July 12, 1932. C. FÖHL 1,867,143

METHOD AND APPARATUS FOR CONTROLLING STEAM GENERATION

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Fig. 1

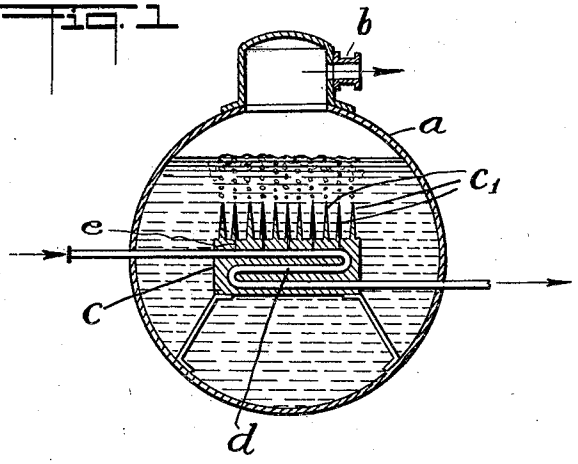

Fig. 2

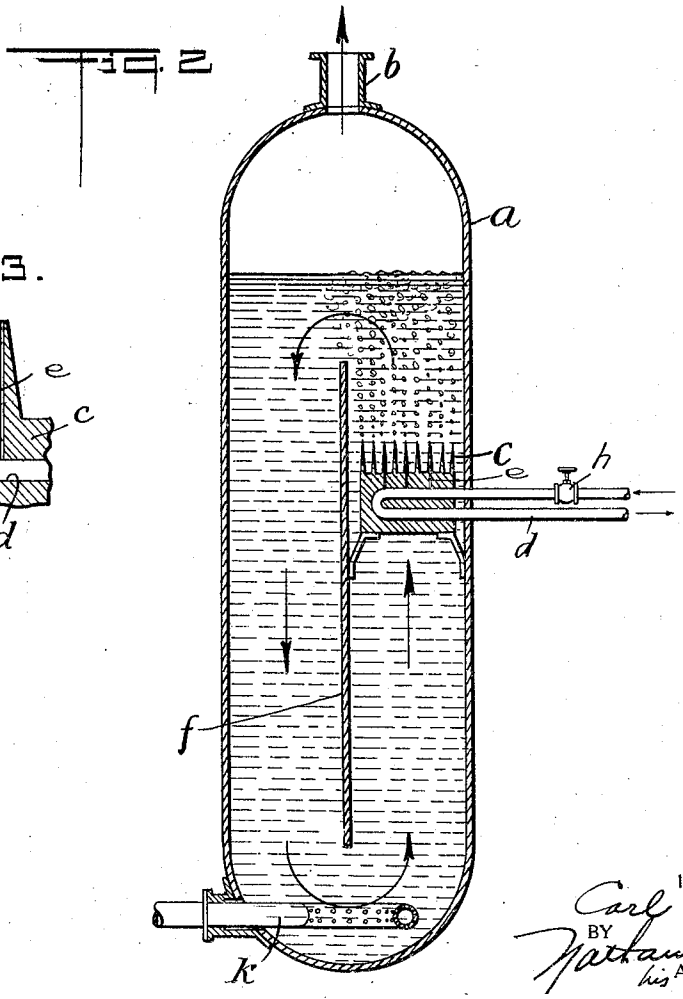

Fig. 3.

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METHOD AND APPARATUS FOR CONTROLLING STEAM GENERATION

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The subject matter of the invention comprises a novel method and apparatus for controlling steam generation in steam supplying vessels. The invention is particularly suitable for storage vessels from which steam is discharged by relief of pressure, the manner of charging the vessels with steam being immaterial. Such a storage vessel or accumulator is shown and described, for example, in Wettstein U. S. Patent No. 1,654,955, granted January 3rd, 1928.

When the pressure drops in a vessel of this type, because of removal of steam, it theoretically follows that steam first forms on the water surface, because a greater pressure prevails in every deeper layer of water in accordance with the depth, and that the deeper layers of water increasingly participate in the generation of steam only during progressive discharge, the entire amount of water then gradually and uniformly starting to boil.

Actual tests, however, show that steam generation does not take place in this orderly fashion, and that steam bubbles are first formed wherever a special impulse is produced. Such impulses may result from small air or steam bubbles in the liquid, dust particles, or the like, and may also result from inserted parts, such as the charging element or the like.

It has been observed that such special impulses, such as produced by air bubbles in the liquid, cause immediate steam generation at a considerable depth below the water level, while superposed layers of water are still at rest, although these layers also consist of so-called superheated water which is in the proper state for steam generation. The steam bubbles thus produced rise through the quiet water layers to the surface, and in their turn cause sudden violent steam generation in these layers, since the superheated water utilizes the surface of the bubbles for evaporation, which generation may be explosive in character, and often results in forcible entraining of water with the discharged steam, the water thus being conveyed to steam consuming apparatus or machines.

Such non-uniform and uncontrolled steam generation upsets the regulated water circulation in the vessel necessary for proper equalization of temperature.

The object of the present invention is to remove these defects and to provide means whereby the steam generation may be started and controlled in a suitable manner. The invention comprises the use of means similar to those which heretofore have caused disturbances, which means may be artificially produced, or, in certain cases, the use of existing irregularly acting impulses, suitably controlled, thus compelling the water to vary its aggregate state as desired, particularly at places where steam generation is preferable.

In one embodiment of the invention the steam generating vessel is provided with means for forming steam bubbles in the water content of the vessel. This may be accomplished in various ways, for instance, by introducing small finely divided gas (e. g. steam) bubbles into the water content, thus starting uniform steam generation at the point or points of introduction. The introduction of the steam bubbles may be effected by any well-known device, such as nozzles, perforated tubes, or the like. If small bubbles of superheated steam are used for initiating steam generation in the vessel, which is quite feasible, as only small amounts of steam are required, condensation in the vessel through cooling because of exterior radiation losses is also counteracted.

Steam generation in the vessel may also be controlled by special elements positioned in the water space, such as sharp edged objects, similar in appearance to large steel brushes or the like, on which the first steam generation occurs. A suitable heating of such elements increases the rapidity of initial generation.

In the accompanying drawing:

Fig. 1 is a transverse sectional view of a storage vessel embodying the invention;

Fig. 2 shows, in cross-section, another form of storage vessel embodying the invention; and

Fig. 3 shows, in detail, a part of a preferred form of device for causing an under-surface agitation.

In Fig. 1, *a* is a storage vessel from which steam may be conducted through outlet pipe *b*. At a suitable height within the liquid content one or more metallic bodies *c* are provided, through which extend passages *d* for flow of a heating agent, as indicated by the arrows. The metal bodies *c* have upwardly projecting metal points *c*1, on which steam generation preferably takes place. If superheated steam is used as the heating agent for metal bodies *c*, the points *c*1 may be provided with longitudinal bores *e*, through which the steam can pass in small amounts into the liquid content of the storage vessel; the release of steam is thus further aided.

When it is desired to simultaneously effect a circulation of water in the storage vessel, the steam generation is limited to one portion or to certain portions of the vessel contents. Over such places, where steam generation preferably begins, the mean weight of the water content becomes considerably less due to displacement by the bubbles, and the greater weight of the other portions of the water content in which no bubbles or very few bubbles are formed produces circulation within the vessel.

For example, the content of the storage vessel can be subdivided by means of a perpendicular or an inclined partition extending from a point below the lowest water level to a point adjacent the bottom, the means for releasing steam bubbles being provided in one section.

Such an arrangement is shown in Fig. 2 of the drawing, *a* designating the storage vessel and *f* the partition. The metal body *c* for facilitating steam release is heated as in Fig. 1. The supply of steam may be controlled in any desired manner as by a valve *h*. The usual charging device for introducing steam into the vessel is shown at *k*. The water circulation in the vessel is produced simultaneously with the steam release, as indicated by the arrows.

The same result may be obtained by inserting perpendicular circulation tubes (not shown) in the liquid, the formation of steam bubbles occurring in the tubes or in the surrounding water jacket. Instead of cylindrical tubes, conically shaped inserts or suitable inserts of other types may be used.

The inventive idea is capable of many variations, the essential feature consisting in the use of controlled exterior means to provide an impulse for the initiation of steam generation.

I claim:

1. Apparatus of the character set forth comprising a shell for holding a body of water, means for charging steam into said shell, means for introducing a gaseous fluid in a finely divided state into the water content of the shell to produce bubbles therein to initiate generation of steam, and means to withdraw steam from the shell.

2. Apparatus of the character set forth comprising a shell for holding a body of water, means for charging steam into said shell, means for introducing superheated steam into the water content of the shell to produce bubbles therein to initiate generation of steam, and means to withdraw steam from the shell.

3. The method of storing and producing steam which comprises charging steam into a body of water when there is a surplus of steam to heat the body of water and store the steam, reducing the pressure above the surface of the body of water when there is a demand for stored steam to produce surface evaporation and introducing a relatively small amount of steam into the body of water below the surface to produce internal disturbance.

4. The method of storing and producing steam which comprises charging steam into a body of water when there is a surplus of steam to heat the body of water and store the steam, reducing the pressure above the surface of the body of water when there is a demand for stored steam to produce surface evaporation and introducing a relatively small amount of steam in a plurality of upwardly directed streams into the body of water below the surface to produce internal disturbance when there is a demand for stored steam.

5. The method of storing and producing steam which comprises charging steam into a body of water when there is a surplus of steam to heat the body of water and store the steam, reducing the pressure above the surface of the body of water when there is a demand for stored steam to produce surface evaporation and producing internal disturbance in the body of water when there is a demand for stored steam by contact of a localized portion of the water with an irregular pointed surface and heating the irregular surface.

6. The method of storing and producing steam which comprises charging steam into a body of water when there is a surplus of steam to supply an appreciable amount of heat to the body of water and store the steam, reducing the pressure above the surface of the body of water when there is a demand for stored steam to produce surface evaporation and producing internal disturbance in the body of water when there is a demand for stored steam by contact of a localized portion of the water with an irregular pointed surface, supplying a relatively small amount of heat to the irregular surface and controlling the amount of heat applied to the irregular surface.

7. The method of storing and producing steam which comprises charging steam into a body of water when there is a surplus of steam to supply an appreciable amount of

heat to the body of water and store the steam, reducing the pressure above the surface of the body of water when there is a demand for stored steam to produce surface evaporation and producing internal disturbance in the body of water when there is a demand for stored steam by contact of a localized portion of the water with an irregular surface having upwardly projecting points and supplying a relatively small amount of heat to the irregular surface.

8. A steam storer comprising a shell, means to charge steam into said shell constituting the principal source of heat for the storer, means to withdraw steam from said shell and a member in said shell having a plurality of pointed projections for producing localized steam generation and having a passage for steam therein.

9. A steam storer comprising a shell, means to charge steam into said shell constituting the principal source of heat for the storer, means to withdraw steam from said shell and a pointed member in said shell for producing localized steam generation having an extended surface and a passage for steam therethrough, means for supplying steam to said passage for heating said member, and means for controlling the supply of steam to the pointed member independently of the charging of steam into the shell.

10. A steam storer comprising a shell having an extended vertical extent, a partition in said shell dividing the same into a number of compartments in circulatory relationship with each other, means to withdraw steam from said shell, means to charge steam into said shell and means in one of said compartments for producing localized steam generation in liquid contained in the shell.

11. A steam storer comprising a shell having an extended vertical extent, a partition in said shell dividing the same into a number of compartments in circulatory relationship with each other, means to withdraw steam from said shell, means to charge steam into said shell, a member other than the charging means in one of said compartments for producing localized steam generation having an extended surface and means to heat said member.

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