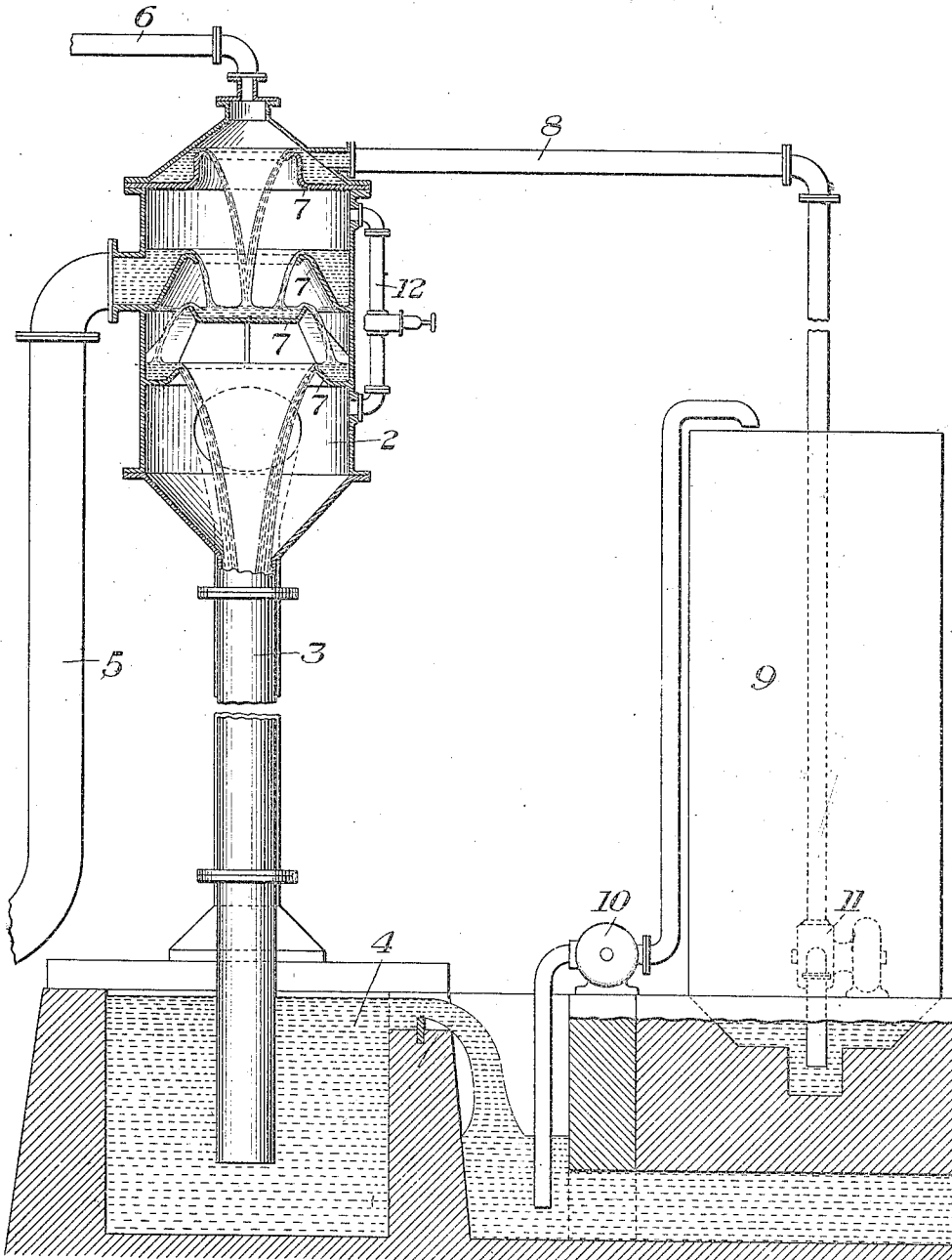


E. G. HELANDER.
CONDENSER.
APPLICATION FILED OCT. 28, 1915,

1,248,112.

Patented Nov. 27, 1917.



WITNESSES

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UNITED STATES PATENT OFFICE.

ERNST G. HELANDER, OF YOUNGSTOWN, OHIO.

CONDENSER.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ERNST G. HELANDER, a citizen of the United States, residing at Youngstown, Mahoning county, Ohio, have
5 invented a new and useful improvement in Condensers, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming part of this specification.

10 The figure is a view partly in side elevation, and partly in vertical section, and largely diagrammatic, showing my invention applied to one form of condenser.

15 My invention has relation to condensers, and is designed to increase the efficiency of a condenser.

20 More particularly, my invention is designed to provide means for improving the vacuum in a condenser, and is specially designed for use at such times as the cooling water available is relatively warm, as in summer time, or where the water has been previously heated to some extent.

25 It is well known that the efficiency of a condenser depends largely upon the temperature of the cooling water. Thus, if the cooling water available is at a temperature of 120 degrees Fahrenheit and a twenty-five inch vacuum is maintained, this corresponds
30 to a temperature of 134 degrees Fahrenheit. This gives only a maximum range of 14 degrees Fahrenheit available for heat transfer. If, however, the water is cooled to 75 degrees Fahrenheit, the range available for
35 heat exchange is 59 degrees, or four and two-tenths times as great; and the same result may be obtained by using 1000 gallons of water, as would be obtained by the use of 4200 gallons at the higher temperature.

40 It is practically impossible in the operation of large condensers to cool all the water used, owing to the large capacity of the cooling apparatus which would be required, and the expense of operating the
45 same. My invention provides for the use of a relatively small secondary supply of cooling water, which is either taken from some natural source, such as a well, in which the temperature is relatively low; or which is
50 artificially cooled to a relatively low temperature. This secondary supply of cooling water is introduced into the condenser at a point between the main inlet for the cooling water and the air outtake, so that the water
55 from the secondary inlet will, in falling, intercept the gases that have passed through

the main cooling water before such gases are drawn off by the air pump. This causes a further cooling and condensation of the steam; and the air will then be drawn from
60 the lower part of the condenser toward the air outtake, until it has a pressure corresponding to the separate air pressure due to the lower temperature. If the air pump keeps working at its ordinary speed, the
65 vacuum will then rise at the upper portion of the condenser chamber; and as no steam is now being drawn off, the air will be removed at a rapid rate.

Furthermore, by injecting the cooled sec-
70 ondary water at the top of the condenser in such a way as to cool the out-going gases, the volume of air is considerably reduced, due to the fact that the air does not expand in proportion to the total pressure at the top
75 of the condenser only, but in proportion to the separate air pressures, which is the total pressure, minus the steam pressure corresponding to the temperature at the top of the condenser chamber. The steam pressure
80 corresponding to 120 degrees Fahrenheit is approximately 1.75 pounds, while the steam pressure corresponding to 75 degrees Fahrenheit is only approximately .5 pounds. Therefore the corresponding separate
85 pressures, when gases are withdrawn at 120 degrees and 75 degrees Fahrenheit, respectively, are .75 pounds and 2 pounds. That is to say, in the first case any air that enters the condenser and is withdrawn by
90 the air pump expands approximately twenty times in volume, while in the second case the expansion is only about 7.5 times in volume. This has the additional advantage of enabling the air pump to draw the air quickly
95 from the condensing space in which its accumulation retards the heat exchange and prevents rapid condensation.

Referring to the accompanying drawing, I have shown my invention applied to a
100 counter-current vacuum condenser of a well known type. 2 designates the condensing chamber, 3 the tail-pipe extending downwardly into the well 4; 5 is the main water supply pipe; 6 is the usual exhaust connected
105 to a suitable pump; and 7 designates the internal baffles in the chamber 2.

8 designates the secondary water supply connection above referred to, and which enters the chamber 2 at a point between the
110 main water supply and the exhaust connection. As above indicated, the secondary sup-

ply may come from a well or other natural source having a relatively low temperature, or it may be furnished by a cooling tower indicated at 9. 10 is a pump pumping the water into the cooling tower, and 11 is another pump for pumping the water from the base of the cooling tower into the secondary supply pipe 8.

As a tower for this purpose only has to take care of a small fraction of the total cooling water, the expense of its construction and operation is relatively small and but comparatively small space is required. In plants where there are a number of condensers, one cooling tower and two pumps will be sufficient for several condensers.

My invention very greatly improves the vacuum in the condenser since, as above indicated, it enables the gas and air which have already been cooled to a temperature approximating that of the main cooling water, to be further cooled and thus materially reduce the volume of gas that must be withdrawn by the air pump. This also tends to rapidly empty the condensing space of air and thus increase the rate of heat exchange between the cooling water and the steam.

If the effective range of heat exchange for the cooler water is, for instance, four times that of the main cooling water, one volume of the secondary water is equal in heat exchange to four volumes of the main cooling water. If the secondary water is of this relatively lower temperature, and say one-tenth that of the main supply in volume, it carries off as much heat as would an increase in the main supply of four-tenths of its volume. Also the cooler secondary water does not carry more than one-tenth as much air into the condenser.

My improvement therefore makes it possible to maintain a good vacuum with hot cooling water without materially changing the condenser, as would be necessary if the supply of main cooling water were sufficiently increased.

The invention may be applied to various types of jet and surface condensers.

I preferably provide the condenser with an equalizing connection 12 between its upper and lower portions, thus preventing any great difference in the degree of vacuum at these two portions.

I claim:

1. A countercurrent condenser having a steam inlet, a main cooling water-distributing system above the steam inlet, a source of water supply therefor, a suction offtake above said water-distributing system for removing the air from the condenser, an auxiliary cooling water-distributing system between the main system and the suction offtake, the water from the auxiliary system commingling with the water from the main

system above the steam inlet, and means for supplying water to the auxiliary system independently of the source of supply for the main system, substantially as described.

2. A countercurrent condenser having a steam inlet, a main cooling water-distributing system above the steam inlet, a source of water supply therefor, a suction offtake above said water-distributing system for removing the air from the condenser, an auxiliary cooling water-distributing system between the main system and the suction offtake, the water from the auxiliary system commingling with the water from the main system above the steam inlet, means for supplying water to the auxiliary system independently of the source of supply for the main system, and an equalizing connection connecting the space between the two water-distributing systems and the space below the main water-distributing system, substantially as described.

3. A countercurrent condenser having a steam inlet, a main cooling water-distributing system above the steam inlet, a source of water supply therefor, a suction offtake above said water-distributing system for removing the air from the condenser, an auxiliary cooling water-distributing system between the first mentioned system and the suction offtake, a well below said condenser, a tail-pipe leading from the condenser to the well, a cooling tower, means for passing water from the well to the cooling tower, and means for lifting the water from the cooling tower to the auxiliary water-distributing system, substantially as described.

4. A countercurrent condenser having a steam inlet, a tail-pipe leading from the lower end thereof, a main cooling water-distributing system above the steam inlet formed of a baffle having a central opening therein, the baffle being so arranged as to form an annular water jacket in the condenser, means for supplying water thereto, a suction offtake connected to the upper portion of the condenser, and an auxiliary cooling water system between the first mentioned system and the suction offtake, said auxiliary system comprising a baffle having a central opening through which the water passes in one direction while the steam and air pass in the reverse direction, said baffle forming an annular water jacket for the upper portion of the condenser, and means for delivering water to the auxiliary water-distributing system from a point independent of the water supply to the main system, substantially as described.

5. A countercurrent condenser having a steam inlet, a main cooling water-distributing system above the steam inlet, said system comprising a plurality of annular baffles over which the water is adapted to pass, means for delivering water to said system,

some of said baffles extending in the reverse direction from another of said baffles so as to cause the water to fall toward the center of the condenser when passing over one 5 baffle and toward the wall of the condenser when passing over the next baffle, a suction offtake above said water-distributing system for removing the air from the condenser, an auxiliary cooling water-distributing system between the first mentioned system, and the suction offtake, the auxiliary 10 system comprising a baffle having an annular opening to cause the water to fall to-

ward the center of the condenser when passing over said baffle and to commingle with 15 the water in the main system after it passes over this first baffle, and means for supplying water to the auxiliary system independently of the supply for the main system, substantially as described. 20

In testimony whereof, I have hereunto set my hand.

ERNST G. HELANDER.

Witnesses:

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JOE MAHON.