

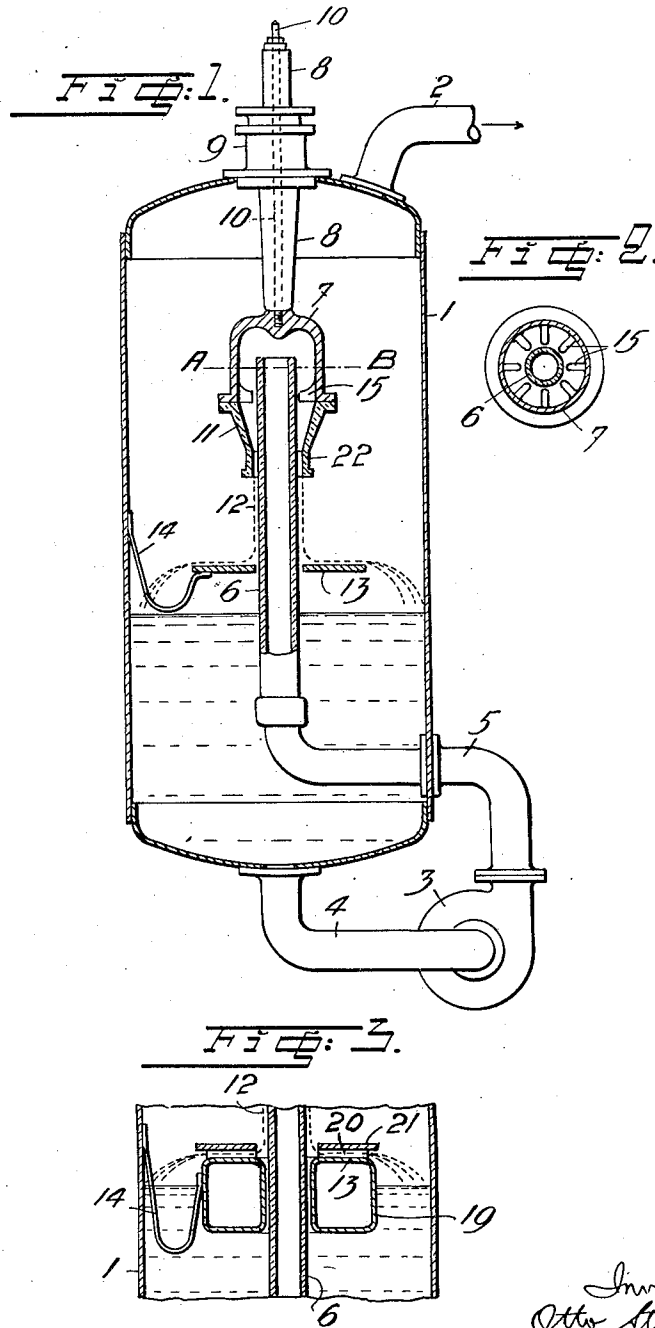
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ELECTRICAL STEAM BOILER OR HOT WATER HEATER

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ELECTRICAL STEAM BOILER OR HOT
WATER HEATER

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In electrical steam boilers or hot water heaters adapted for high voltages, the active portion of the water to be heated, or being heated, i. e. that portion in which the heat is preferably generated, has heretofore, by means of a circulation pump, been formed as free jets in the boiler between conductive mouthpieces or nozzles and counter-electrodes. This arrangement entails, however, the disadvantage that in case a certain, comparatively low speed of the water of the jets is exceeded, splash water will be formed as the jets impinge against the counter-electrode, which splash water may cause that arcs are formed in the boiler. Since the maximum load of the jets is proportional to the velocity of the water in the jet, the formation of splash water thus signifies a limitation of the maximum effect developed by the boiler.

For the purpose of avoiding this disadvantage arrangements have been proposed in which the water forming the "jets" is allowed to flow along bodies made of electrically insulating material and is guided by such bodies (compare for instance the German Patent Nos. 411,819 and 453,522), whereby there will be produced what may be called semi-free jets in which the formation of splash water is avoided. However, as will be readily understood, neither in case of these arrangements it is possible to increase the velocity of the water to any essential extent during its passage through the entire current-carrying zone above the velocity corresponding to the falling velocity, thus it being possible only in a small degree to take advantage of that possibility of increasing the effect which is inherent in an increased velocity of the water. This possibility may, on the other hand, be utilized in an essentially higher degree through the present invention which is characterized by the fact that in the boiler is arranged a vertical or nearly vertical tube ("central tube") made of a material that is a non-conductor of electricity, or a plurality of such tubes, said tube (or tubes) being by its lower end connected to the pressure side of the circulating means, the suction side of which is connected to the water space of the boiler, and being at its upper end covered by a hood partially or completely made of metal, the metal parts of which are connected to the power line under tension and which is of such a shape as to cause the water flowing upwards through the interior of the tube to change its direction of movement, after it has flown out through the upper mouth of the central tube, and to flow down along the outside of the central tube in form of a water jacket

of annular cross-section which water jacket slides along the tube wall and is free towards the steam space (steam room) of the boiler, and that the central tube below the lower edge of the hood and at a suitable distance therefrom is surrounded by an entire or perforated body (counter-electrode) partially or completely made of metal and electrically connected to the neutral point (or earthed pole) of the electrical network or current system, so that electric current may be caused to flow between the metal parts of the hood and the counter-electrode and to pass in this way through the water layer on the outside of the tube. By trials it has been ascertained that with this arrangement the water velocity in the semi-free jet may be materially increased (to 10 to 12 meters per second) beyond what has been possible with hitherto known arrangements, and that thus the effect of a boiler having a given volume may, according to the present invention, be increased considerably beyond the effect previously obtained. As an example it may be stated that, in a given electrical steam boiler built according to a previously known system, it has been possible to increase the effect of the same from 2000 to 4000 kw. by replacing the older active members by novel ones constructed according to the present invention.

An embodiment of the invention is illustrated diagrammatically on the accompanying drawing, in which—

Figure 1 is a vertical section of a boiler constructed according to the present invention.

Figure 2 is a corresponding cross-section taken on the line A—B of Figure 1, and

Figure 3 shows a modification of a detail in vertical section.

In Figure 1, which shows a monophasic steam boiler, 1 designates the boiler vessel, and 2 the steam outlet. 3 is a circulation pump for the water, having an inlet pipe 4 and a discharge pipe 5. Through the first-mentioned pipe the water is sucked from the bottom of the boiler, whereas the pipe 5 is coupled, within the boiler, to an ascending pipe 6 made of electrically insulating material, for instance porcelain or steatite. Above the upper end of said ascending pipe there is provided a hood 7 made of a material which is a conductor of electric current, preferably a metallic material, said hood being on its inside of such a shape that it turns back the stream of water, at as small a loss as possible, from an upward to a downward direction. At the same time, it serves as one of the electrodes of the boiler and is, for this purpose, connected

to a conductor 10 which passes through a leading-in insulator 8 secured to the boiler shell plate by means of a tightening socket 9. At the lower part of the hood 7 there is attached a funnel shaped body 11 of insulating material, between the lower end of which and the pipe 6 there is provided an annular opening having substantially the width which corresponds to the desired thickness of the cylindrical water jet or layer 12.

At the lower end said jet is caught by a counter-electrode in the shape of a metal plate 13 which should suitably be adjustable in vertical direction, to enable the length of the free jet of water to be adjusted and hence also the development of heat in the same at constant voltage. The adjustment of the plate may, for example, be effected by means of a suitable mechanism arranged to be operated from the outside of the boiler, or by means of the arrangement which will be described in conjunction with Figure 3. Preferably, the plate is secured to the boiler shell-plate—which serves as the other pole of the current source—by means of suitable devices, for instance a flexible conductor 14, so that sliding or make-and-break contacts are avoided. Within the hood 7 there are preferably provided radial flanges or wings 15, shown in cross-section in Figure 2, which augment the current-transmitting contact surface between the electrode and the water, in order to avoid arcing at that place.

The regulation of the boiler may, if desired, be brought about also by adjusting the thickness of the water jet 12 in similar manner as carried out in connection with the adjustment of the thickness of the water jet in the case of the known Pelton wheels, i. e. by providing the pipe 6 on the outside with a conical portion, so that the width of the annular passage opening can be regulated by adjusting the pipe and the funnel 11 in relation to each other in vertical direction.

In Figure 3, the plate 13 forms the top-side of a float 19 which floats on the water in the boiler, and, thus, by adjusting the water level it is possible to regulate the length of the water jet 12 and, by this means, the development of heat. Moreover, radial laminæ or flanges 20 are disposed on the upper side of the plate, in order to augment the contact surface between the water and the lower electrode formed by the plate. Said laminæ may be partially or completely covered with a plate 21 for the purpose of catching possibly occurring splash water.

If desired, the funnel 11 shown in Figure 1 may at the lower end, at 22, be substantially of a cylindrical shape, so that the stream of water in this portion will have the same cross-section as in the semi-free jet and will, accordingly, be included in the active portion of the circulating water. If desired, said cylindrical portion may be of such a length that the water column enclosed in the same becomes longer than the semi-free jet when the latter is shortest, i. e. when the plate 13 occupies its highest position and, consequently, the generation of power is greatest. In this case, less than half of the total generation of power will, therefore, take place in the semi-free jet.

Obviously, by employing a sufficiently low specific load in the effective water layer it will be possible to avoid steam generation, and, by this means, to employ the boiler for the purpose of heating water.

It may be obvious that the pipe 6 or the body, along the surface of which the water layer 12 is formed, need not necessarily have the circular

cross-section shown by way of example on the drawing. As a matter of fact, said portion may possess any cross-section suitable to the purpose. As will be understood from the foregoing, the expression "semi-free jet or layer" means that the water jet or water layer has, to a greater or smaller extent, a free surface towards the boiler space but, for the rest, follows the surface of a body or pipe 6.

Having thus described my invention I declare that what I claim is:—

1. Apparatus for electrically heating water which comprises a vessel, at least one tube composed of electrically non-conductive material mounted substantially vertical within the vessel, water circulation means having its delivery side connected to the lower end of said tube and its intake side in communication with the vessel, an electrically conductive hood covering the upper end of said tube connected to a source of electricity, said hood causing water flowing upwards through the interior of the tube to change its direction after it has left the upper mouth of said tube and to flow down on the outside thereof, and a counter-electrode electrically connected to a neutral point, said counter-electrode being located below said hood at a suitable distance therefrom and surrounding said tube so that electric current may flow from said hood to said counter-electrode and pass through the water flowing on the outside of the tube.

2. A heating system for electrical steam boilers comprising at least one substantially vertical tube composed of electrically non-conductive material mounted within the boiler, circulation means for water having its delivery side connected to the lower end of said tube and its intake side in communication with the water space of the boiler, a metal hood covering the upper end of said tube and having its metal parts connected to a current source, the inner diameter of said hood being considerably greater than the outer diameter of said tube, surface enlarging portions provided on the inside of said hood at the lower end thereof for facilitating the transition of current from the hood to the water, and a counter-electrode electrically connected to a neutral point of the system, said counter-electrode being located below said hood at a suitable distance therefrom and surrounding said tube or tubes.

3. Apparatus for electrically heating water which comprises, a vessel, at least one tube composed of electrically non-conductive material mounted substantially vertical within the vessel, circulation means having its delivery side connected to the lower end of said tube and its intake side in communication with the vessel, a hood composed in part at least of metal covering the upper end of said tube and having its metal part connected to a current source, said hood causing the water flowing upwards through the interior of the tube to change its direction and to flow down on the outside of said tube, a funnel-shaped extension made of electrically non-conductive material and projecting downwards from the lower end of said hood and adapted to give the water flowing down on the outside of said tube a suitable cross-section, and a counter-electrode electrically connected to a neutral point of the network, said counter-electrode being located below said hood at a suitable distance therefrom and surrounding said tube.

4. A heating system for electrical steam boilers, comprising at least one substantially ver-

tical tube composed of electrically non-conductive material mounted within the boiler, circulation means having its delivery side connected to the lower end of said tube and its intake side in communication with the water space of the boiler, an electrical conductive hood covering the upper end of said tube connected to a current source, a funnel-shaped extension made of electrically non-conductive material attached to and projecting downwards from the lower end of said hood, and a counter-electrode electrically connected to a neutral point of the system, said counter-electrode being located below said hood at a suitable distance therefrom and surrounding said tube.

5. A heating system for electrical steam boilers, comprising a substantially vertical tube composed of electrically non-conductive material and mounted within the boiler, circulation means having its delivery side connected to the lower end of said tube and its intake side in communication with the water space of the boiler, a hood composed of metal covering the upper end of said tube connected to a current source, a counter-electrode electrically connected to a neutral point of the system, said counter-electrode being located below said hood at a suitable distance therefrom and surrounding said tube or tubes, and a flexible conductor connecting said counter-electrode electrically with the boiler shell-plate for enabling the vertical position of said counter-electrode to be varied in relation to the hood without connections having to be removed.

6. A heating system for electrical steam boilers comprising a substantially vertical tube composed of electrically non-conductive material mounted within the boiler, circulation means having its delivery side connected to the lower end of said tube and its intake side in communication with the water space of the boiler, a hood formed of electrically conductive material cov-

ering the upper end of said tube connected to a current source, said hood being adapted to cause water flowing upwards through the interior of the tube to change its direction of movement, after it has left the upper mouth of said tube, and to flow down on the outside of said tube, a counter-electrode connected to a neutral point of the system and to a float, for enabling the vertical position of said counter-electrode to be varied relative to said hood by raising or lowering the water level in the boiler said counter-electrode being located below said hood and surrounding said tube, and a flexible conductor connecting said counter-electrode electrically with the boiler shell-plate.

7. A heating system for electrical steam boilers comprising a substantially vertical tube composed of electrically non-conductive material mounted within the boiler, circulation means having its delivery side connected to the lower end of said tube and its intake side in communication with the water space of the boiler, a hood composed of metal covering the upper end of said tube connected to a current source, said hood causing the water flowing upwards through the interior of the tube to change its direction of movement, after it has left the upper mouth of said tube, and to flow down on the outside of said tube, and a metallic counter-electrode electrically connected to a neutral point of the electrical system, said counter-electrode being located below said hood at a suitable distance therefrom and surrounding said tube and being provided on its upper face with surface enlarging radial flanges composed of metal and adapted to facilitate the current transition from the water to said counter-electrode.

8. The combination with the arrangements set forth in claim 7, the surface enlarging laminae being covered with a plate for catching splash water possibly caused by the laminae.

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