Feb. 27, 1968 P. J. HAMM 3,370,647

CONDENSER

Filed Feb. 8, 1966 2 Sheets-Sheet 1

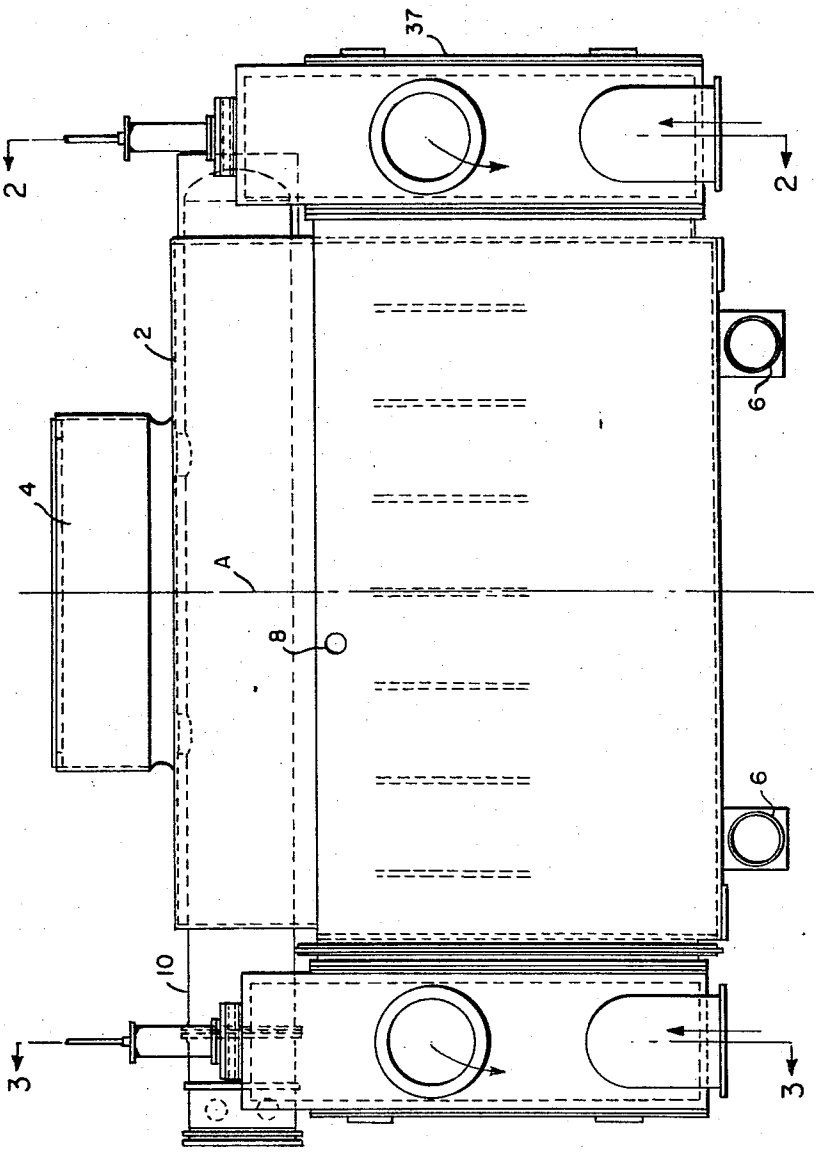

FIG. 1.

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Feb. 27, 1968 P. J. HAMM 3,370,647

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Filed Feb. 8, 1966 2 Sheets-Sheet 2

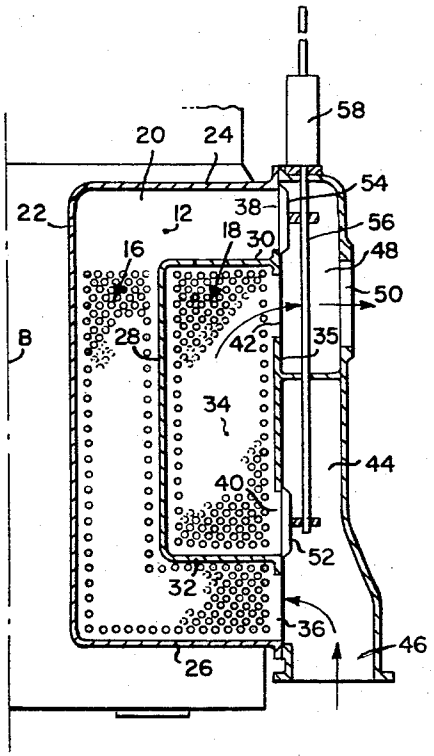

FIG. 2.

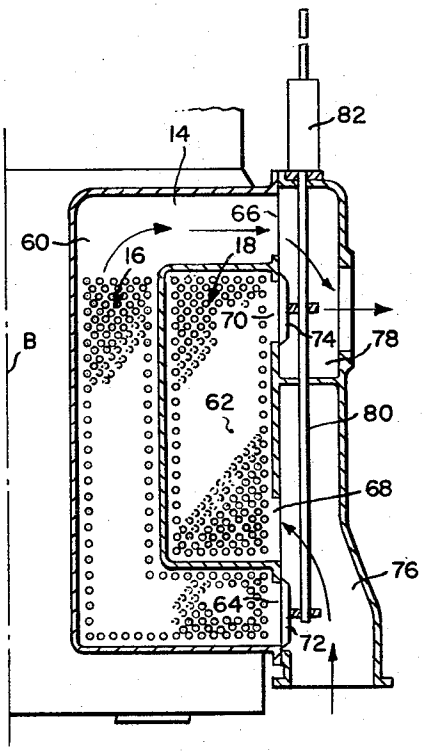

FIG. 3.

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CONDENSER

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ABSTRACT OF THE DISCLOSURE

A surface condenser comprising first and second sets of tubes for carrying a cooling liquid in opposite directions within a vapor-receiving shell is provided with slide valves at either end of the sets of tubes for effecting reversal of flow of cooling liquid.

This invention relates to condensers and particularly to provisions for backwashing the water side.

Heretofore backwashing has involved asymmetry of operation, meaning that during backwashing the operation of the condenser took on an aspect different from what was normal. This, in turn, meant that full load could not be maintained, and that the backwashing generally had to be accomplished in a minimum of time.

In accordance with the present invention, during both forward and reverse flows of the water essentially the same aspects of water flow are presented to the steam so that full operation may be maintained. While there may be a preference for flow in one direction, that will be a minor preference depending only on factors of little significance.

The general object of the invention relates to the achievement of the type of operation just mentioned, i.e. the maintenance of similar steam-water relationships, and the achievement of this and other secondary objects of the invention will become apparent from the following description, read in conjunction with the accompanying drawings, in which:

FIGURE 1 is a side elevation of a condenser provided in accordance with the invention;

FIGURE 2 is a vertical section taken on the plane indicated at 2—2 in FIGURE 1 and showing the arrangement existing at one end of the water tubes; and

FIGURE 3 is a vertical section taken on the plane indicated at 3—3 in FIGURE 1 showing the construction existing at the other end of the water tubes.

The shell of the condenser is indicated at **2** and provides the steam space surrounding the water tubes which run from right to left as viewed in FIGURE 1. A steam inlet connection is shown at **4**, and condensate outlet connections are shown at **6**. Offtake connections for air are provided in the upper portion of the shell as indicated at **8**. A conventional heater **10** may be located in the upper portion of the shell.

The condenser is substantially symmetrical, from the standpoint of water-steam relationships, about a central plane, the trace of which is indicated at A in FIGURE 1 and it is also substantially symmetrical about a central plane parallel to the plane of the paper containing FIGURE 1, the trace of this last plane of symmetry being indicated at B in FIGURES 2 and 3. Because of this symmetry, FIGURES 2 and 3 illustrate only halves of the vertical sections involved. For purposes of consistent description, references will be made to the elements shown in FIGURES 2 and 3 with the understanding that these would be duplicated on the left-hand side of the plane indicated at B.

The ends of the steam space are delimited by tube sheets **12** and **14**, the latter being indicated as to its location though it is in front of the section shown in FIGURE 3. Affixed in these tube sheets in conventional

fashion are groups of tubes **16** and **18** forming independent single passes. Referring particularly to FIGURE 2 the tubes **16** of one pass communicate with one compartment **20** of a water box, which compartment is delimited exteriorly by walls **22**, **24** and **26** and interiorly by walls **28**, **30** and **32**, the last mentioned walls delimiting the second compartment **34** of the water box with which the tubes **18** of the second pass communicate. The wall arrangements may, of course, be other than as shown. Both of the compartments are further delimited by a wall **35** which is provided with respective inlet and outlet openings **36** and **38** for inflow and outflow from the first compartment and openings **40** and **42** for inlet and outlet from the second compartment. Both compartments are closed also by removable plates of conventional type as indicated at **37** provided with manholes. Exteriorly of the wall **35** there is a water inlet chamber **44** provided with an inlet passage **46** and a water outlet chamber **48** provided with an outlet passage **50**.

To control inlet and outlet flow, slide valves **52** and **54** are provided connected for simultaneous movement to a rod **56** which may be operated by hydraulic pressure by connection to a piston within a cylinder **58**, conventional provision being made for reversal of movement of the piston. In their upper positions illustrated in FIGURE 2 the valves **52** and **54** respectively close the ports **40** and **38**. In their alternative lower positions they will close the ports **36** and **42**.

It will be understood that what has been described is duplicated on the other side of the plane B at the same end of the condenser.

There is also duplication of the structure described at the other end of the condenser as illustrated in FIGURE 3, and the structure will not be repeated in detail. Compartments **60** and **62** are provided with which the respective bundles of tubes **16** and **18** communicate. These compartments are provided with the ports **64**, **66**, **68** and **70** as illustrated, the former being the respective inlet and outlet ports for the compartment **60**, and the latter the respective inlet and outlet ports for the compartment **62**. At this end of the condenser the ports are controlled by the slide valves **72** and **74** and communicate with the inlet and outlet chambers **76** and **78**, the valves being connected to the common rod **80** movable in both directions by a piston in the cylinder **82**. It will be understood that here again the structure is repeated on the left-hand side of the plane B in FIGURE 3.

Considering for consistency what is on the right-hand side of the plane B in FIGURES 2 and 3, operation is as follows:

FIGURES 2 and 3 show consistent positions of the control valves, and flow of water will take place through the connection **46** into the chamber **44** and through the open port **36** into the compartment **20** from which flow will take place away from the observer through the tubes **16** of the first pass. Referring to FIGURE 3, flow from these tubes is then into the compartment **60** and out through the port **66**, which is then open, and into the chamber **78** for discharge.

Simultaneously water flow entering the chamber **76** passes through the open port **68** into the compartment **62** whence flow takes place toward the observer through the tubes **18** of the second pass into the chamber **34** and outwardly through the port **42** into the discharge chamber **48**. It will thus be seen that the flow of the water is countercurrent in the two passes. Similar flow conditions will occur in the passes at the left of the plane B.

To effect backwashing, the valves **52** and **54** are moved downwardly and the valves **72** and **74** are simultaneously moved upwardly. These movements may be so rapid that substantially no disturbance in operating conditions will

be evident, and any disturbance may be further minimized merely by moving at different times the valves at the right and left of the plane B. Without going into details, it will be evident that such repositioning of the valves will provide full flows of the water through the passes in directions opposite those previously described. This flow will effect the backwashing which is necessary from time to time.

It will also be evident that the flows presented to the steam are identical, though reversed, and that the condensing action will continue in the same fashion irrespective of the flow directions. The result is that full vacuum may be maintained with continuous loading of the mechanism (a turbine) with which the condenser is associated. The backflushing may be carried out at the convenience of the operator and whenever required without limitation to or by operating conditions, i.e., it is immaterial whether full or partial load conditions are involved when the backwashing takes place. Good balance of cooling water temperature is achieved along the length of the condenser with resulting better balancing of steam flow within the condenser, leading to improvement in condenser performance as compared with a condenser which has hot and cold ends due to asymmetry.

While a single water pass construction has been described, it will be evident that, more elaborately, multiple pass construction may be adopted in which the water may flow through tube bundles in series between each water entrance and the corresponding water exit, while maintaining the same aspects of water-steam relationships during water flows in both directions.

It will be evident that other details of arrangement may be made without departing from the invention as defined in the following claims.

What is claimed is:

1. A condenser comprising a vapor-receiving shell, at least two passes for cooling liquid, each pass comprising an array of tubes extending across the interior of the shell, the tubes of the two passes being approximately coextensive in length, boxes communicating with the ends of the respective arrays of tubes, and valve means controlling inflow of cooling liquid into the box associated with one pass at one end thereof, outflow of cooling liquid from the box associated with the same pass at the other end thereof, inflow of cooling liquid into the box associated with the other pass at said other end thereof, and outflow of cooling liquid from the box associated with said other pass at the first mentioned end thereof, said valve means comprising a pair of simultaneously movable slide valves at one end of the passes and a second pair of simultaneously movable slide valves at the other end of the passes, and said valve means being movable to reverse the aforementioned flows, so that in both conditions of operation the flows of cooling liquid in the passes are countercurrent to each other and present similar configurations of the cooling liquid flows to the vapor in the shell.

2. A condenser according to claim **1** comprising cooling liquid inflow and outflow chambers associated with said boxes, said slide valves being within said chambers.

References Cited

UNITED STATES PATENTS

1,430,172	9/1922	McIntire	137—309 X
1,684,227	9/1928	Johnsen	165—97
2,460,499	2/1949	Grace	165—97
2,655,363	10/1953	Roof	137—310 X

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