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SELF-SCALING TUBE

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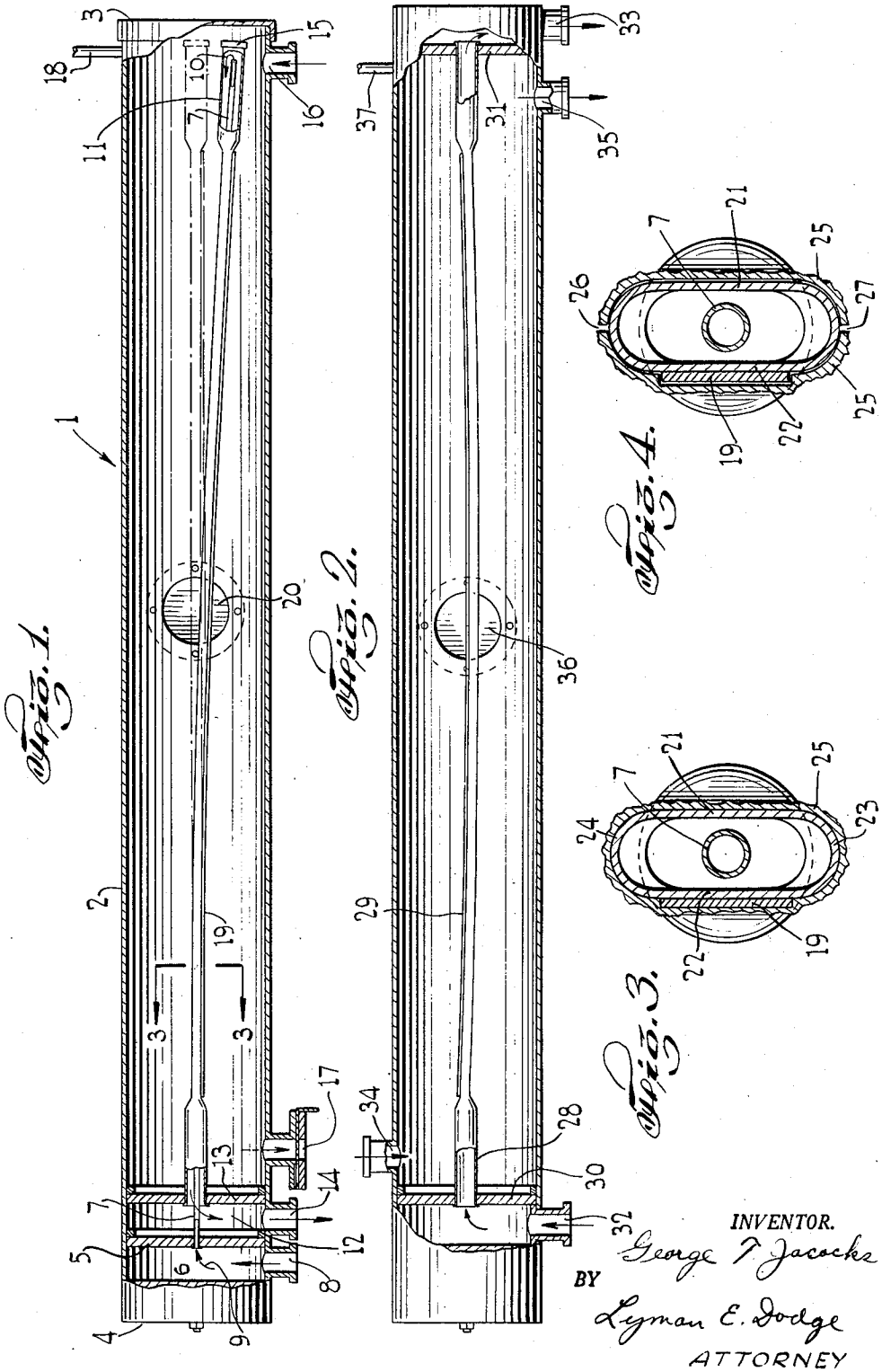


Fig. 1.

Fig. 2.

Fig. 4.

Fig. 3.

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SELF-SCALING TUBE

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10 Claims. (Cl. 257—1)

This invention relates to tubes, especially tubes upon which a deposit is formed, which must be, at times, removed therefrom.

Such tubes are especially adapted for evaporators of the type in which distillation is made from a liquid containing material in solution or suspension therein, and particularly to devices for evaporating salt ocean water for the purpose of obtaining distilled water therefrom.

The principal object of this invention is the provision of a tube of the type specified which will provide an elongated body attached either at one end only to a fixed member or attached at each end to fixed members which tube in use receives a deposit caused by the evaporation of a fluid surrounding it containing soluble or suspended material, so constructed and arranged that the tube or elongated body will act to disengage the deposit thereon by change of temperature merely.

A further object of the invention is to form a self-scaling tube or like body of such form and having its vertical axis so positioned that scale which has been loosened thereon may readily fall therefrom.

A further object of the invention is the production of a self-scaling tube by attaching rigidly to the tube an elongated body of material having a different thermal coefficient of expansion from that of the material of the tube.

Other objects and advantages will appear as the description of the particular physical embodiments selected to illustrate the invention progresses and the novel features will be particularly pointed out in the appended claims.

In describing the invention in detail and the particular physical embodiments selected to illustrate the invention, reference will be had to the accompanying drawing and the several views thereon, in which like characters of reference designate like parts throughout the several views, and in which:

Figure 1 is a top plan view, having some parts broken away to more clearly show the construction, of a device embodying the invention; Fig. 2 is also a top plan view with some parts broken away to more clearly show the internal construction of a device embodying the invention as differently embodied from that shown in Fig. 1; Fig. 3 is a vertical cross-sectional view of the device as shown by Fig. 1 on the plane indicated by the line 3—3 of Fig. 1, viewed in the direction of the arrows at the ends of the line; Fig. 4 is a view identical with Fig. 3 except scale has been represented as having been cracked and about to fall.

In the drawing, numeral 1, conventionally shown, designates any usual or ordinary distillation vessel. This vessel includes a shell 2 of any usual or ordinary form and construction having any usual and ordinary heads as 3 and 4 at each end thereof.

A partition or tube sheet 5 is positioned near the left hand end of the vessel 1 and removably secured in any usual or ordinary manner. This tube sheet 5 serves to form an entrance chamber 6 and to support the heating tube 7.

A fluid heating medium entrance 8 allows a fluid heating medium to enter chamber 6 and thus the tube 7, entering as shown by the arrows 9. This fluid medium traverses the tube 7 and exits at the other open end thereof, returning, as shown by the arrow 10, through the tube 11 and thus reaching the chamber 12, formed by the partition 5 and the partition or tube sheet 13, and leaving by means of the discharge opening 14.

The heating medium used may be any of the usual or ordinary heating mediums. It may be a liquid, or gas, or a vapor. It is preferably steam at the desired or appropriate temperature.

The partition of tube sheet 13 supports the tube 11. This tube 11, as clearly shown by the drawing, is supported at one end only, that is, at the end where it passes through the partition 13.

The tube 11 may be made of any suitable or proper material. It is usually and would preferably be made of metal, usually copper or the so called Admiralty metal.

The tube 11 may assume various forms. It is preferable to have at least one end, that is the end which passes through the tube sheet 13, of circular cross-section because the attachment of the tube 11 to the tube sheet 13 is thereby greatly facilitated. This fastening end may be made of various lengths but it is proper to make it only of such length as will conveniently facilitate its attachment to the tube sheet 13. The right hand end of tube 11, as shown in Fig. 1, may be closed in any suitable or appropriate manner as by placing a cap, such as 15, thereon.

The impure liquid which is to be distilled may enter the vessel 1 by the entrance passage 16 and flow through the vessel to the discharge opening 17. During its passage through the vessel it will become heated because it will come in contact with the tube 11 which has been heated by the passage of heated fluid medium

therethrough and in so becoming heated, some of the water will be evaporated and may pass out in any usual or proper manner, as through tube 18, to any suitable condensation apparatus.

If impure liquid is entered through the passage 16, this impure liquid coming in contact with the heated tube 11 will deposit sediment thereon and in time this sediment may become quite thick and so seriously interfere with heat interchange between the heating medium within the tube 11 and the liquid being distilled outside of tube 11.

In order to prevent a too thick permanent deposit of sediment upon the tube 11, a metal strip or bar 19 is attached to one side of the tube 11. This tube or bar 19 must be made of material having a thermal coefficient of expansion differing from the thermal coefficient of expansion of the material of the tube 11 and the material 19 must be firmly attached to the tube 13, in fact, so firmly attached, that one cannot move without a movement of the other. This attachment may be made in various ways but that found preferable is to solder or weld the member 19 to the tube 11 throughout its entire extent.

Suitable material from which to make the tube 11 and the member 19 would be Admiralty metal for the tube and Monel metal for the bar 19.

With the tube 11 constructed as herein before described, at one given temperature, the tube will be straight as shown in dot and dash line in Fig. 1 but at another temperature the tube will be bent, as shown in full lines in Fig. 1. It is immaterial whether the materials are selected and combined so as to have the tube 11 bent when at a very high temperature or straight when at a very high temperature. It is merely necessary to have the tube so constructed and arranged that it will be straight or substantially straight at one temperature and substantially bent at another temperature and the degree of bending with a difference of temperature may be more or less in accordance with the material selected and the results desired.

If the tube 11 with the member 19 is so constructed that it is straight, as shown in dash dot line in Fig. 1, when at a high temperature, but curved, as shown in full line in Fig. 1, when at a low temperature, then after the still has been operated for some time, it may be allowed to cool down and the tube 11 bending, as shown in Fig. 1, will loosen the adherent scale so that it will fall from a tube 11, whereupon the vessel may again be used for distillation.

It is convenient to provide means for removing any scale which has been displaced from the tube 11. This scale will fall to the bottom of the vessel 1 and may then be removed through the hand hold 20 in any suitable or appropriate manner, as by flushing.

Although the scale can be made to disengage itself from a tube which is circular in cross-section, it is preferred to make the tube with a cross-section such that its vertical axis, that is, the neutral axis, as shown in Fig. 3 is longer than its transverse axis at a right angle thereto so that a tube having a cross-section exhibiting parallel side walls, as 21 and 22, is provided, having rounded ends as 23 and 24. The exact outline of the cross-section is not critical, it merely suffices to make that cross-section which will best allow the scale 25 to drop away from the tube when it is broken at points, such as 26 and 27, by the bending of the tube 11. That is, the tube should be preferably of such form that a neutral axis is vertical and bisects the tube and the top and bottom faces are rounded, because, in that way, the greatest tendency to breaking will appear at the points 26 and 27 and then the scale may easily drop away from each side of the tube, differing from the case where the tube is circular in cross-section where the top semi-cylindrical shell of scale would tend to remain on the tube.

In Fig. 2 a tube 28 has been shown combined with a different material bar 29. This tube, in general, is exactly like the tube 11 of Fig. 1 but the invention is shown in a different embodiment in Fig. 2, in that, the tube 28 passes through tube sheets, as 30 and 31, at each end so that the tube is rigidly held at each end and so upon change of temperature forms into somewhat the arc of a circle of very large radius upon the proper change of temperature thereby furnishing the necessary movement to crack the scale at the top, as at 21, and at the bottom of 27, as shown by Fig 4.

In Fig. 2 it is contemplated that the heating medium will enter at 32, pass through the tube 28, and pass away at 33. The liquid to be distilled may enter at 34 and the excess pass off at 35 while the removed scale may be removed at the hand hold 36 and the distilled water may pass out through the pipe 37.

It is desired to have it understood that in embodying the invention in tangible materials, advantage will be taken of all present knowledge in regard to evaporators and stills, especially those used for evaporating or distilling such material as brine or sea water and that the present knowledge of the terminal coefficients of expansion of the different materials will be availed of and such materials will be combined as are most suitable for the situation in which they will be placed having due regard to the liquids and vapors with which they will be in contact and any possible electrolytic action which might take place by reason of the contact of dissimilar metals may, in particular, be provided against by suitable plating of the entire tube and bar, as by tinning.

Although I have particularly described several particular embodiments of my invention and explained the construction and principle thereof, nevertheless, I desire to have it understood that the forms selected are merely illustrative but do not exhaust the possible physical embodiments of the idea and means underlying my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A self-scaling tube formed of at least two metals having different thermal coefficients of expansion, one of the metals formed into a tube flattened throughout its length except for a distance at each end sufficient for attachment to a tube sheet at each end and the other metal attached to one of the flat sides of the tube.

2. A self-scaling tube formed of at least two metals having different thermal coefficients of expansion, one of the metals formed into a tube which when positioned with a selected transverse axis vertical has vertical plane sides and rounded top and bottom and the other metal attached to one of the vertical faces.

3. A self-scaling tube formed of at least two metals having different thermal coefficients of expansion, one of the metals formed into a tube which when positioned with a selected transverse axis vertical has vertical plane sides and rounded top and bottom for the major portion of the length of the tube with an end circular in cross-section for a distance sufficient for conveniently attaching the tube to a tube sheet and the other metal attached to one of the vertical faces.

4. A self-scaling tube formed of at least two metals having different thermal coefficients of expansion, one of the metals formed into a tube which when positioned with a selected transverse axis vertical has vertical plane sides and rounded top and bottom for the major portion of the length of the tube with both ends circular in cross-section for a distance sufficient for conveniently attaching the tube to tube sheets, one at each end and the other metal attached to one of the vertical faces.

5. A self-scaling tube formed of at least two metals having different coefficients of expansion with change of temperature, one of the metals forming a tube of elongated cross-section along one transverse axis and the other metal being attached to one of the elongated sides of the tube.

6. A self-scaling tube formed of at least two metals having different coefficients of expansion with change of temperature, one of the metals formed into a tube flattened somewhat throughout its length except for a distance at one end sufficient for attachment to a tube sheet and the other metal attached to one of the flat sides of the tube.

7. A self-scaling tube formed of at least two metals having different thermal coefficients of expansion, one of the metals formed into a tube which when positioned with a selected transverse axis vertical has vertical plane sides for a major portion of its length and the other metal attached to one of the vertical faces.

8. A self scaling tube formed with means for bending by change of temperature and providing for a major portion of its periphery non-support surfaces for loosened scale.

9. A self scaling tube formed with means for bending by change of temperature and providing for a major portion of its length more vertical face than that provided by a circular tube.

10. A self scaling tube formed with means for bending by change of temperature and providing vertical faces at least partially along its length whereby loosened scale on such faces is unsupported by said faces.

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