F. LJUNGSTRÖM.

AIR COOLED CONDENSER.

APPLICATION FILED APR. 1, 1919.

1,435,612.

Patented Nov. 14, 1922.

2 SHEETS—SHEET 1.

Fig. 1.

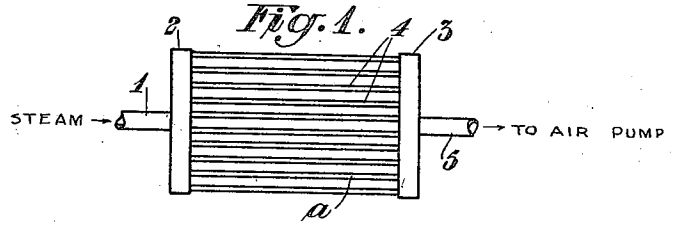


Fig. 2.

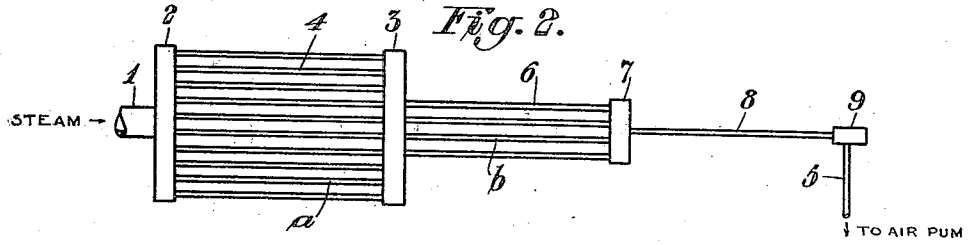


Fig. 3.

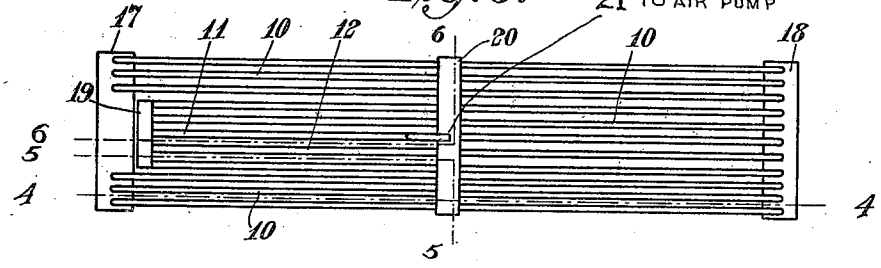


Fig. 4.

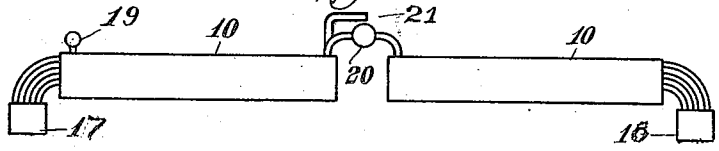


Fig. 5.

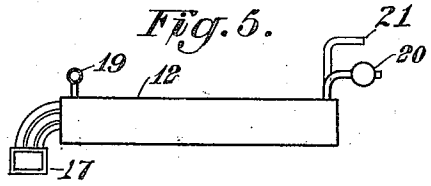
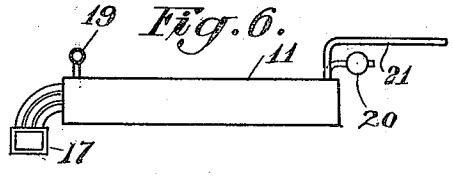


Fig. 6.



Inventor

F. Ljungström.

By H.R. Kerslake

Atty

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2 SHEETS—SHEET 2.

Fig. 7.

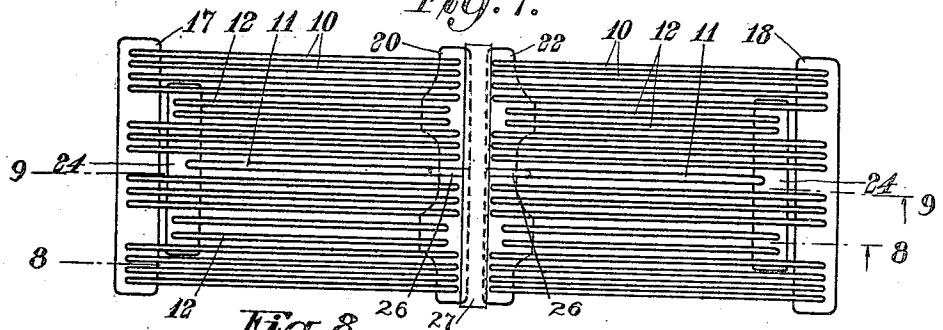


Fig. 8.

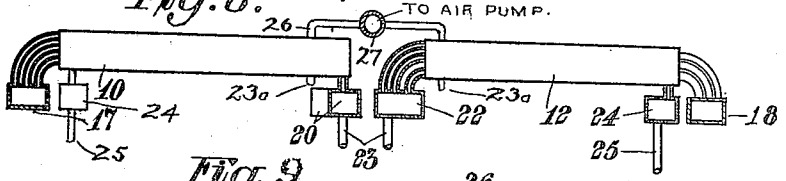


Fig. 9.

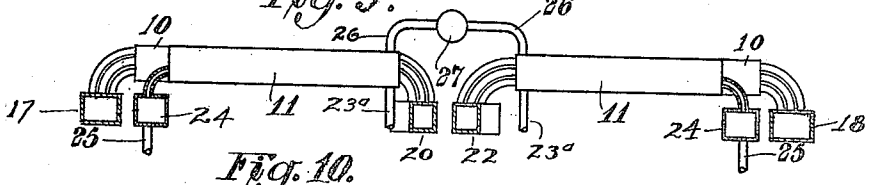


Fig. 10.

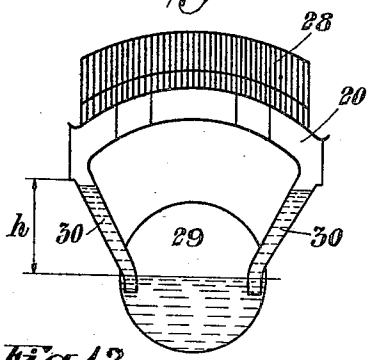


Fig. 11.

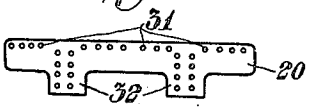


Fig. 13.

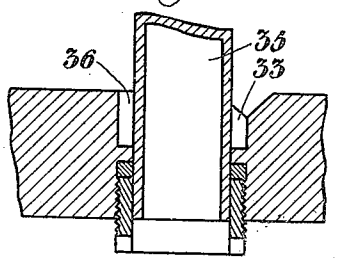
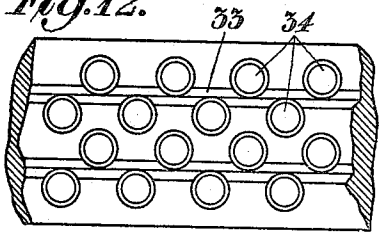


Fig. 12.



Inventor

F. Ljungström

By H. R. Kerslake

Atty

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UNITED STATES PATENT OFFICE.

FREDRIK LJUNGSTRÖM, OF BREVIK, SWEDEN, ASSIGNOR TO AKTIEBOLAGET LJUNGSTRÖMS ANGTURBIN, OF STOCKHOLM, SWEDEN, A CORPORATION.

AIR-COOLED CONDENSER.

Application filed April 1, 1919. Serial No. 286,790.

To all whom it may concern:

Be it known that I, FREDRIK LJUNGSTRÖM, chief engineer, subject of the King of Sweden, residing at Brevik, Lidingon, Sweden, have invented certain new and useful Improvements in Air-Cooled Condensers, of which the following is a specification.

In air cooled condensers composed of a plurality of elements it has proved difficult to make use of an air pump to any advantage because of certain difficulties arising in the case of a leak occurring in any of the several elements.

This invention has for its object to prevent such difficulties by facilitating the work of the air pump in case of leakage as above mentioned.

In the accompanying drawing wherein an approved embodiment of the invention is illustrated:

Figure 1 is a plan view of a well known type of air cooled condenser.

Fig. 2 is a plan view of a condenser constructed according to the present invention.

Fig. 3 is a top plan view of a modification of the invention.

Fig. 4 is a longitudinal section on the line 4—4 of Fig. 3.

Figs. 5 and 6 are sections on the lines 5—5 and 6—6 respectively, in Fig. 3.

Fig. 7 is a top plan view of a type of condenser especially adapted for use in locomotives.

Fig. 8 is a longitudinal sectional view on the line 8—8 of Fig. 7.

Fig. 9 is a longitudinal section on the line 9—9 of Fig. 7.

Fig. 10 is a transverse section of a condenser of somewhat modified form.

Fig. 11 is a top plan view of a header of the type used in the apparatus shown in Fig. 7.

Fig. 12 is an enlarged fragmentary plan view of the tube plate of one of the headers.

Fig. 13 is an enlarged fragmentary section through the tube plate showing the water receiving grooves therein.

Referring to Fig. 1, 1 denotes the steam inlet of the condenser, the numerals 2 and 3 designate the headers and 4 designates the air cooled tubes and 5 the conduit leading to the air pump.

The air pump in this case draws the same quantity of air from all the tubes of the condenser. Should a leak occur in the condenser, for instance, in the tube *a*, the vacuum in the condenser will be reduced proportionately to the quantity of air entering through the leak. In order to maintain the vacuum in the condenser the work of the air pump must, therefore, be increased and co-incident with said increase a quantity of steam corresponding to said quantity of air will be drawn out by the pump from all the other pipes.

This inconvenience is eliminated by the present invention by the provision of means whereby the quantity of steam is condensed or nearly so before reaching the air pump.

In the improved type of condenser shown in Fig. 2 the apparatus is divided into three sections. Should a leak occur, for instance, in the pipe *a*, the additional quantity of steam drawn by the air pump from the remaining tubes 4 during its increased work for maintaining the vacuum in spite of the leak, will be condensed in the following section 6 of the condenser. If the leak occurs in the section 6, for instance, of the tube *b*, then additional quantities of steam will be condensed in the section 8. The pipes 4, 6 and 8 constituting the several elements or sections of the condenser are connected with headers 2, 3, 7 and 9, the latter header having connection with the air pump by a pipe 5 and the header 2 having connection with a steam inlet pipe 1.

In carrying the invention into practice, all the tubes are preferably disposed within the same cooling range, the tubes, however, being divided into sections or groups connected in series.

Figs. 3 to 6 illustrate an embodiment of the invention as applied to a condenser in which the elements consist of flat tubes situated at a short distance from each other, the steam passing through the tubes as in the apparatus shown in Fig. 2. In this embodiment of the invention the steam, which at first passes through the elements 10 from the headers 17 and 18 to the central air conduit 20, afterwards flows through the somewhat smaller section 12 (Figs. 3 and 5) disposed within section 10 to the collecting pipe 19, after which any steam that might not have been condensed flows through the last section 11 (Figs. 3 and 6) which is disposed within section 12. The air pump is connected to the last section by means of the pipe 21. The whole of this combination

works, in the case of a leak occurring, in the manner of the condenser hereinbefore described and diagrammatically shown in Fig. 2.

Fig. 7 shows two element-condensers connected to the same air pump, but otherwise operating separately. In both of the condensers the steam enters the headers 17 and 18 respectively, and in turn passes through the elements 10, 12 and 11 which are symmetrically alike, the same being shown in sectional detail in Figs. 8, and 9.

In each condenser, the steam upon passing through the element 10, enters the header 20 or 22 underneath the condenser, in which header the water of condensation is collected, and from which it is then removed through the pipe 23. From the headers 20 or 22 the remaining steam is sucked through the elements 12 to the header 24, in which water is also collected, and from which it is then removed through pipe 25. The still remaining steam passes through the last element 11, and is drawn off in the form of water through pipe 23^a. This element is connected by means of the pipes 26 and 27 to the same air pump as the last element 11 of the second condenser.

Fig. 10 shows the condenser in section. In the present case the sections of the air-condenser proper 28 and of the header 20 are preferably shaped on the lines of circular arcs, and situated above the vessel 29, serving as collectors of the water of condensation. The said vessel 29 communicates with the headers 20 by means of pipes 30, and it must be situated so far underneath the condenser that the pressure of the water column h in the pipes 30 is greater than the difference in pressure between the vessel 29 and the condenser.

The whole of the construction closely approximates the form of a circular sector. The condenser proper preferably consists of a number of thin and narrow spaces with walls of sheet-metal, every other of these spaces containing cooling fluid (cooling air), and every other the steam to be condensed.

In Fig. 11, the header 20 is shown in plan with the holes in the tube plate for the connections between the various elements and the header so arranged, that the holes 31 are adapted to receive the elements 10, the holes 32 being adapted to receive the elements 12.

Fig. 12 shows a detail of the tube plate of the headers illustrating means to provide for a water packing around the tubes. The tube plate is provided with grooves 33 so as to lead the water along these grooves to each tube hole 34. Fig. 13 illustrates a detail of such a hole in which the packing around the tube 35 is effected by means of water. The hole 34 (Fig. 12), into which the tube 35 is inserted, is enlarged at the top as at 36 forming a pocket into which water flows from the groove 33. The tube will then be completely surrounded by water so that in case of the tube not being properly fixed to the tube plate, water will be sucked in instead of air. The condenser or its constituent parts containing steam or condensed steam in the form of water, a little additional quantity of water from the outside by leakage will not have the same injurious effect on the working of the condenser as the leaking in of air into the same would have.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. An air cooled condenser composed of a plurality of sections connected in series, each section including a plurality of tubular elements decreasing in number with each consecutive section, a steam inlet connected with the largest section of the condenser and an air pump in connection with the smaller section thereof.

2. An air cooled condenser composed of a plurality of sections connected in series and including a tubular elements decreasing in number with each consecutive section, headers arranged beneath the adjacent sections and connected with the tubular elements and positioned therebeneath so as to serve as a collector for both water and steam, a steam inlet connected to the header adjacent the largest section and an air pump in connection with the header adjacent the smallest section.

3. An air cooled condenser as claimed in claim 2 wherein a water receptacle is provided and situated under the header, pipes between the header and the water receptacle, said pipes being of such a length that the pressure of the water column in each pipe is greater than the difference in pressure between the water receptacle and condenser.

4. An air cooled condenser as claimed in claim 2 wherein a pipe is employed for connecting each element with the adjacent header.

5. An air cooled condenser as claimed in claim 2 wherein a water packing is provided around the connection of each tubular element with the tube plate of the header.

In testimony whereof I affix my signature in presence of two witnesses.

FREDRIK LJUNGSTRÖM.

Witnesses:
T. H. BERGROTHE,
GRETA PRIEN.