April 25, 1933. D. S. JACOBUS 1,905,470

ECONOMIZER

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Fig. 1.

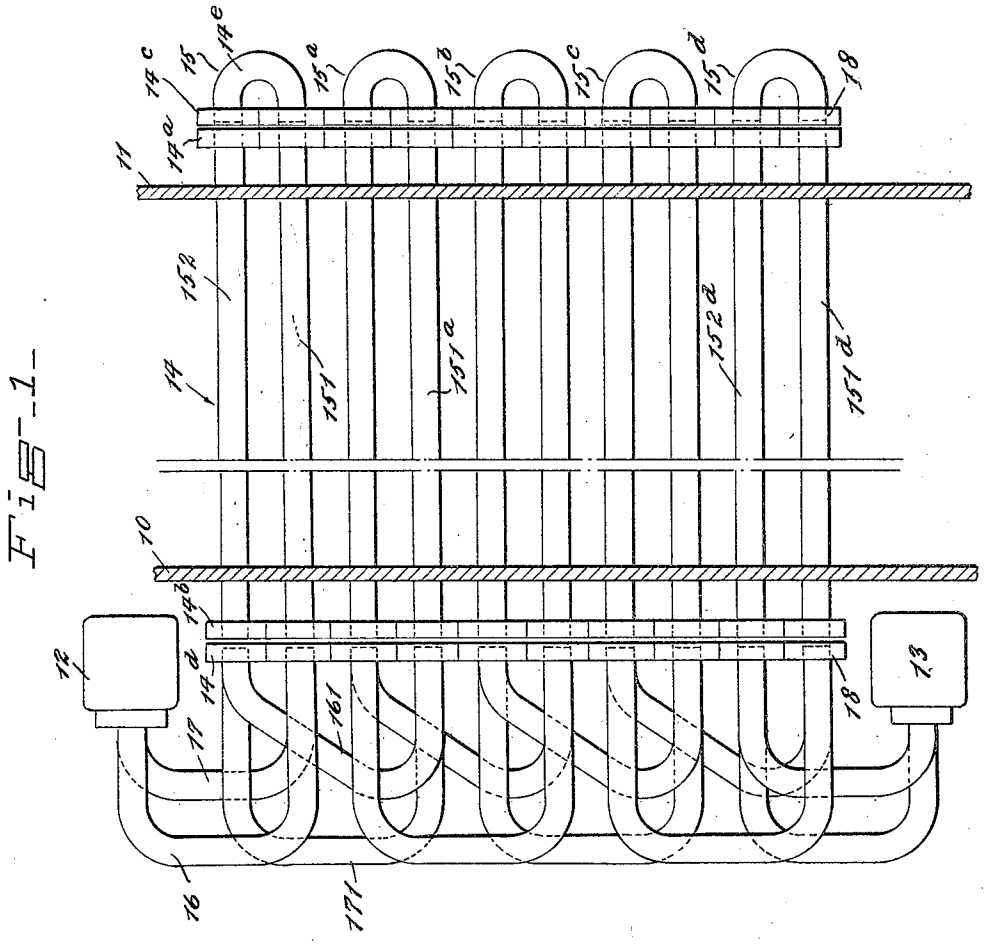
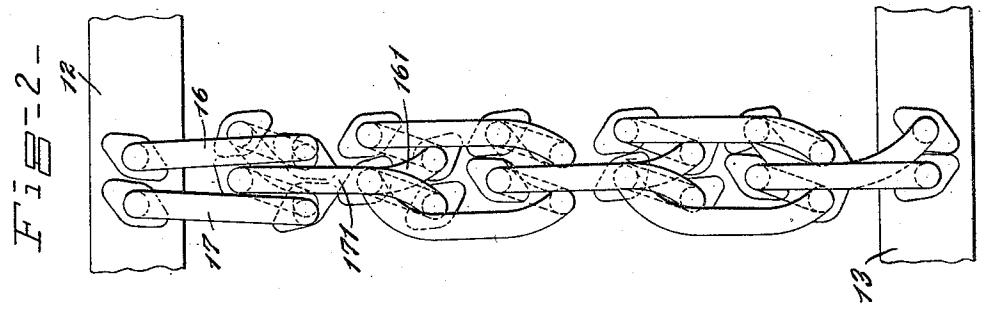


Fig. 2.



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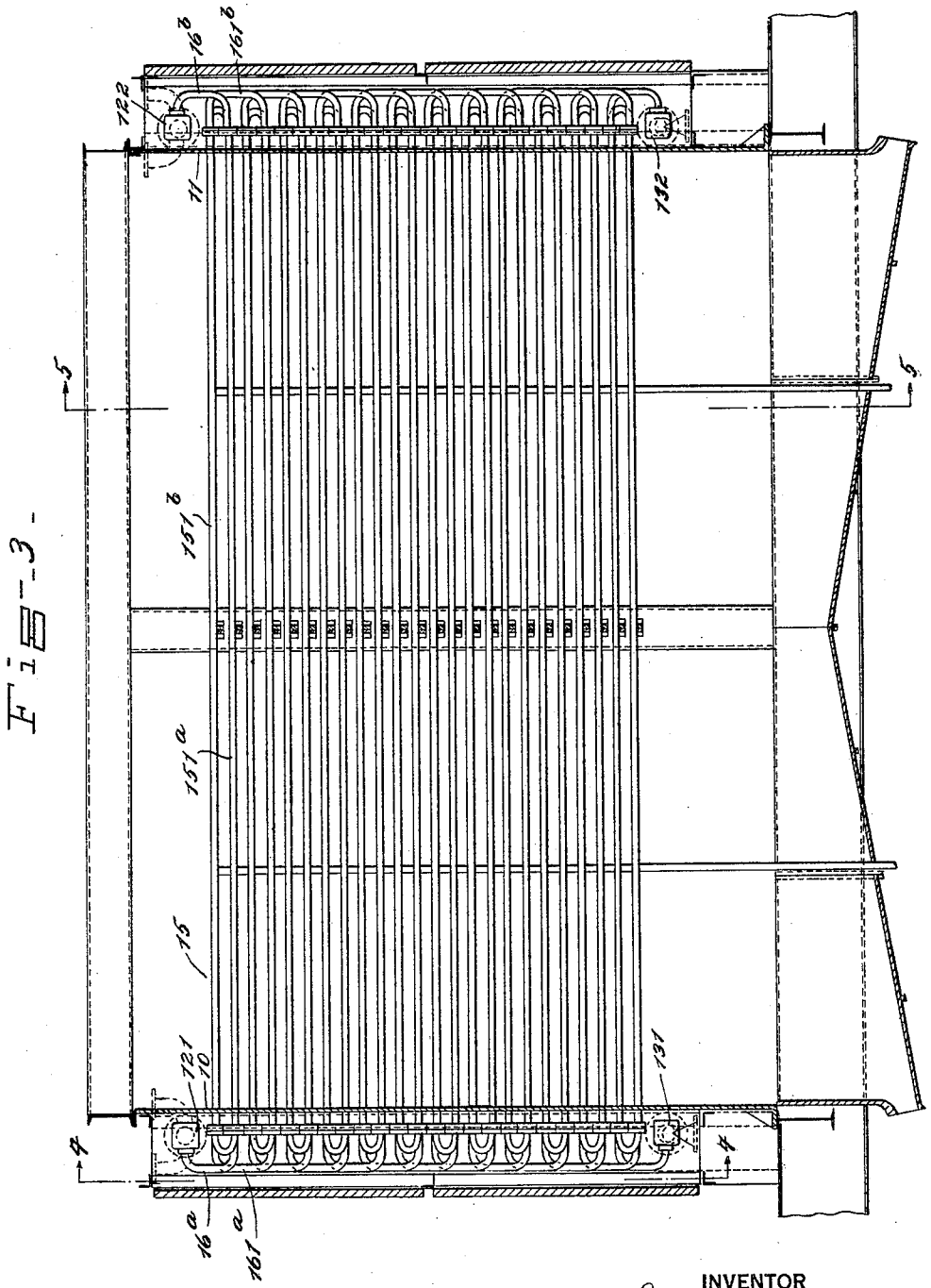


Fig. 3.

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Fig. 5.

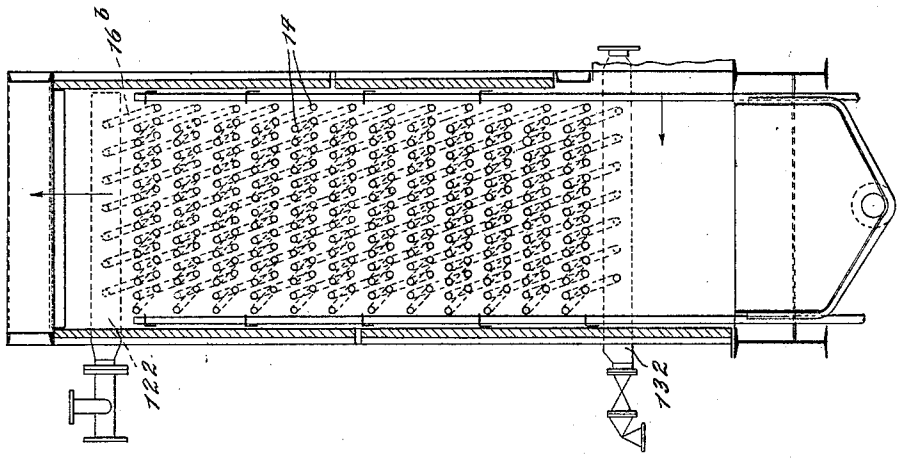
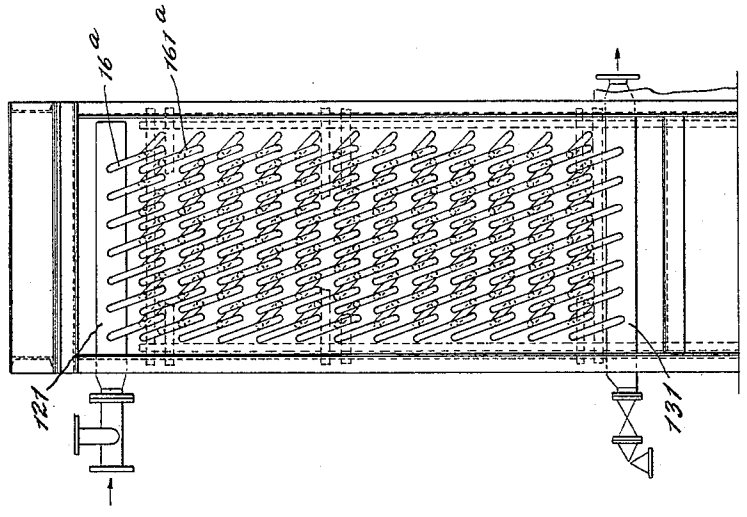


Fig. 4.



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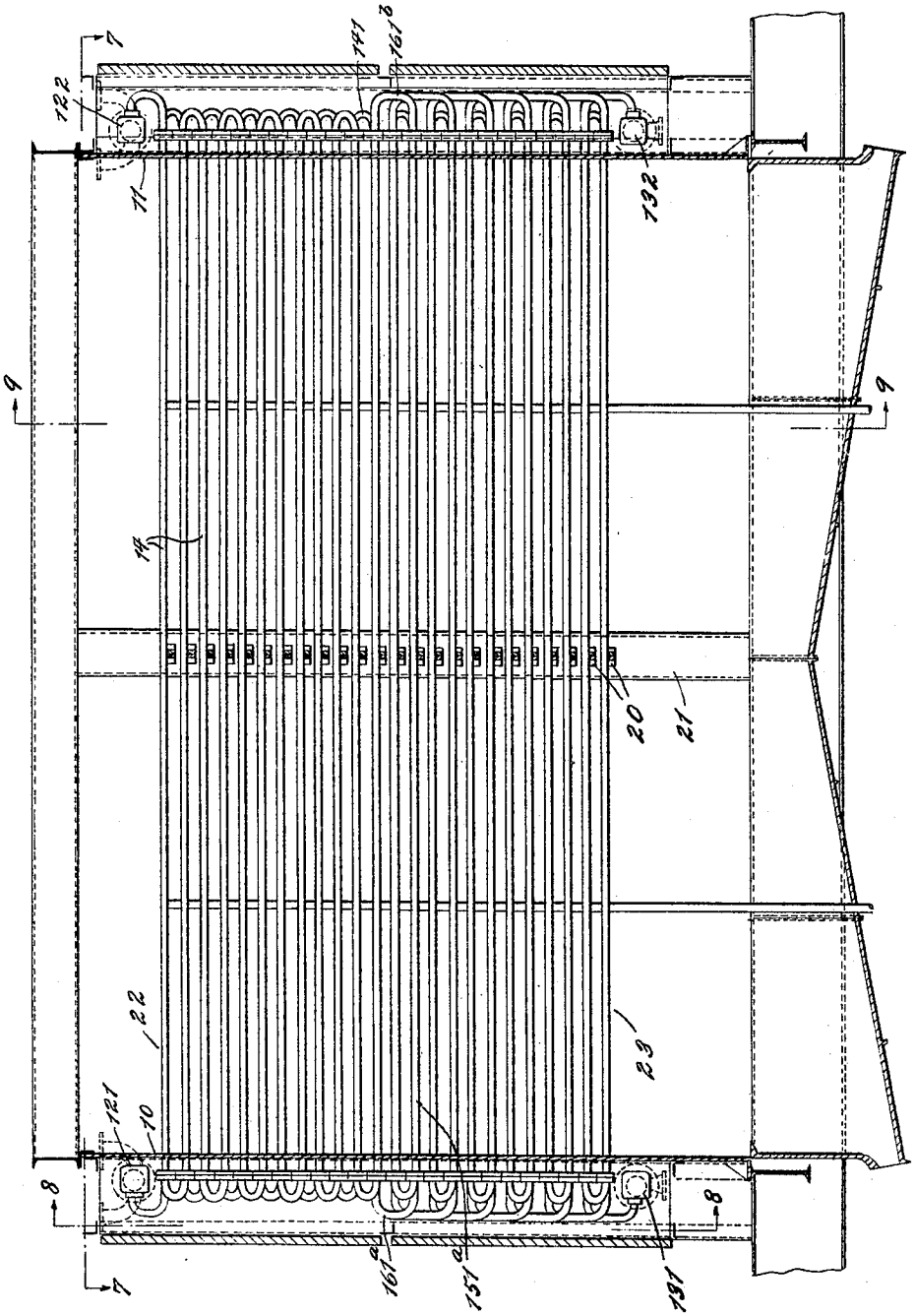


FIG-6-

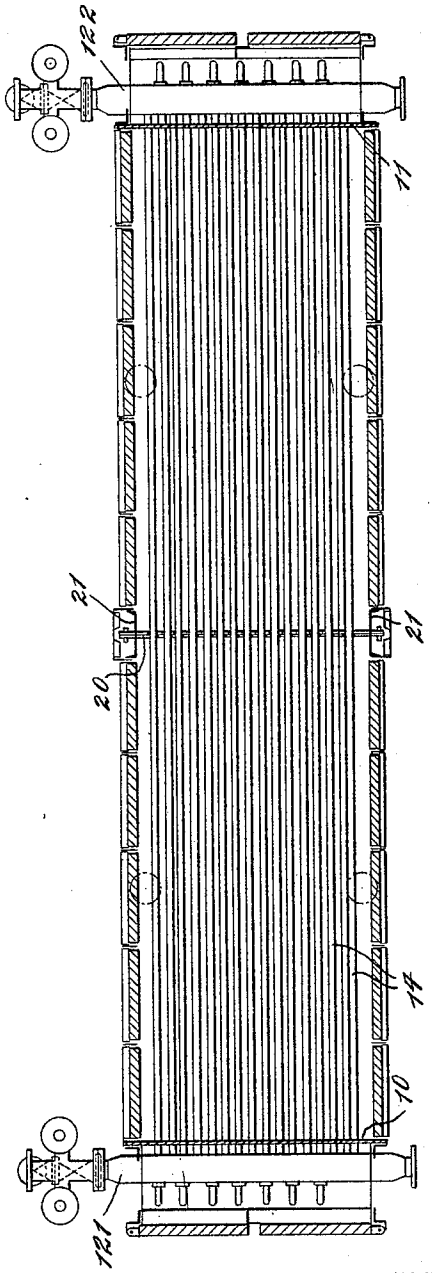
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Fig. 7.



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Fig. 9.

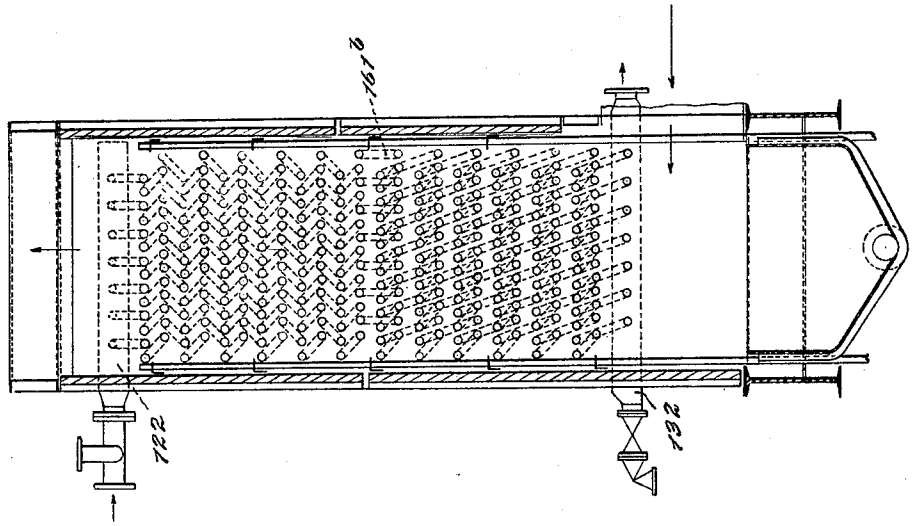
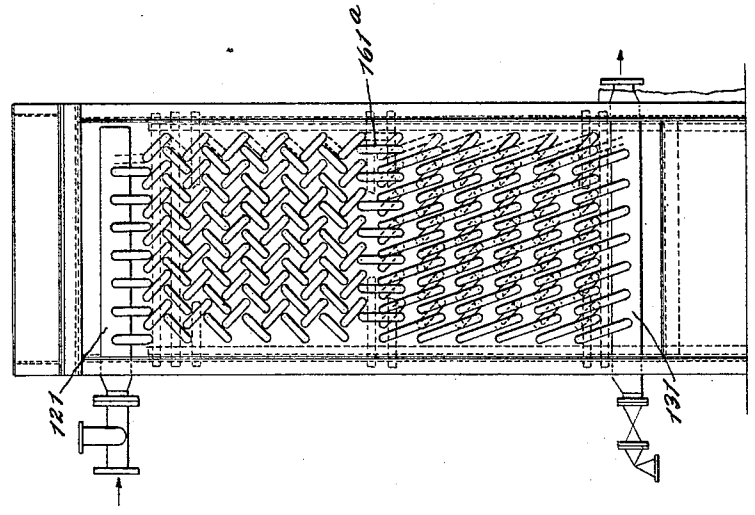


Fig. 8.



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UNITED STATES PATENT OFFICE

DAVID S. JACOBUS, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY

ECONOMIZER

Application filed December 4, 1928, Serial No. 323,716. Renewed January 17, 1931.

My invention more particularly relates to an economizer having return bend tubes.

My invention will best be understood by reference to the accompanying drawings, in which Fig. 1 is a somewhat diagrammatic view of an economizer embodying my invention with the casing and supporting structure therefor omitted; Fig. 2 is a fragmentary end view of Fig. 1 taken at the left; Fig. 3 is a sectional side view of a modified form of an economizer embodying my invention; Fig. 4 is an end view taken along the line 4—4 of Fig. 3; Fig. 5 is a sectional view taken along the line 5—5 of Fig. 3; Fig. 6 is a sectional side view of an economizer illustrating a further modification of my invention; Fig. 7 is a sectional plan view taken along the line 7—7 of Fig. 6; Fig. 8 is an end view taken along the line 8—8 of Fig. 6, and Fig. 9 is a sectional view taken along the line 9—9 of Fig. 6.

Like reference characters indicate like parts throughout the drawings.

Referring first to Figs. 1 and 2, 10 and 11 are end walls of a flue which, in the embodiment illustrated, extend vertically and in which flue the gases flow upwardly. An upper header 12 and a lower header 13 are preferably located at the same end of the economizer and both extend transversely of the economizer.

The tubes indicated generally at 14 are bent at their ends, and are divided into a plurality of sections indicated generally at 15, 15^a, 15^b, 15^c, and 15^d. The lower tubes 151 of the uppermost section 15 are connected to the upper header 12 by bent tubes 16 and 17, the bends being of different heights as illustrated at the left in Fig. 1, in order to permit the use of a spanner wrench in coupling together the straight tubes and the bent ends.

Preferably, the major portion of each of the tubular elements is straight and passes through openings in the walls 10, 11 of the flue, the ends of the tubes extending beyond the walls as illustrated in Fig. 1, and being provided with flanges as at 14^a and 14^b which are coupled to flanges 14^c and 14^d formed on the return bends, the two portions forming a joint as at 18. The details of this joint are more fully illustrated and described in an application of James E. Trainer and Ivar L. Langvand, which was filed in the United States Patent Office on or about the 11th day of January 1928, Serial No. 245,970, and as the same constitutes no part of my present invention, I have not shown or described such details.

It will of course be understood that continuous tubes of substantially uniform diameter could be used instead of the jointed tubes illustrated, and in the claims the word tubes is intended to cover tubes of either character.

Water enters the inlet header 12 and flows through the bent tubes 16 and 17 to the lowermost row 151 of the upper section 15 from which it flows through the short bend 14^e at the right-hand end as viewed in Fig. 1, to the uppermost row of tubes 152, from which it flows through long bends 161 and 171, to the lowermost row 151^a of the next lower section 15^a, and thus continues until it is discharged from the upper row of tubes 152^d of the lowermost section 15^d, to the outlet header 13.

By the provision of the various sections, with the water entering the lowermost row of tubes of a given section and flowing to the upper row thereof, the difficulty of water hammer caused by any steam which may be generated in the economizer coming in contact with the feed water is eliminated. It will be noted that any steam that is formed in a tube of a given row can flow upwardly no further than the tube above with which it communicates. For example, any steam generated in the tube 151^d can flow upwardly only to the tube 152^d and is not permitted, therefore, to come into contact with cold water that is being fed into the economizer, and water hammer cannot be produced.

In the embodiment of my invention illustrated in Figs. 1 and 2, it will be noted that only a single upper and a single lower header, both preferably located at the same end of the economizer, are provided.

In the embodiment of my invention illustrated in Figs. 3, 4, and 5, a pair of upper headers 121 and 122, and a pair of lower headers 131 and 132 are located at opposite

ends of the economizer and extend transversely thereof. In the embodiment here illustrated, the water flows from the inlet headers 121 and 122, through the bent tubes 16^a and 16^b, to the lowermost row of tubes 151^a of the uppermost section indicated generally at 15, the horizontal tubes 151^a with which the bent tubes 16^a and 16^b connect alternating transversely of the economizer. From the tubes 151^a, the water flows upwardly through the short bends, to the uppermost row of tubes 151^b, from which it flows downwardly through the long bends 161^a and 161^b, to the lowermost row of the next lower section, and thus continues until it is discharged into the lower headers 131 and 132.

By providing upper and lower headers at both ends of the economizer, the center to center distances between the tubes entering the headers is twice the center to center distance where all of the tubes enter a single upper and a single lower header as shown in Fig. 1. Furthermore, causing the water to enter the alternate tubes of a given row at opposite ends, results in a more even cooling of the gases which are flowing over the tubes than would be the case if all of the water entered the tubes at the same end, and this in turn tends to minimize or prevent altogether the lamination or laning of the gases in their flow over the economizer. Considering the row of tubes 151^a, for example, it will be noted that at the left-hand end of these tubes, comparatively cool water received from the header 121 is flowing through the left-hand ends of alternate tubes of this row, whereas water at a relatively high temperature is flowing through the other tubes at the left-hand end because of the fact that the water has flowed through the tubes of this row and been contacted by the gases passing thereover. The same is true at the right-hand end of the row, and of all of the lower rows. This feature is particularly important where the tubes are long, and where there would be a considerable difference in temperature in the flow of the water in a single tube across the flue.

In the embodiment of my invention illustrated in Figs. 6, 7, 8, and 9, the tubes are divided into two groups 22 and 23, the lowermost group 23 only having sections forming pockets of the same character as described in connection with Fig. 3. The water flows from the upper headers 121 and 122 through bent tubes, to the uppermost row of tubes of the upper group 22, from which it flows downwardly through U-tubes, to the next lower row, and thence continues downwardly to the lowermost row 141 of the group 22 from which it is discharged through the tubes 161^a and 161^b, to the lowermost row 151^a of the upper section 15, from which it flows through the bent tubes to the upper row of said section, and thence to the lowermost row of the next lower section, the water flowing upwardly in the individual sections and downwardly from section to section, the same as in the arrangement described in connection with Fig. 3, until it is discharged into the headers 131 and 132. Where the tubes are long, as illustrated in Fig. 3, they are preferably supported by intermediate transverse members 20 connected at their ends to fixed members 21.

The arrangement shown in Figs. 6 to 9, inclusive, is particularly advantageous where the gases are cooled down by the lower group of tubes 23 of the economizer to a point that would cause no steam to be formed above this group of tubes, and hence no steam can flow upwardly through the upper group of tubes 22 to come in contact with the cold feed water.

I claim:

1. In an economizer, a gas flue in which the gases flow upwardly, an upper and a lower header extending transversely of said flue, continuous tubular members connected at their ends to said headers and bent to extend back and forth across said flue, the tubes located in the lowest portion of said economizer being divided into sections, the water flowing upwardly in individual sections and downwardly from section to section, whereby a series of pockets are formed and any steam formed in a given tube can rise no further than the higher tube with which it directly communicates.

2. In an economizer, a gas flue in which the gases flow upwardly, an upper and a lower header extending transversely of said flue, continuous tubular members connected at their ends to said headers and bent to extend back and forth across said flue, the tubes located in the lowest portion of said economizer being divided into sections, each comprising two rows of tubes, the water flowing upwardly from the tubes of the lower row of a given section to the upper row thereof and downwardly from the upper row of a given section to the lower row of a next lower section.

3. In an economizer, a gas flue, an upper and a lower header at each end of the economizer extending transversely of said flue, rows of tubes extending back and forth across said flue, alternate tubes of one of the upper rows being connected at one end to one of the upper headers and at their other ends to one of the lower headers, and the other tubes being connected at one end to the other upper and lower headers, the tubes located in the lowest portion of said economizer being divided into sections, the water flowing upwardly in individual sections and downwardly from section to section, whereby a series of pockets are formed and any steam formed in a given tube can rise no further than the

higher tube with which it directly communicates.

4. In an economizer, a gas flue in which the gases flow upwardly, an upper and a lower header extending transversely of said flue, continuous tubular members, the major portions of which extend horizontally, connected at their ends to said headers and bent to extend back and forth across said flue, the tubes located in the lowest portion of said economizer being divided into sections, the water flowing upwardly in individual sections and downwardly from section to section, whereby a series of pockets are formed and any steam formed in a given tube can rise no further than the higher tube with which it directly communicates.

5. In an economizer, a gas flue in which the gases flow upwardly, an upper and a lower header extending transversely of said flue, continuous tubular members connected at their ends to said headers and bent to extend back and forth across said flue, the tubes of said economizer being divided into sections, the water flowing upwardly in the individual sections and downwardly from section to section, whereby a series of pockets are formed and any steam formed in a given tube can rise no further than the higher tube with which it directly communicates.

6. In an economizer, a gas flue, an upper and a lower header at each end of the economizer extending transversely of said flue, rows of tubes extending back and forth across said flue, alternate tubes of one of the upper rows being connected at one end to one of the upper headers and at their other ends to one of the lower headers, and the other tubes being connected at one end to the other upper and lower headers, the tubes of said economizer being divided into sections, the water flowing upwardly in the individual sections and downwardly from section to section, whereby a series of pockets are formed and any steam formed in a given tube can rise no further than the higher tube with which it directly communicates.

7. In an economizer, a gas flue in which the gases flow upwardly, an upper and a lower header at one end of the economizer, tubes connecting said headers and divided into groups, the tubes of the upper group communicating with the upper header and being bent at their ends and extending back and forth across said flue, the water flowing downwardly from each row of tubes to the next lower row, through the tubes of the upper group, the tubes of the lower group being divided into sections, the water flowing upwardly in a given section and downwardly from section to section, whereby a series of pockets are formed in the lower group of tubes and any steam formed in a given tube can ascend no further than the higher tube with which it directly communicates, the water flowing from the upper group to the lower.

8. In an economizer, a gas flue, a pair of upper and a pair of lower headers extending crosswise of the flue at opposite ends thereof, tubes bent at their ends and extending horizontally back and forth in rows across said flue, said tubes being divided into two groups, the water entering the uppermost row of tubes of the upper group and flowing downwardly from row to row through the tubes of said group, the tubes of the lower group being divided into sections, the water from the upper group entering the lowermost row of tubes of the upper section of the lower group and flowing upwardly therefrom to an upper row of tubes of that section and from thence to the lower row of tubes of the next lower section, whereby a series of pockets are formed in the lower group and any steam formed in a given tube can ascend no further than the higher tube with which it directly communicates.

9. An economizer comprising, in combination, opposite walls defining a passage for a stream of heating gases, return bend tubes extending across the passage and through said walls, an upper header supplying water to the tubes for passage in separated streams to the lower part of the economizer, a lower header receiving the dicharge from the tubes, and bends outside said walls connecting the tubes into groups constituting economizer sections each having an entirely downflow discharge, the flow of one tube of one section to a succeeding tube of the same section being upward to make that section a means for limiting the flow of steam to the other parts of the economizer.

10. In an economizer, a gas flue for the passage of heating gases, an economizer inlet header adjacent the gas outlet zone of the flue, an economizer outlet header adjacent the gas inlet end of the flue, and groups of tubes connecting the headers, some of said tubes extending back and forth in successive rows across the flue to conduct water in a flow which is entirely counter to the gas flow through a plurality of successive groups of the tubes, the remaining tubes being so disposed that they reverse the water flow to form means for limiting the flow of steam through the economizer.

11. In an economizer, a gas flue, an upper and a lower header located at each end of the economizer and extending transversely of the flue, rows of tubes extending back and forth across the flue for conducting streams of water across a stream of heating gases in the flue, connections between similar ends of some tubes of one of the upper rows, and one of the upper headers, connections between the other ends of the same tubes and a lower header, and similar connections between the remaining tubes and the remaining headers, the said remaining tubes being offset from

the first mentioned tubes, some of the tubes near one end of the economizer constituting a section in which there is a reversal of water flow with respect to the water flow throughout a substantial part of the economizer.

12. In an economizer, a gas flue for the passage of heating gases, an economizer water inlet adjacent the gas outlet zone of the flue, an economizer water outlet adjacent the gas inlet end of the flue, groups of tubes connecting the water inlet and outlet, some of said tubes extending back and forth in successive rows across the flue to conduct water in a flow which is counter to the gas flow through a plurality of successive groups of the tubes, and connections joining some of the remaining tubes so that the water flow therethrough is parallel with respect to heating gas travel, the latter tubes and connections thereby forming means for limiting the flow of steam through the economizer.

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