thus losing a portion of its heat and partly condensing, whereupon the steam enters a condenser C. Further, this method and the apparatus embodying its ideas involve the advantage of relatively small work being required of the air-pump, a very small pump thus being sufficient. Indeed an ejector may often successfully replace a pump, securing a very satisfactory vacuum at the same time as the latent heat of the exhaust-steam is profitably made use of.

The condenser C will not be claimed herein *per se*, a divisional application, Serial No. 167,612, filed July 30, 1903, covering said subject-matter.

What is claimed is—

1. In an apparatus for utilizing exhaust-steam, the combination of a superheater through which the exhaust-steam passes, a passage conveying the superheated exhaust-steam from said superheater, a feed-water heater in branched communication with said passage from which a portion of the steam passes to the heater to heat a supply of water, and a condenser to which the exhaust is finally led connected with said feed-heater and the steam-passage.

2. In an apparatus for utilizing exhaust-steam, a heating-chamber, and a superheater in said chamber comprising a plurality of

groups of tubes through which the steam passes during the superheating, each group having a larger number of tubes than the preceding group whereby the area of the steam-passage is in approximately the same ratio as the expansion of the steam the speed of the steam being thereby rendered substantially constant.

3. In apparatus of the kind described, a superheater comprising a series of tubes, a closure at the inlet end of each tube said closure having therethrough a perforation or inlet-opening smaller than the size of the passage in the tube with which it communicates.

4. In an apparatus for utilizing exhaust-steam, a superheater comprising a plurality of tubes, a spirally-formed deflector dividing each tube into two or more longitudinal passages and acting to force particles of steam into contact with the wall of the tube, a closure at the inlet end of each tube having perforations or inlet-openings therethrough communicating respectively with the passages in its tube, each of said inlet-openings being smaller in size than the passage in the tube with which it communicates.

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

JOHAN FREDERIK ADOLPH BRUUN.

Witnesses:

C. J. MAGLEKILDE,
SIGURD E. CHRISTENSEN.