H. H. WAIT.

STEAM EQUALIZER.

APPLICATION FILED AUG. 27, 1910.

996,740.

Patented July 4, 1911.

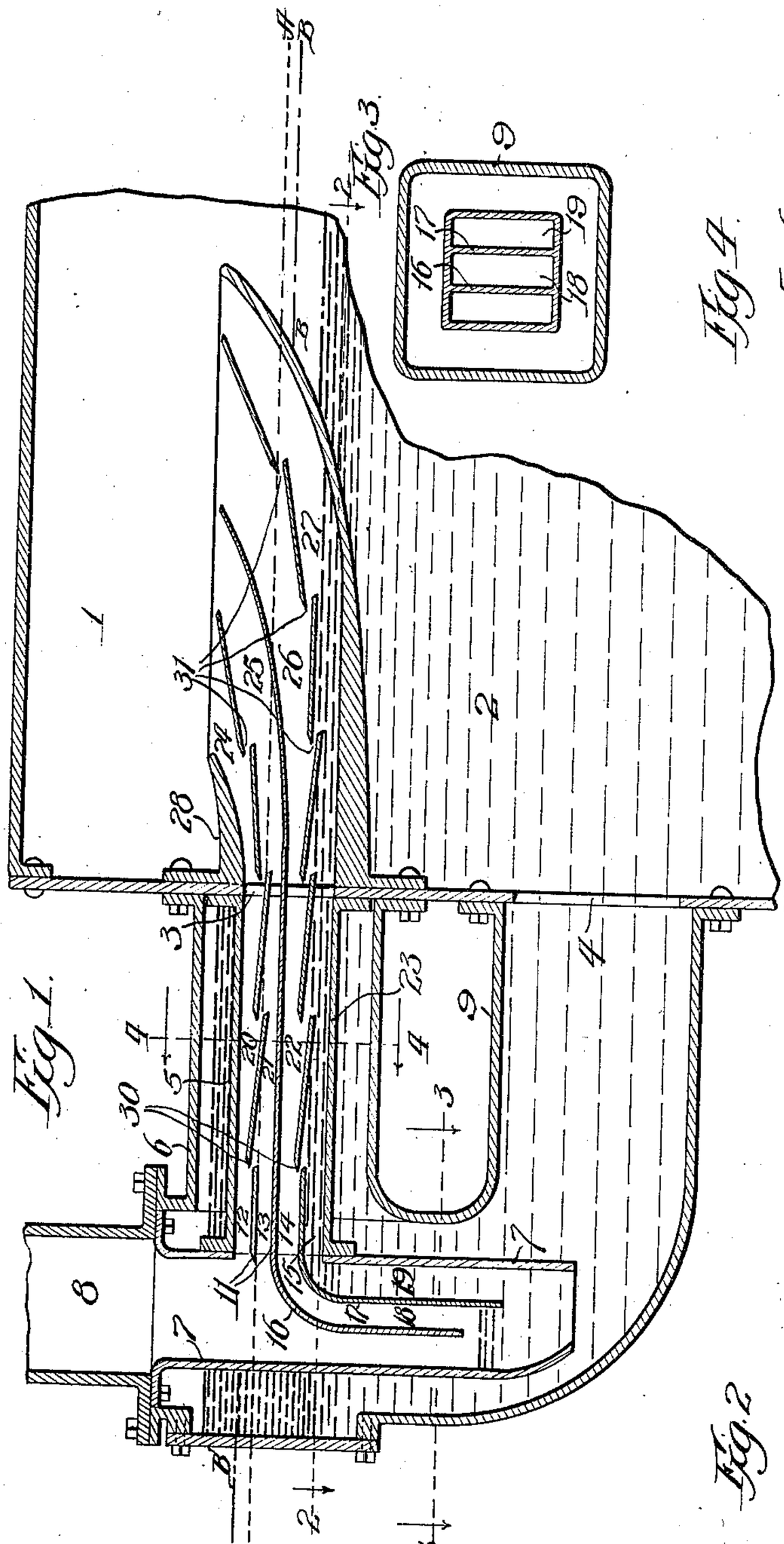

Fig. 1.

Fig. 3.

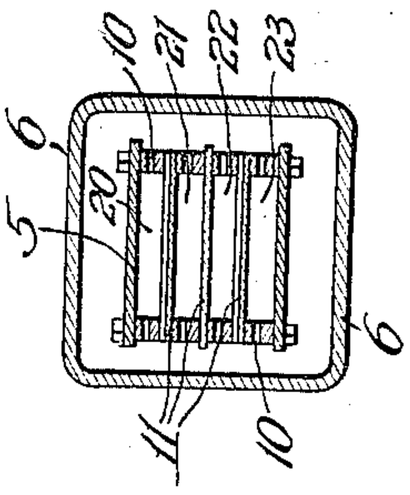

Fig. 4.

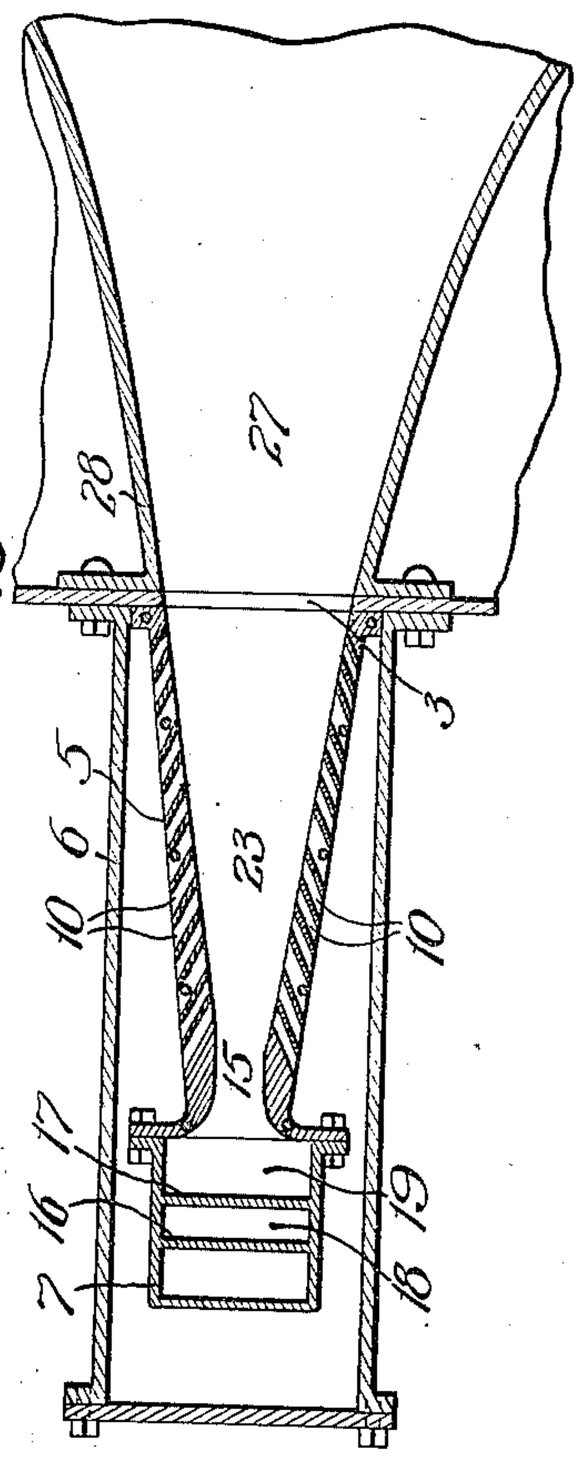

Fig. 2.

Witnesses.

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STEAM-EQUALIZER.

996,740. Specification of Letters Patent. Patented July 4, 1911.

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To all whom it may concern:

Be it known that I, HENRY H. WAIT, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Steam-Equalizers, of which the following is a full, clear, concise, and exact description.

My invention relates to steam equalizers or accumulators. Its object is to provide an improved apparatus adapted to receive exhaust steam from engines and to mingle the steam with the heat absorbing water contained in the accumulator in such manner as to absorb the heat of the exhaust steam with a minimum amount of back pressure on said engines.

My present invention is an improvement on the broad invention disclosed in United States Letters Patent, No. 938,356, granted to me on October 26th, 1909.

In accordance with my present invention, the apparatus is so constructed that the steam received at a low pressure impinges in substantially free and unimpeded jet or jets at the surface or subdivided surfaces of a portion of the water of the accumulator, entrains such water and is mingled therewith, the combined mass flowing onward in a current substantially in the direction of the jets and being replaced by fresh supplies of steam and water directed to the place of impact.

My apparatus is further so constructed as to provide automatic adjustment of the cross sectional area of the current of steam to vary with the amount of the steam received from the engines, the velocity of the steam current being thereby maintained within suitable limits. In its preferred embodiment, this latter feature of my invention consists in sub-dividing the current of steam into a plurality of jets each of which acts upon a separate portion or subdivided portion of the mass of water, such separate jets being successively brought into action as the amount of steam from the exhaust engine increases.

These and other features of my invention may be more readily understood by reference to the preferred embodiment of my invention shown in the accompanying drawings in which—

Figure 1 is a sectional elevation of so much of the accumulator as is necessary to the understanding of the invention; and Figs. 2, 3 and 4 are sections on the lines 2—2, 3—3 and 4—4, respectively, of Fig. 1.

The same reference characters indicate the same parts wherever shown.

The main tank or container 1 of the accumulator in which is held the mass of heat absorbing liquid or water 2 may be of any suitable construction. On one of its side faces the tank 1 is provided with openings, the opening 3 being approximately at the upper surface of the liquid in the accumulator and the lower opening 4 being near the bottom of the accumulator. Extending horizontally and outwardly from the opening 3 is a chamber or compartment 5 which is surrounded by a pipe 6. The forward end of the chamber 5 communicates with an opening in the side of a vertically disposed pipe or header 7. The steam pipe 8, which supplies the exhaust steam from the engine, communicates with the vertical header 7. The lower opening 4 communicates with a pipe 9 which extends horizontally from said opening and is curved upwardly into communication with the forward end of the pipe 6. The lower end of the header 7 projects down into the pipe 9. It will thus be noted that the pipes 6 and 9 form a return bend or U-shaped pipe detachably secured to the body of the accumulator, and that the header 7 projects into the elbow of such return-bend pipe. The header 7 near its upper end communicates with the chamber 5, which is inclosed by the upper arm 6 of the return-bend pipe. Thus, dependent upon the pressure in the container 1 and in the piping 7 and 8, water will wholly or partially fill the space between the pipe 6 and the chamber 5.

The chamber 5 is preferably contracted in cross section from the opening 3 outwardly and is provided in its vertical side walls with a series of openngs or nozzles 10 for the admission of water. At its end which communicates with the header 7, the chamber 5 is provided with any desired number of horizontal partitions 11 and the chamber 5 and partitions 11 are so constructed as to provide a plurality of superposed nozzles 12, 13, 14 and 15. The partitions 11 which separate the nozzle 13 from the nozzle 14, and the nozzle 14 from the nozzle 15, are curved downwardly to form the partitions 16 and 17, respectively, in the header 7, the

partition 17 extending a greater distance downward than the partition 16. By such construction the nozzles 14 and 15 are provided, as it were, with downwardly extending feed tubes 18 and 19, respectively, to bring said nozzles into action only when the level of the water in the header 7 is forced down by the steam pressure below the lower ends of the partition 16 and 17, respectively, as will hereinafter be more fully described. The chamber 5 between the above-mentioned nozzles and the opening 3 is likewise subdivided by horizontal partitions corresponding to or forming continuations of the partitions 11, which latter divide the space in the chamber 5 into a series of superposed mixing chambers 20, 21, 22, and 23 in which the steam is thoroughly intermingled with the water admitted through the openings or nozzles 10. Each of the mixing chambers 20, 21, 22 and 23 communicates through the opening 3 with a diffusion chamber 24, 25, 26 and 27, respectively, which diffusion chambers are adapted to gradually reduce the velocity of the combined jets of steam and water and convert the energy of momentum into pressure. The diffusion pipes are preferably formed by disposing suitable, approximately horizontal, partitions in a pipe 28 which is mounted upon the interior of the container 1 about the opening 3 and which is curved upwardly to extend slightly above the normal level of the water or liquid in the container. The partitions in the pipe 28 form continuations of the partitions in the chamber 5, so that the steam from the pipe 8 passes successively through one or more of the nozzles 12, 13, 14, 15, the corresponding mixing chambers 20, 21, 22, 23 and finally the corresponding diffusion chambers 24, 25, 26, 27. Since each of the mixing chambers has a series of openings in its side walls communicating with the water surrounding the chamber 5, the water, as it is subjected to the action of a jet of steam from the nozzle communicating with such mixing chamber, is thus subdivided at the point of impact of the steam.

The operation of the apparatus is as follows: When there is no flow of steam whatever the normal level of water in the accumulator and the pipes communicating therewith may, for example, be as is indicated by the dotted lines A—A. When there is only a very slight flow of steam, the pressure of the steam in the accumulator 1 will cause the water to assume the levels indicated by the dotted lines B—B. The nozzle 12 will then be the only one that is acting, and only a small amount of water will be entrained, the steam from the nozzle 12 being impinged on the surface of the water in the mixing chamber 20, and impelling said water through said mixing chamber 20 and the diffusion chamber 24 into the accumulator tank 1. As the amount of the steam flow increases, with a resulting increase of pressure in the header 7, the level of the water in said header 7 will be lowered so as to also bring the nozzle 13 into action. A still greater flow of steam at a considerable pressure, such as would ordinarily occur in the starting or a rolling mill or hoisting engine, will still further reduce the level of the water in the header 7 so that it will be depressed below the partition 16, thereby letting the steam flow through the feed tube 18 and bringing the nozzle 14 into action, as indicated in Fig. 1, in which the water 2 is indicated in broken lines. In a similar manner a still greater steam pressure in the header 7 will bring the nozzle 15 into action. The pipe 7 thus constitutes, as it were, an expansible steam chamber at the intake ends of the nozzles, the area of such expansible steam chamber increasing with the depression of the level of the liquid in the pipe 7. At the same time that the level of the liquid is thus lowered with respect to the intake ends of the nozzles, the liquid level is raised with respect to the orifices of said nozzles. The steam jets passing through the nozzles 12, 13 and 14 acts to suck in water into the chamber 5 through the openings 10, such openings being preferably forwardly inclined and extending in the same general direction as the steam nozzles. Since each nozzle has its own mixing and diffusion chamber, the several jets of steam and water are maintaned in an independent relation, so that the water can not accumulate in masses and fall to the bottom of the chamber 5 when the velocity of the steam jets is below a certain value. However, one or more of the partitions in the pipe 5 may be provided with openings 30 through which water falling into the bottom of one passage is sprayed in the next lower passage. Likewise the partitions in the pipe 28 may be provided with openings 31. It will thus be apparent that as the amount and pressure of steam delivered by the pipe 8 increases, the cross sectional area of the current of steam passing through the nozzle or nozzles is increased automatically, thereby maintaining the velocity of the steam within the desired limits. The velocity of the steam jet and the cross sectional area of the nozzles, mixing passages and diffusion passages are so calculated as to get the maximum result from the velocity of the steam, and this velocity is converted in the diffusion passages into pressure. An increase of pressure in the tank 1 decreases the water level in said tank and raises the level of the water in pipes 9 and the pipe 6 which communicates therewith. The action of the steam nozzles sucking in water through the openings 10 likewise tends to draw in water from the bottom of the tank 1 through the pipe 9

and into the pipe 6, water from the colder portions of the accumulator being thus carried to the point of impact of the steam jets.

The term normal as applied to the level of the liquid or water is intended to designate the level which the liquid or water would assume by reason of gravity alone, unaffected by the pressure of steam in the container or by the pressure of steam admitted to the header. Such normal level of the liquid is that indicated by the dotted line A—A in Fig. 1.

I claim:—

1. In a steam equalizer, the combination with a vessel adapted to store a mass of heat-retaining water, of a header for conveying steam to said vessel, a steam nozzle leading from said header to said vessel, said nozzle being arranged to provide a passageway for steam from said header to said vessel above the normal level of water in said vessel, and a conduit arranged to conduct water from said vessel into entraining contact with steam passing through the orifice of said nozzle.

2. In a steam equalizer, the combination with a vessel adapted to store a mass of heat-retaining water, of a header for conveying steam to said vessel, a steam nozzle leading from said header to said vessel, said nozzle being arranged to provide a passageway for steam from said header to said vessel above the normal level of water in said vessel, and a conduit having a plurality of nozzles, each partly above the normal level of water in said vessel, arranged to conduct water from said vessel into entraining contact with steam passing through the orifice of said steam nozzle.

3. In a steam equalizer, the combination with a container for liquid, of a steam nozzle for directing steam into entraining contact with liquid stored in said container, said nozzle having its passage substantially at the normal level of liquid in said container, a pipe communicating at its lower end with said container at a point below the liquid level and communicating at its upper end, through a plurality of small openings, with the steam passing through said nozzle.

4. In a steam equalizer, the combination with a vessel for storing a heat-retaining liquid, of a header for conveying steam to said vessel, the bottom of said header communicating with the liquid in said vessel to normally provide the same liquid level in said header and said vessel, and a plurality of superposed steam nozzles extending from said header at and below the normal liquid level and arranged to direct steam into entraining contact with liquid stored in said vessel, whereby the number of said nozzles in action varies in proportion to the variation in the pressure of steam in said header.

5. In a steam equalizer, the combination with a container for heat retaining liquid, a horizontally extending chamber communicating therewith at approximately the normal liquid level, partitions dividing said chamber into a plurality of independent passageways for steam, and means controlled by the pressure of the steam for regulating the admission of steam to said passageways.

6. In a steam equalizer the combination with a container for liquid, of a steam nozzle arranged to provide a passageway for steam to said container above the normal level of the liquid in said container, a series of water nozzles opening into said steam nozzle, and a pipe for conducting liquid from the bottom of said container through said series of nozzles into contact with the jets of steam passing through said steam nozzles.

7. In a steam equalizer, the combination with a container for liquid, of a plurality of steam nozzles for admitting jets of steam into entraining impact with portions of said liquid, said nozzles being in parallel and providing passageways for steam both above and below the normal level of the liquid in said container.

8. In a steam equalizer, the combination with a container for liquid, of a header, a steam nozzle arranged to direct a jet of steam from said header into entraining contact with the surface of said liquid, and additional steam nozzles arranged to be brought into action to direct steam from said header into entraining contact with said liquid as the flow of steam into said header increases.

9. In a steam equalizer, the combination with a container for liquid, of a header communicating at its lower end with the liquid in said container to normally provide the same liquid level in said header and said container, a steam nozzle having its intake communicating with said header and arranged to direct a jet of steam into entraining contact with said liquid, a supplemental steam nozzle likewise having its intake communicating with said header and arranged to direct a jet of steam into entraining contact with said liquid, and a partition extending in said header below the normal liquid level therein and cutting off the steam supply from said supplemental nozzle when the flow of steam is less than a predetermined amount.

10. In a steam equalizer, the combination with a container for liquid, of a vertically disposed header in communication with said liquid to normally provide the same liquid level in said header and said vessel, a steam nozzle in said header at substantially the normal liquid level, and a supplemental steam nozzle in said header also at substantially the normal liquid level, but having its inlet located at a lower level than said first

mentioned nozzle, said steam nozzles being arranged to direct jets of steam into contact with said liquid.

11. In a steam equalizer, the combination with a container for liquid, of a vertically disposed header in communication with the liquid in said container to normally provide the same liquid level in said header and said container, a nozzle extending from said pipe above the liquid level and arranged to direct a jet of steam into contact with said liquid, and a supplemental steam nozzle opening below the normal liquid level in said header.

12. In a steam equalizer, the combination with a container for liquid, of a chamber communicating therewith at substantially the normal liquid level, a pipe surrounding said chamber and communicating with said container at a point below the liquid level, said chamber having openings in the walls thereof, and a nozzle for directing steam into entraining contact with the liquid admitted to said chamber through said openings.

13. In a steam equalizer, the combination with a container for liquid, of a chamber communicating with said container at substantially the normal liquid level, said chamber being provided with openings in its walls, a return-bend pipe having an upper and a lower arm, the upper arm surrounding said chamber and the lower arm communicating with said container below the fluid level, a vertically disposed steam-inlet pipe having a lower, open end projecting into the elbow of said return-bend pipe, and a steam nozzle extending from said vertical pipe into said chamber and arranged to direct a jet of steam into entraining contact with the liquid in said chamber.

14. In a steam regenerator, the combination with a container for liquid, of a nozzle for delivering steam to the liquid in said container, the orifice of said nozzle providing a passageway for steam above the normal liquid level, and means whereby increase in pressure of steam at the intake end of said nozzle raises the liquid level with respect to the orifice of said nozzle.

15. In a steam regenerator, the combination with a container for liquid, of a header communicating with said container to normally provide the same liquid level in said header and said container, and a plurality of nozzles for delivering steam from said header to the liquid in said container, the intakes of said nozzles being in different relations with respect to the normal liquid level in said header.

In witness whereof, I hereunto subscribe my name this 24th day of August, A. D., 1910.

HENRY H. WAIT.

Witnesses:

ALFRED H. MOORE,

MCCLELLAND YOUNG.