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HEAT EXCHANGER HAVING FOREIGN MATTER TRAPPING AND REMOVING MEANS

Filed Aug. 6, 1962 2 Sheets-Sheet 1

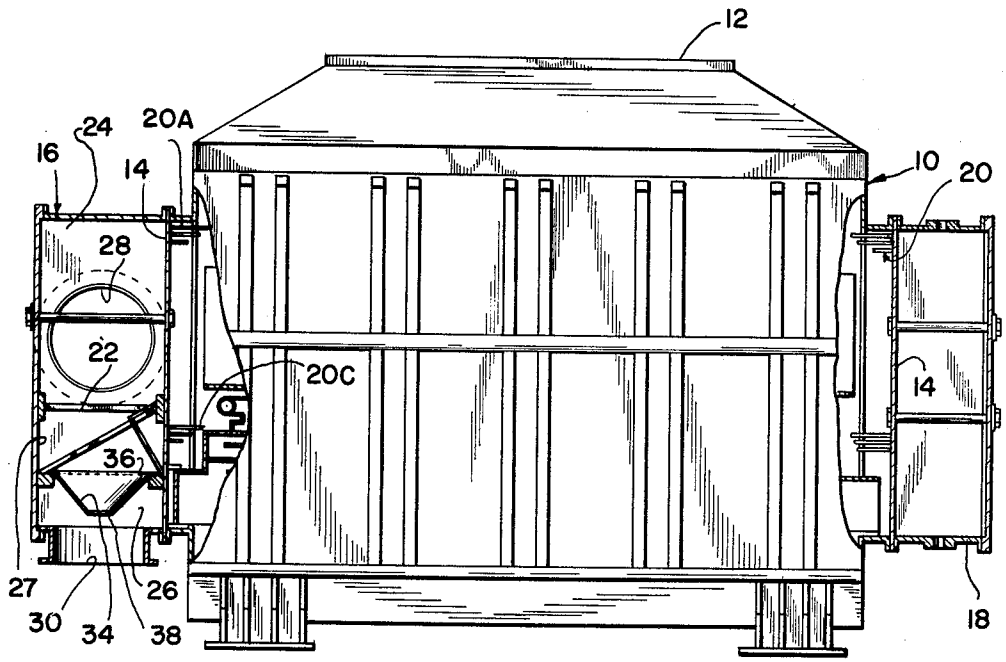


FIG. 1

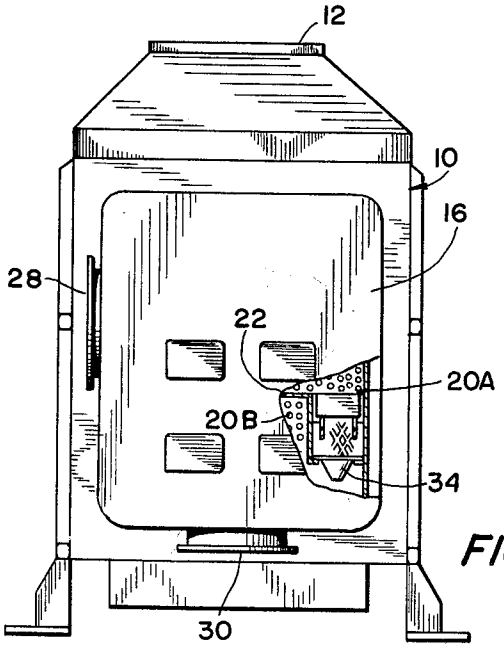


FIG. 2

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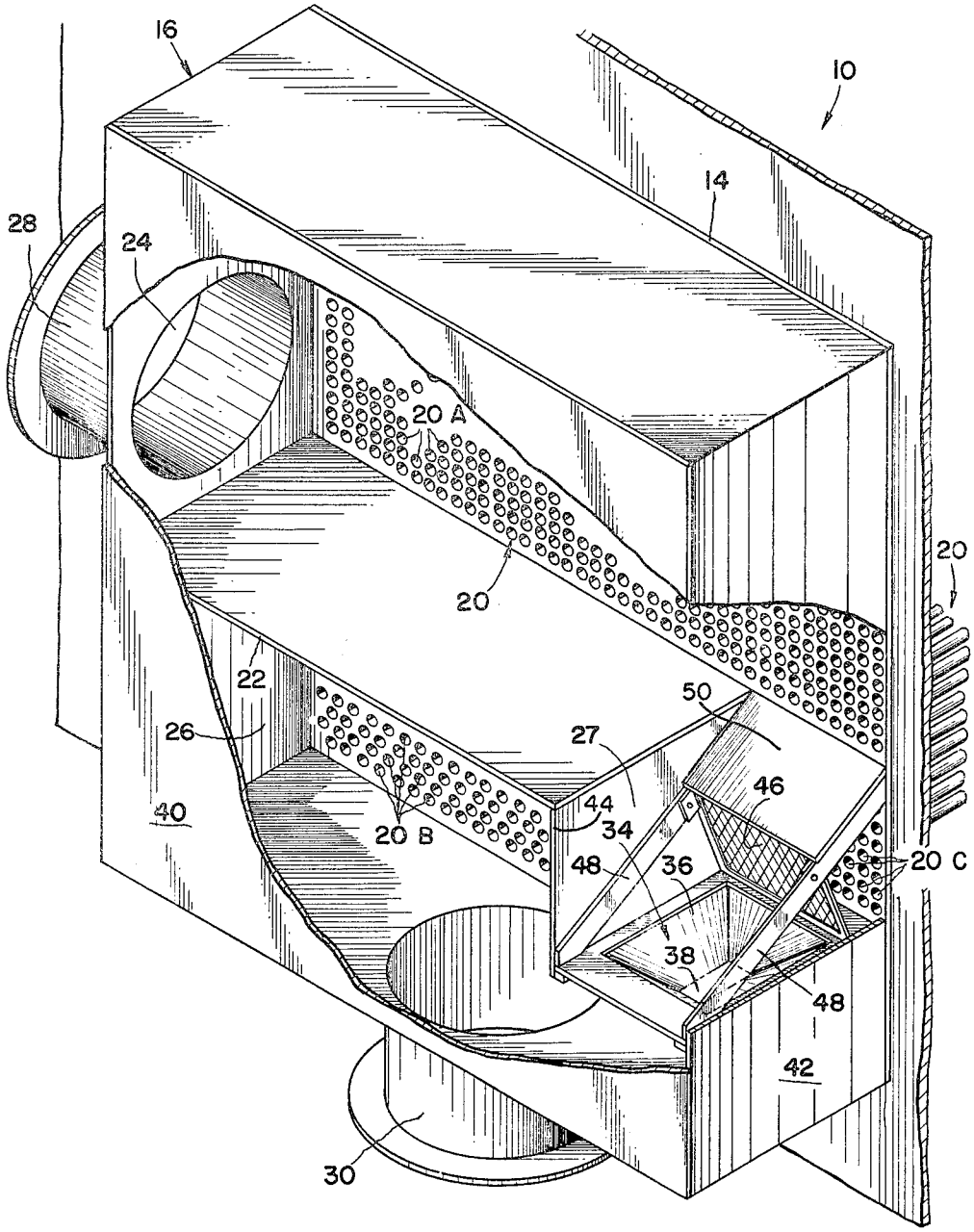


FIG. 3

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HEAT EXCHANGER HAVING FOREIGN MATTER TRAPPING AND REMOVING MEANS

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This invention relates to heat exchangers in general, and in particular to steam condensers of the type known as surface condensers.

In installations of surface condensers, the cooling water is usually taken from rivers, streams, lakes or other sources of cheap water supply. Water from such sources is generally contaminated with foreign matter, and when circulated through the relatively small tubes of the condenser causes a partial or complete blocking of the tubes with a resultant reduction of water circulation through the condenser, and consequently, a forced shut-down of the condenser.

The use of screens or gratings in the inlet water tunnel of the condenser installation is only effective for preventing the larger size foreign matter from entering the condenser. However, with presently known arrangements the smaller size foreign matter cannot be prevented from entering the condenser without substantially restricting the water flow to the condenser. Such smaller size foreign matter in the cooling water is in particular objectionable when it accumulates at the tube entrances, obstructing the flow of the cooling water and considerably reducing the efficiency of the condenser.

The use of "backwashing" as a measure to prevent accumulation of foreign matter in the water boxes and at the tube entrances requires not only a substantial investment in piping, valves, and other equipment, but also considerable skill to properly perform the various operations to accomplish the contemplated result without interrupting the normal operation of the condenser.

It is then an object of this invention to provide a condenser structure in which the accumulation of foreign matter in the water boxes is prevented.

Another object of this invention is to provide a condenser structure in which a simple means is incorporated to prevent accumulation of foreign matter in the water boxes.

Yet another object of this invention is to provide a condenser structure in which the means to prevent accumulation of foreign matter in the water boxes is effective and reliable.

These and other objects of the invention will be apparent from the following description read in conjunction with the accompanying drawings in which:

FIG. 1 is a side elevation, partly broken away, of a surface condenser embodying the invention,

FIG. 2 is an end elevation, partly broken away, taken at one end of the condenser, and

FIG. 3 is an enlarged sectional view in perspective showing the foreign matter trap and removed used in accordance with the invention.

Referring more particularly to the drawings, the improved condenser structure illustrated comprises a shell 10 provided with an inlet 12 for exhaust steam or other vapor to be condensed, tube plates 14 at each end of the shell, a water box 16 at one end of the shell, and a water box 18, a return water box, at the other end of the shell. A plurality of tubes 20 extending longitudinally of the shell are mounted with their terminal portions in the tube plates and positioned in groups to communicate the two opposing water boxes with each other.

Water box 16 is provided with a longitudinally extending partition 22 separating the interior of the water box into an inlet chamber 24 and an outlet chamber 26. Inlet chamber 24 includes a compartment 27 in the form of a conduit formed at the right-hand side of partition 22. Compartment 27 extends downwardly from partition 22 into the outlet chamber and is open at the top and at the bottom to permit communication between the inlet chamber and the outlet chamber, as will be explained hereinafter more in detail. Two water connections 28 and 30 are formed on water box 16, connection 28 serving as an inlet to conduct the incoming water into the inlet chamber 24, while connection 30 serves as an outlet to conduct the water from the outlet chamber 26 to a suitable discharge duct (not shown).

Tubes 20 include groups of tubes 20A, 20B, and 20C. Tubes 20A and 20C extend longitudinally from the portion of the tube plate associated with the inlet chamber 24, including compartment 27, to the corresponding portion of the tube plate associated with the return water box 18, while tubes 20B extend longitudinally from the portion of the tube plate associated with the outlet chamber 26 to the corresponding portion of the tube plate associated with the return water box 18. The group of tubes 20C forms the cooler section of the condenser for cooling the air and non-condensible gases present in the condenser in a well-known manner and is integral with the condenser shell and water boxes. As shown in FIGS. 1 and 3, the group of tubes 20C extends longitudinally from the tube plate portion associated with compartment 27 of inlet chamber 24 to the corresponding tube plate portion associated with the return water box 18.

In normal operation cooling water is conducted from a source of supply (not shown) to the water inlet 28 and inlet chamber 24. From the inlet chamber 24 of water box 16 the water flows through the associated groups of tubes 20A and 20C to return water box 18, from where the water is returned through the associated lower group of tubes 20B to the outlet chamber 26 and the water outlet 30 of the water box 16.

To provide for prevention of accumulation of foreign matter in the water boxes, and in particular at the inlet ends of the tubes, compartment 27 of inlet chamber 24 is equipped with means with which the foreign matter present in the cooling water is trapped and removed before it accumulates to restrict the water flow through the water boxes and the tubes. It is to be noted that the aforementioned means is preferably, although not necessarily, located at the inlet end of the cooler for air and non-condensibles, since, as is commonly known, effective operation of the cooler section of the condenser installation is of prime importance relative to the effective operation of other sections of the condenser.

As shown in FIG. 3, the right-hand side portion of partition 22 is cut away to provide a passage for the cooling water to flow downwardly from the inlet chamber 24 through compartment 27 into the cooler tubes 20C as well as directly into the outlet chamber 26. Compartment 27 is formed by the portion of tube plate 14 associated with the group of cooler tubes 20C, the corresponding opposing front wall portion 40 of outlet chamber 26, the corresponding right-hand side wall 42 of outlet chamber 26, and a side wall 44 extending downwardly from partition 22 with its lower end suspended above the bottom of the outlet chamber 26. The bottom of compartment 27 is formed by a downwardly tapered conduit 34 positioned with its upper or inlet end 36 at a level slightly lower than that of the lowermost row of cooler tubes 20C, and its discharge end 38 suspended above the bottom of the outlet chamber 26.

A screen **46**, positioned angularly relative to tube plate **14**, is provided to face the group of tubes **20C** of the cooler for air and non-condensibles to separate the foreign matter from the cooling water flowing into the cooler tubes **20C**. The lower end of screen **46** is mounted on the inlet end **36** of conduit **34** adjacent the lower row of cooler tubes **20C**, while the upper end of screen **46** is positioned spaced from the upper row of cooler tubes **20C**. Screen **46** is supported in its overhung position by a pair of downwardly sloping bars **48** mounted at either side of the screen. Bars **48** also support a baffle plate **50** positioned sloping downwardly from the tube plate **14** at a level slightly higher than that of the uppermost row of cooler tubes **20C** to the upper end of screen **46**. As shown in FIG. 3, baffle plate **50** is mounted in the manner illustrated to prevent the cooling water flowing downwardly into compartment **27** from flowing directly into the cooler tubes **20C** without passing through the screen **46**.

In operation, cooling water is conducted from a source of supply (not shown) to the inlet **28** of water box **16** and flows through the inlet chamber **24**, tubes **20A** and cooler tubes **20C**, return water box **18**, tubes **20B**, and into outlet chamber **26**, from where the cooling water is discharged through outlet **30**. It is to be noted that the foreign matter present in the cooling water flowing through the condenser is of the smaller size since the larger size foreign matter is prevented from entering the condenser by the use of screens or gratings in the inlet water tunnel of the condenser installation. A portion of the cooling water flowing though inlet chamber **24** flows to the right-hand side of the inlet chamber and is further conducted downwardly through compartment **27**, while the other portion of the cooling water makes a 90° horizontal turn to flow into and through tubes **20A**. A substantially large portion of the foreign matter present in the cooling water is carried by that portion of the cooling water flowing to the right-hand side of the inlet chamber because of the tendency of the foreign matter, by reason of its weight, to follow a linear flow path rather than to follow that portion of the cooling water making a 90° horizontal turn to flow into the tubes **20A**. Since the discharge end **38** of conduit **34** is substantially restricted relative to the inlet end **36**, the greater portion of the cooling water flowing into compartment **27** flows through screen **46** and into the group of tubes **20C** of the cooler. Screen **46** prevents the foreign matter present in the cooling water to enter tubes **20C**, and the foreign matter which accumulates on the screen is washed away by the cooling water flowing past the screen and into the inlet end **36** of conduit **34**.

It is to be noted that, with the nozzle type conduit **34** and the pressure differential between the pressure of the cooling water in the inlet chamber **24** and the pressure of the cooling water in the outlet chamber **26**, the cooling water flowing through compartment **27** will be ejected from the discharge end **38** of conduit **34** into the outlet chamber **26**. This causes the cooling water to flow with a substantial velocity through the discharge end **38** of conduit **34** and insures that substantially all foreign matter carried by the cooling water in the inlet chamber is drawn into compartment **27** and ejected therefrom into the outlet chamber **26**. It also insures that the screen **46** is continuously washed clean of foreign matter to provide for a free flow of substantially uncontaminated cooling water through the cooler tubes, and efficient operation of the condenser is thereby effected.

It is further to be noted that the overhung position of the screen relative to the inlet end **36** of conduit **34** serves to prevent accumulation of foreign matter on the screen as the cooling water flows through the screen. In the position illustrated, the foreign matter on the screen will be easily washed away because of the tendency of the foreign matter to detach itself from the overhung screen by gravity.

While we have shown and described one embodiment of the invention, it is obvious that variations may be made in the specific embodiment without departing from the spirit and scope of the invention as set forth in the appended claims. This invention is not limited to a condenser, but is applicable to other cases of heat exchange apparatus in which foreign matter is to be removed from the cooling medium flowing therethrough.

We claim:

1. A heat exchanger comprising:
   - (*a*) casing means forming a chamber,
   - (*b*) inlet and outlet means communicating with said chamber to provide the flow of one fluid therethrough,
   - (*c*) a plurality of first tubes and a plurality of second tubes extending across said chamber to conduct a second fluid in indirect heat exchange relationship with the first fluid,
   - (*d*) transfer means at one end of said casing means to communicate the adjacent ends of said first and said second tubes and provide the flow of fluid from the first tubes to the second tubes,
   - (*e*) a header disposed at the casing means at the opposite end from said transfer means,
   - (*f*) a partition in said header to divide the interior of the latter into an inlet chamber communicating with said first tubes and an outlet chamber communicating with said second tubes,
   - (*g*) an inlet port in said header communicating with said inlet chamber and disposed with the longitudinal axis of the port normal to the longitudinal axes of said first tubes so as to pass a second fluid having foreign matter entrained therein into said inlet chamber,
   - (*h*) said partition having a recessed portion to form a trap remote from the inlet port to receive foreign matter separated from substantially all of the second fluid flowing into said first tubes as the second fluid changes the direction of flow into said first tubes,
   - (*i*) a passageway in said recessed portion of the partition and communicating with the outlet chamber to pass separated foreign matter into the outlet chamber along with some of said second fluid, and
   - (*j*) an outlet port in said header communicating with said outlet chamber to pass from the heat exchanger the second fluid discharging from said second tubes and the second fluid which contains separated foreign matter flowing from said passageway.

2. The apparatus of claim 1 wherein said passageway has a restricted flow area adjacent the outlet chamber to increase the velocity of flow through the passageway.

3. The apparatus of claim 1 wherein a filter is disposed in said recessed portion of the partition between said passageway and said first tubes communicating in said inlet chamber with the recessed portion to prevent foreign matter entrained in some of said second fluid in said recessed portion from flowing into the first tubes communicating with the recessed portion.

4. The apparatus of claim 1 wherein said passageway is in the configuration of a hopper with the narrow open end communicating with the outlet chamber.

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