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1,501,646

S. BROWN
EVAPORATOR COIL

Filed Feb. 1, 1922

Fig. 1,

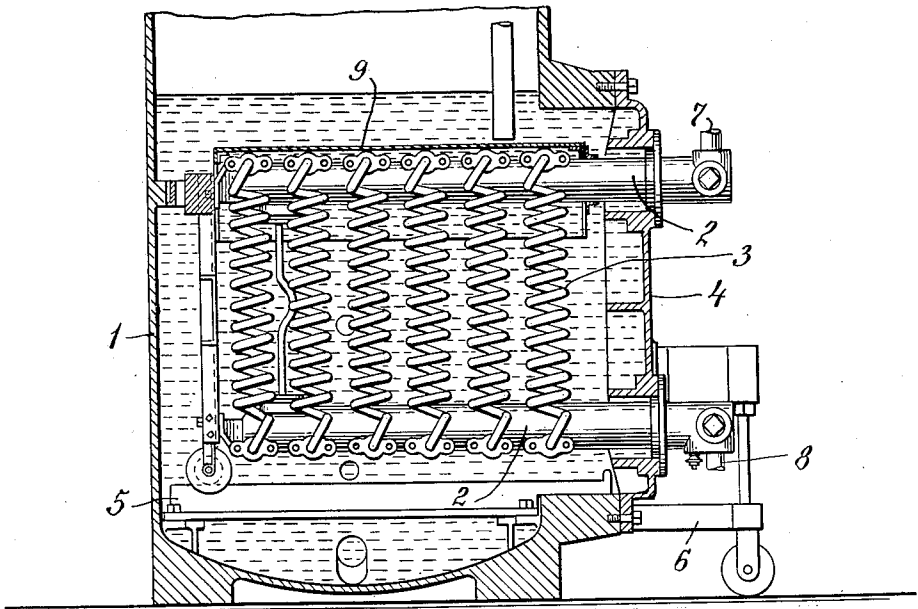


Fig. 2,

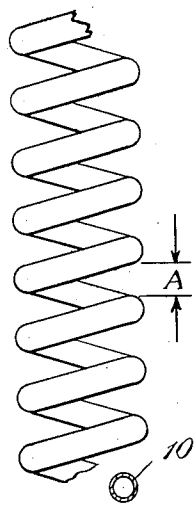


Fig. 3,

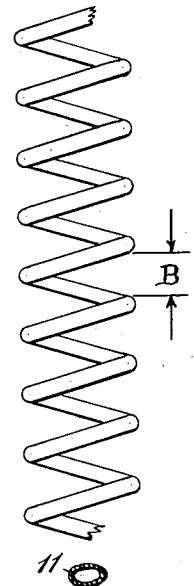


Fig. 4,

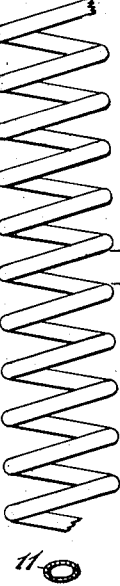


Fig. 5,

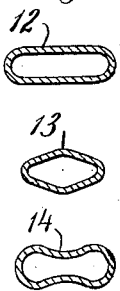
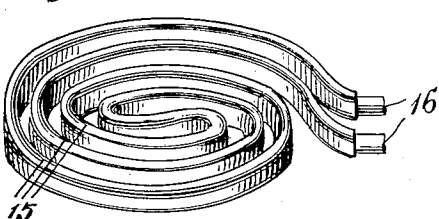


Fig. 6,



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UNITED STATES PATENT OFFICE.

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EVAPORATOR COIL.

Application filed February 1, 1922. Serial No. 533,235.

To all whom it may concern:

Be it known that I, STANLEY BROWN, a citizen of the United States, residing at Garden City, in the county of Nassau, State of New York, have invented certain new and useful Improvements in Evaporator Coils; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to evaporator construction, and has to do particularly with the construction of a heating element for evaporators employed in the distillation of salt water or other water having scale-forming properties which render it unfit for use in steam generating boilers.

Evaporators of this general type extensively used at the present time commonly consist of a chamber for the liquid to be evaporated with transverse upper and lower manifolds for the heating steam, and banks of heating coils extending between the manifolds and furnishing the necessary heat transferring surface required for vaporizing the liquid. In the operation of the apparatus impure water is admitted to the container and steam is supplied to the heating coils. It has been found that the heating coils must be closely wound and that the various coils must be arranged to occupy the space within the container as completely as possible in order that a satisfactory output for the apparatus may be obtained. The close positioning of the coils and the proximity of the adjacent convolutions of each coil increase the tendency of scale deposits to form a bridge between convolutions and, as a result, the coils must be cleaned at frequent intervals.

Evaporators of this type are now commonly operated with the heating coils completely submerged, a baffle element being provided in the upper portion of the container for diminishing the agitation of the liquid surface resulting from violent boiling and preventing particles of the liquid becoming entrained in the evolved vapor as it passes out of the apparatus. In this arrangement the entire surface of the heating coils is available as effective heat transferring surface for vaporizing the liquid, but it has been found that the coils must be

wound so closely that scale will nevertheless accumulate over the surface of the coil tubing and that scale formations bridging adjacent turns of the coils are likely to form after the apparatus has been in use for a short time.

It is a principal object of the present invention to provide in an apparatus of this class a heating element which will accumulate a minimum of scale or impurities when used for evaporating water having scale forming properties, and in which the tendency for bridging over of the scale between adjacent coil turns may be avoided without impairing the efficiency of the apparatus or reducing the vapor output.

It is a further object of the invention to provide a heating coil for evaporators of the above type in which a greater length of tubing may be employed, with a corresponding increase in heat transferring properties, without increasing the effective length of the coil or impairing its scale resisting qualities.

It is also an object to provide a heating coil which presents an increased heat transferring surface for a given length of coil without increasing the sectional area of the fluid passage.

It is a still further object to provide an evaporator of the above type comprising a heating element in which any scale or deposit accumulated upon the heat transferring surfaces may be thoroughly removed in a quick and convenient manner.

I have illustrated a preferred embodiment of my invention in the accompanying drawings; in which Figure 1 is a vertical sectional view of an evaporator embodying my invention; Fig. 2 is an elevational view showing a heating coil for an evaporator having a fluid passage of circular cross section; Figs. 3 and 4 are, respectively, views similar to Fig. 2 illustrating heating coils according to my invention; Fig. 5 is a view illustrating in section modified forms of fluid passage; and Fig. 6 shows a modified type of coil embodying my invention.

Referring to Fig. 1 of the drawings, 1 indicates the shell of the evaporator effect which serves as a container for the liquid to be evaporated. The heating element consists essentially of upper and lower manifolds 2 extending transversely of the apparatus and interconnected by means of the heating coils

3 which are preferably of helical form, as shown, having their opposite ends detachably connected to the manifolds 2. The manifolds 2 may be supported in a door 4 at one side of the container 1 which is removably secured to the body of the container. For facilitating the withdrawal of the heating element from the container its inner end may be supported as shown upon a track 5 mounted within the container, while its outer end may be provided with a roller support 6 so that the heating element may be conveniently rolled out of the evaporator shell on to the floor in front of the apparatus, and may thus be conveniently inspected or repaired. Steam is admitted to the upper manifold through the inlet 7 from whence it traverses the various coils of the heating element. The condensate accumulates in the lower manifold 2 and is discharged through the outlet 8. Continuous operation of the evaporator is effected by supplying steam to the heating element in sufficient quantity to maintain the contained liquid in a state of constant ebullition, a baffle 9 being preferably provided to surround the upper ends of the coils and minimize the agitation at the upper surface of the liquid.

In Fig. 2 I have illustrated a heating coil in which the fluid passage is of circular section throughout. The coil is wound in helical fashion, the successive turns of the coil being equally spaced, and it is understood that suitable end connections are provided for fastening the coil to the upper and lower manifolds with a fluid tight connection. It is evident that the effective heat transferring surface in any coil is dependent upon the number of turns which it comprises. It is consequently common practice to wind the turns of the coil as closely adjacent as is compatible with the scale forming qualities of the liquid to be evaporated. Accumulations of scale will eventually form on the coil and bridge over between adjacent turns with a consequent decrease in heat transfer efficiency, and the coils are accordingly wound with a pitch such that a bridging over of the scale will occur at intervals sufficiently remote to avoid excessive cleaning of the coils by manual means.

I have illustrated in Fig. 3 a heating coil embodying my invention. The coil is wound in helical form with a number of turns equal to that of the coil shown in Fig. 2. As shown at 11, however, the section of the coil tubing is distorted from a circular form and is here shown as an oval figure with its maximum dimension lying in a horizontal direction. The smallest cross sectional dimension of the tubing lies in a direction substantially parallel with the length of the coil, and the coil tubing when viewed from the side as shown appears to be appreciably thinner than a tubing of circular cross sec-

tion of the same area. The vertical distance between adjacent faces of successive coil turns is thus appreciably increased, the amount of this increase being equal to the difference between the diameter of a circular section and the minimum dimension of an oval section of the same area, the oval section being formed from the same tubing. Since the bridging over of scale between adjacent coil turns depends directly upon the proximity of the adjacent faces of such turns, it is evident that with my improved coil the tendency toward such bridging over of the scale is effectively diminished. The distance indicated at B in Fig. 3 represents the distance over which scale must accumulate before a bridging between turns is effected. It is to be noted that this distance B is materially greater than the corresponding distance A indicated in Fig. 2 for a coil of similar construction but having a circular section.

In Fig. 4 I have illustrated a coil embodying my invention in which, by way of example, the distance A between adjacent faces of successive coil turns is shown equal to the similar distance A in Fig. 2. In my improved construction it is possible to maintain the distance A the same as that employed in a coil of circular section, and consequently provide a coil of the same scale resisting quality and of the same length, but having a greater number of turns. Such a coil comprises a fluid passage whose effective length is increased with a corresponding increase in available heat transferring surface without increasing the dimensions of the heating coil. The ends of the coil which are adapted for adjustment to the manifolds of the evaporator may conveniently be made of circular section, if desired, so that coils embodying my invention may readily be installed in existing apparatus.

In my improved form of coil construction the coil section is distorted from a circular form and consequently a tubing of this type will present a greater periphery than a circular tubing of the same sectional area. Hence in a fluid passage of a given capacity the effective heat transferring surface along a given length of tubing is increased proportionally to the increased periphery of the section. In the coil shown in Fig. 3, which comprises the same number of turns and consequently substantially the same length of tubing as occurs in a coil having a fluid passage of circular section, the effective heat transferring surface of the coil is increased due to the distorted section and at the same time the scale resisting qualities of the coil are bettered. In the coil shown in Fig. 4 the scale resisting qualities are substantially the same as that of a coil of circular section, but the heat transferring properties of the coil are in-

creased not only through the additional length of tubing employed in the coil but also due to the variation of the tubular section from a circular form.

It is common to remove the scale deposited on evaporator heating coils of this type by subjecting the coils to an abrupt change in temperature. This may be conveniently accomplished by successively passing cold water and high pressure steam through the coils. When the superheated steam enters the cold coils the metal of the tubing will suddenly expand and crack the scale deposit on its outer surface, after which the scale will drop off or hang loosely on the coils in condition to be readily removed. With my improved coil construction the stresses due to sudden expansion of the coil tubing in this fashion tend to render the section of the tubing circular. Hence some portions about the periphery of the tubing will expand to a greater degree than others, and this inequality in expansion will materially facilitate cracking off of the deposited scale.

In the foregoing description I have referred to an evaporator employing coils of the helical type, but it is evident that my invention may be embodied in coils of any type designed for use in evaporators or similar apparatus. For instance, in Fig. 6 I have illustrated a coil of the kind employed in evaporators known to the trade as the Weir type. In this type of evaporator, which is particularly well known in England, a plurality of flat coils of the type shown in Fig. 6 are arranged one above the other within the evaporator shell and serve to contain the steam which is supplied as heating medium to the evaporator. Each coil consists of several convolutions in a horizontal plane and is provided with end connections for attachment to the inlet and outlet manifolds.

In a coil of this type embodying my invention the coil tubing is distorted from a circular form and is wound in such manner that the broad faces of successive convolutions lie adjacent each other. It is thus evident that the distance between the adjacent faces of successive convolutions is materially greater than the corresponding distance in a similar coil composed of a like length of tubing of circular cross section. The increased distance between adjacent coil turns makes bridging over of scale from turn to turn more difficult, and the intervals at which the coils must be manually cleaned are correspondingly less frequent. On the other hand, the distance between adjacent convolutions may be made the same as in a coil composed of tubing of circular cross section by employing a greater length of tubing when forming the coil. As a result, a greater amount of ac-

tive heat transferring surface will be presented in each coil without impairing its scale resisting properties. Furthermore, in a coil of the Weir type embodying my invention, it is to be noted that the broad faces of adjacent convolutions of tubing extend in a substantially vertical direction, and thus are more readily freed from scale when it is cracked off by subjecting the tubing to an abrupt change in temperature. That is, the exfoliated scale will be largely removed during the cracking process by merely falling to the bottom of the evaporator shell.

While I have described my improved coil construction as comprising a tubing of oval section, it is obvious that any section distorted from a circular form may be employed. For instance, the flattening out of the tubing may be carried further as indicated at 12 in Fig. 5, so that the cross section presents upper and lower surfaces which are substantially flat and parallel, the side surfaces being rounded. Likewise, a square or diamond shaped figure having rounded corners such as indicated at 13, or a shape such as shown at 14, may conveniently be employed. Other coil shapes will suggest themselves to those skilled in the art and various other changes may be made in the specific embodiment of the invention within the full scope of the appended claims.

I claim:—

1. In an evaporator, the combination with a containing shell of a heating element within said shell, comprising a continuous tubing having a plurality of convolutions, the cross section of said tubing being distorted from a circular form, and the broad faces of successive convolutions being adjacent, whereby a maximum clearance between convolutions is obtained and bridging over of scale between successive convolutions is restricted.

2. In an evaporator, the combination with a containing shell of a heating coil comprising a continuous tubing having a plurality of convolutions arranged one above the other, the tubing of said coil having its greatest cross sectional dimension extending in a substantially horizontal direction whereby a maximum clearance between adjacent convolutions is obtained and bridging over of scale is correspondingly restricted.

3. In an evaporator, the combination with a containing shell of a heating element within said shell, comprising a plurality of convolute heating coils, each coil being constituted of a continuous length of tubing and having the broad faces of successive convolutions adjacent, whereby a greater number of convolutions are formed in each coil, with correspondingly increased heat

transferring surface without diminishing the distance between adjacent faces of successive convolutions.

4. In an evaporator the combination with
5 a containing shell of a scale resisting heating element comprising a continuous tubing wound into convolute form with adjacent convolutions substantially equi-distant throughout the extent of the heating element,
10 ment, the tubing forming said heating element being of cross-section flattened to such

extent that the flattened faces will flex a substantial amount upon abrupt temperature change and having the said flattened faces of successive convolutions lying adjacent, whereby an ample clearance between convolutions is obtained to thereby restrict bridging over of scale between adjacent convolutions. 15

In testimony whereof I affix my signature.

STANLEY BROWN.