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SELF-SCALING TUBE

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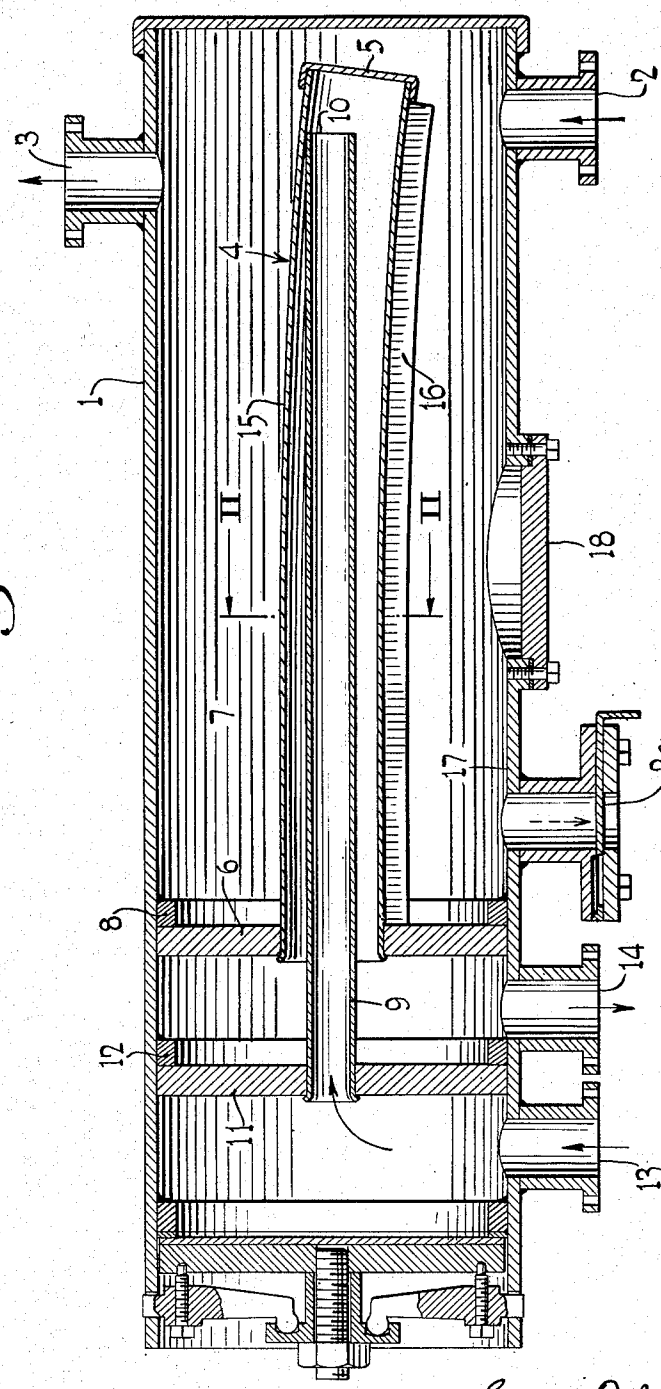

Fig. 1.

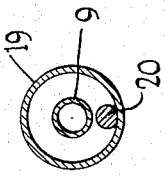

Fig. 3.

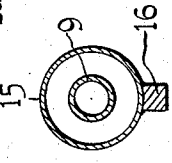

Fig. 2.

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SELF-SCALING TUBE

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Application March 21, 1941, Serial No. 384,475

5 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 adaptable for evaporators of the type in which distillation is made from a liquid containing material in solution therein, and particularly to devices for evaporating salt water for the purpose of obtaining distilled water therefrom.

A principal object of this invention is the provision of a tube of the type specified which will provide an elongated body attached at only one end to a fixed member which tube in use receives a deposit caused by the evaporation of a fluid surrounding it containing soluble 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 by constructing the tube of metals having different thermal coefficients of expansion.

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 embodiment 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 cross-sectional view of an evaporator embodying applicant's invention; Fig. 2 is a cross-sectional view of the device of Fig. 1 on the plane indicated by the line II—II of Fig. 1, viewed in the direction of the arrows at the ends of the line; Fig. 3 is a cross-sectional view, corresponding to Fig. 2, of a modified form of self-scaling tube.

It is well known to those skilled in the evaporator art that when such a fluid as ocean water or salt water is evaporated for the purpose of obtaining pure distilled water that a deposit is produced in the evaporator. This deposit may include suspended matter such as mud but is largely composed of the salts which are ordinarily found in solution in salt water and which are deposited when the water is evaporated. It is also well known that these salts deposit upon the entire interior of a salt water evaporator and attach themselves quite firmly thereto especially to those parts of the evaporator which are directly heated to cause the evaporation. These heated parts are generally in the form of tubes and the deposit forms a thick scale on these tubes. This scale is very adherent and is not only difficult to remove but also necessitates a more or less complete dismantling of the evaporator in order for a cleaner to get at the tubes so as to scrape, or brush, or knock off the adhering scale.

Applicant contemplates an evaporator in which the tubes or similar bodies upon which the greater part of the deposit occurs shall be practically self cleaning.

In the drawing in Fig. 1 numeral 1 designates a vessel in which evaporation of brine or salt water may take place. This vessel has not been shown as being necessarily either in complete or partial accord with standard and established methods of manufacture but has merely been devised to illustrate the principle involved in applicant's invention. The vessel, as shown, is a substantially cylindrical vessel, that is, a hollow cylinder.

The inlet 2 provides a means whereby salt water may be allowed to flow into the interior of the vessel 1 and duct 3 indicates a means by which water in the form of vapor may be conducted away to be condenses for the purpose of producing distilled water. Duct 2a allows water to flow from the evaporator, as desired.

In order to heat the water in the vessel 1 to the point where evaporation will take place, there is provided an elongated body 4. This elongated body may be in any desired or usual form but it is preferred to have it in the form of a tube closed at one end, as at 5, and held in a tube sheet 6 at the other end.

The space 7 into which the salt water is allowed to flow is shut off from the rest of the interior of the vessel by the tube sheet 6 which makes fluid tight joints with the ring 8 which may be suitably attached to the interior surface of the vessel 1.

In order to heat the tube 4 applicant preferably provides a steam delivery means. This steam delivery means, applicant prefers to have also in the form of a tube 9 extending a desired distance into the tube 4 and terminating at an open end 10. It is preferred to hold the tube 9 in a tube sheet 11 which is also held water tight

against the ring 12 which is seated against the interior surface of the vessel 1.

If steam is allowed to flow into the duct 13 it will pass into the tube 9, issue through the end 10 and coming in contact with the inner walls of the tube 4 will heat the tube 4 and any condensation which occurs will flow out through the duct 14 and may be recovered as condensate.

The tube 4 being the member which is most strongly heated and in contact with the salt water will be the body upon which the greatest amount of deposit will form. This deposit will be quite close and adherent and very difficult to remove by the ordinary methods now used, as by scraping, or brushing, or pounding.

In order to suitably remove the scale or deposit which forms upon the tube 4, applicant makes the tube 4 of two different materials. The tube proper, 4, is made preferably of one metal and the member 16 which may be called a rib is made of another metal. This rib 16 may take any desired form but is substantially a member extending longitudinally of the tube on one side thereof. This member 16 may be attached to the tube in any suitable or appropriate manner as by welding or, preferably, brazing so that it is so intimately connected to the tube 4 that when the tube 4 suffers a predetermined change of temperature as when steam is passed through tube 9, in the normal working of the device, it will bend, as shown in Fig. 1. This bending will take place because of the much higher thermal coefficient of expansion of the material of the tube 4 than the thermal coefficient of expansion of the member 16.

In any event, the coefficient of expansion by thermal change of the material 15 should be preferably as markedly different as possible from that of 16. When this is so, if, at the normal working temperature of the evaporator, the tube 4 is bent as shown in Fig. 1 then if the evaporator is allowed to cool down for a shorter or longer period, then the unequal contraction of the two materials 15 and 16 will cause the tube 4, as a whole, to straighten and in straightening will so loosen any scale or deposit thereon that it will drop off and fall to the lower portion 17 of the vessel 1. Of course, a desired straightening may be obtained by cooling off tube 4 or a desired bending may be obtained by heating tube 4 beyond its normal working temperature as by stopping the flow of salt water into the vessel 1 while continuing the supply of steam. In such case, the tube 4 would heat up above normal and would bend more just as it would straighten if the temperature is allowed to go to below normal.

The loosening of the scale on pipe 4 is obtained either by so arranging that the tube will be bent as shown in Fig. 1 in normal operation and the scale will be loosened by lowering of the temperature of the tube 4 or the tube 4 may be worked so that at normal working temperature it will be straight and will bend upon being lowered to temperature below normal which will also loosen the scale. The main point is that the tube 4 will in one condition, either be straight or bent at normal working temperature and under another thermal condition will either be bent or straightened or may even be worked at normal temperature in a bent condition and then bend more by an increase above normal temperature and may be worked at normal temperature either straight or bent and a reduction of temperature may cause bending or straightening or the tube may be worked bent at normal temperature and be reduced to such a temperature, for the purpose of removing scale, that it will be bent in a reverse sense.

When the scale or deposit has been loosened from tube 4 and falls upon the bottom 17 of the container, it may be removed by opening the clean out 18 which will allow the material to pass out of the vessel 1, aided, if necessary, by a stream of water injected into the vessel 1.

Instead of making the tube 4 with a substantially rectangular or squared rib 16, it may have added thereto a rib 20, as shown in Fig. 3 and this rib 20 may instead of being on the outside of the tube be upon the inside thereof. The member 20, in the form of a metal bar would be attached to the tube 19 in any suitable and appropriate manner as by welding or, preferably, brazing.

As hereinbefore stated, the particular structure associated with the tube 4 is not of primary moment. The essential structure which it is desired to illustrate in this case is a tube such as 4 or such as 19 which, upon changes of temperature, will bend or curve from end to end and to illustrate that such a tube is best held at one end only as by a tube sheet such as 6.

Where applicant's invention is used in an evaporator, the dismantling of the evaporator to withdraw the tube bundle to clean it is obviated so that not only time is saved but wear and tear on the apparatus caused by assembling and disassembling.

As metals for accomplishing the desired result one may use copper as one metal and steel or any other suitable material of a lower thermal coefficient of expansion. It is also to be understood that applicant's result may be obtained by making the tube of the lower coefficient of expansion and the rib of the higher thermal coefficient of expansion, in which case the bending would take place in a reverse sense. It is preferred to make the rib of steel and the tube 15 of copper. It is also preferred to make tube 19 of copper and bar 20 of steel. It must be understood, however, that the specific metals mentioned are illustrative only and applicant does not, by specifically mentioning them, intend to exclude the use of any two suitable metals or even a plurality of metals having different thermal coefficients of expansion for combination to obtain the desired result.

As the two metals, copper and steel, have been joined together in making my improved self scaling tube and as it is contemplated that the combination will at times be placed in water containing salts in solution, it is evident that it will be wise, if not necessary, to make provision to prevent electrolytic action. This may be done in any suitable or appropriate manner, but it is believed that the preferred method would be to coat the entire assemblage of copper tube and steel rib by a hot process, with a metal such as tin. This covering will effectually prevent any electrolytic action.

Although I have particularly described several particular physical embodiments of my invention and explained the operation, 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 of means underlying my invention.

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

1. An evaporator tube, fixed at one end only;

means for bringing in contact with said tube a fluid containing material depositable upon evaporation of said fluid; means for heating said tube for causing evaporation of said fluid; said tube including at least two different metals so intimately united that expansion and contraction of either causes a stress in the other whereby predetermined changes of temperature causes bending or straightening of the tube whereby adherent material is loosened.

2. A self-scaling tube formed of at least two metals having different coefficients of expansion with change of temperature, said metals being so intimately united that predetermined changes of temperature cause bending of the tube as a whole.

3. A heating tube for an evaporator, said tube fixed at one end only; material of a substantially different coefficient of expansion with changes of temperature extending longitudinally of said tube and firmly attached thereto whereby predetermined changes of temperature cause bending or straightening of said tube and loosening of any scale thereon.

4. A self-scaling tube formed of an outer tube of one material and a rib of another material, the materials having substantially different thermal coefficients of expansion, and said materials firmly attached one to the other so that upon change of temperature the tube bends or straightens as a whole whereby scale thereon is loosened.

5. A self-scaling tube formed of a tube of one material and an inner rib of another material, the materials having substantially different thermal coefficients of expansion, and said materials firmly attached one to the other so that the longitudinal expansion or contraction by thermal change of one material is so resisted by theother that bending or straightening of both occurs whereby scale thereon is loosened.

GEORGE T. JACOCKS.