April 6, 1948. W. B. LEAF 2,438,929

FOAM SUPPRESSING APPARATUS

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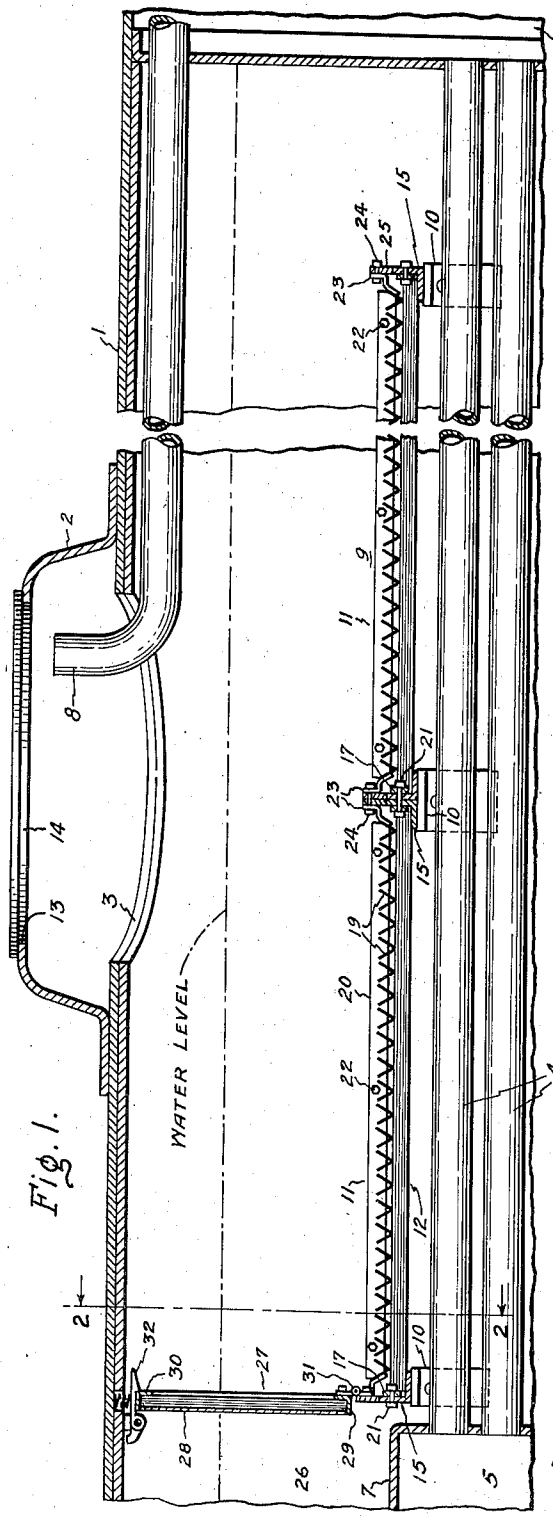


Fig. 1.

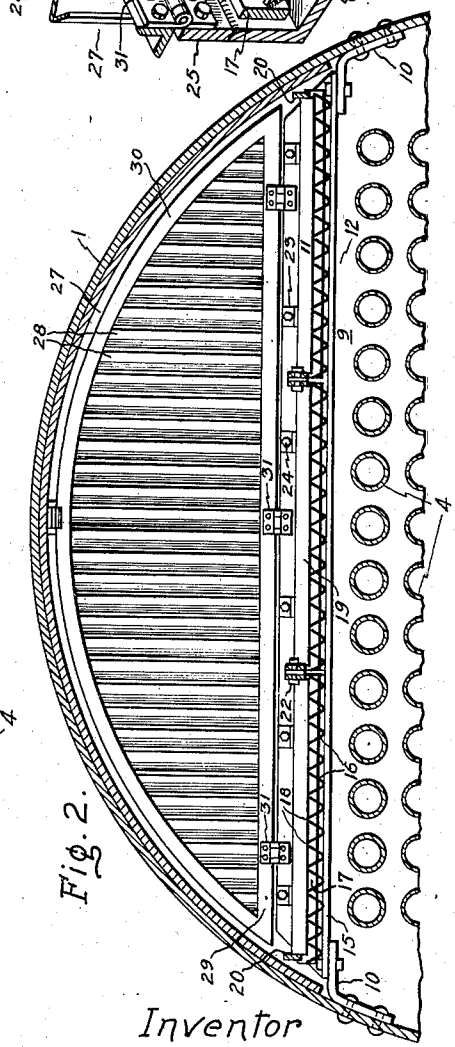


Fig. 2.

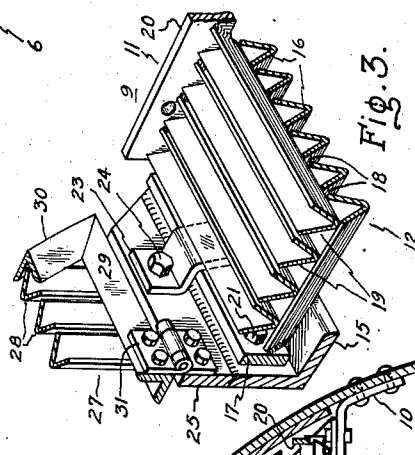


Fig. 3.

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FOAM SUPPRESSING APPARATUS

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10 Claims. (Cl. 252—361)

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This invention relates to apparatus for suppressing the formation of foam and particularly to such apparatus for use in locomotive boilers and similar pressure vessels.

The present invention is an improvement on the invention described and claimed in Patent No. 2,320,366 issued on June 1, 1943, to the same inventor. The production of foam in boilers is caused by the presence of certain substances dissolved in the water which increase the surface tension. The tendency to produce foam becomes greater as the concentration of the dissolved substances increases. Foaming may be reduced by the addition of various chemicals to the boiler water; however, this requires frequent inspection and servicing. In accordance with the disclosure of the above patent, the formation of a layer of foam in a boiler is prevented or minimized by arranging a partition below the liquid surface with a plurality of passages of decreasing cross section; bubbles rising through the body of liquid and entering one of the passages concurrently are brought together and are forced to join or coalesce by the narrowing walls of the passage. The larger bubbles thus formed burst on reaching the surface of the liquid and thus do not collect to form a blanket of foam. This method of foam suppression has been found effective in practice, and it is an object of the present invention to provide an improved apparatus for suppressing foam by forcing bubbles into coalescing engagement during their passage through the body of liquid in which they are produced.

It is another object of this invention to provide an improved and rugged and easily constructed foam suppressing apparatus for locomotive boilers and the like.

It is a further object of this invention to provide an improved foam suppressing apparatus for locomotive boilers and the like, which may easily be repaired or replaced.

Further objects and advantages of this invention will appear more fully in the course of the following description, and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the invention, reference may be had to the accompanying drawing in which:

Fig. 1 is a sectional elevation view of a portion of a locomotive boiler fitted with a coalescing apparatus embodying the invention;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged perspective view of a portion of the apparatus of Fig. 1.

As shown in the drawing, the locomotive boiler includes a shell 1 having a steam dome 2 about

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an opening 3 at the top of the shell. A plurality of firetubes 4 extend longitudinally of the boiler from a fire box 5 to a smoke chest 6 at the forward end of the locomotive. The boiler is filled with water to a normal level as indicated by a dot and dash line, the water covering all the fire tubes and also extending over a crown sheet 7 at the top of the fire box. During the operation of the locomotive, bubbles of steam rise through the body of liquid, the steam collecting in the space above the water. Steam for operation of the locomotive is drawn off through the usual dry pipe, indicated at 8, and opening within the steam dome 2.

Small bubbles, particularly those of say one-fourth of an inch and smaller in diameter, tend to form foam when they reach the surface, each bubble retaining a film of liquid. In order to coalesce these bubbles and form larger bubbles, which will tend to burst and thus not produce appreciable foam, a foam suppressor 9 is arranged in the body of liquid above the fire tubes 4. The suppressor 9 comprises a partition member supported within the boiler shell on a plurality of angle brackets 10 and extending the width of the shell. The suppressor partition is constructed of upper and lower layers or members 11 and 12, respectively, each providing a large number of inverted troughs or elongated recesses of inverted V-shaped cross section. Each trough is open at the top and bottom, the top opening being a narrow slot; it will thus be apparent that bubbles rising concurrently through the body of liquid and entering a trough tend to be brought together by the narrowing walls of the trough. In this manner, the bubbles are forced into coalescing engagement and larger bubbles are formed. The bubbles formed in and passing through the lower partition layer 12 are brought into further coalescing engagement in the troughs of the upper layer 11. The construction of the coalescing passages in the form of long recesses of inverted V-shaped cross-section makes it possible to assemble the partitions easily from readily available parts, and in the embodiment illustrated, the apparatus has been fabricated from strip material.

The partition 9 is made in a plurality of sections, any one of which may be taken out and removed through an opening 13 at the top of the steam dome, a plate 14 being removably secured to the dome to afford access to the interior of the boiler during servicing operations. In order to support the several sections of the partition, a plurality of angle irons 15 are secured at their ends to the brackets 10 and extend across the boiler, single angle irons being provided at the ends and sets of two irons back to back at the intermediate positions. The sections of the partition are rectangular and three are required in

the width of the boiler as shown in Fig. 2. It is not necessary that the suppressor extend longitudinally the entire length of the fire tubes and it has been shown terminating short of the smoke chest 6. Fig. 1 has been shown with a broken section so that both ends of the tubes appear; an intermediate portion of the suppressor is broken out, but it may be assumed that at least three sections are required in the length of the suppressor.

The details of construction of one of the suppressor sections are shown in Fig. 3. The lower layer 12 of troughs is formed by a plurality of metal strips 16 extending between end frame members 17, each strip 16 being welded at its ends to the end members. The strips 16 are arranged in planes sloping alternately in opposite directions. Adjacent top edges of the strips are spaced apart to form slits 18, and the adjacent edges which touch along the bottom of the layer may be welded together. There is thus found a series of inverted troughs presenting decreasing cross sections to bubbles rising therethrough. It has been found that particularly satisfactory operation is attained when the angle between the walls of the troughs is about sixty degrees, although other angles have been found to give satisfactory action. If desired, the troughs may be made from integrally formed angle pieces or strips previously joined along their touching edges or from wider strips bent to the required angle instead of from separate strips, the angle pieces being spaced apart to form the open inverted troughs between adjacent pieces. Thus either metal strip or angle stock may be employed. The upper layer 11 is of essentially the same construction as the lower layer except that the strips indicated at 19 are arranged transversely at right angles to the strips 16 of the lower layer. The strips 19 are secured between longitudinal frame members or strips 20, and are secured in positions to form inverted V-shaped recesses at right angles to those formed by the strips 16.

The end frame members 17 are secured by bolts 21 to the angle irons 15 and thus hold the layer of the foam suppressing partition in position. The upper layers of the several sections between any pair of the angle irons 15 are secured together by bolts 22 in adjacent frame members 20 and the section of the upper layer thus formed is secured to the angle irons 15 by clips 23 welded to the end strips 19 and secured to the angle irons by bolts 24. The entire partition is made up by assembling the several sets of sections between the several pairs of supports formed by the angle irons 15. As shown in Fig. 3 each angle iron has its vertically extending side increased in height by the addition of a strip 25 welded along the edge of the angle iron. This construction thus provides an angle iron having one long flange from standard angle irons and strip stock. It is to these strips 25 that the clips 23 are attached.

The foam tends to move forward from the area above the crown sheet of the fire box, indicated at 26. In order to minimize the passage of such foam to the area below the steam dome, a vertical suppressor partition 27 is provided which extends across the area of the boiler above the rear end of the partition 9. The suppressor 27 is constructed of strips 28 extending vertically in alternately oppositely inclined planes to join a trough structure in the same manner as those of the upper and lower layers 11 and 12 of the suppressor 9. The strips 28 are secured at their ends in an angle iron comprising a straight horizontal member 29 and a curved member 30 conforming generally to the curve of the boiler shell. As shown in Fig. 3 the strips 28 provide troughs, the narrow slits of which open toward the suppressor 9, and it will thus be apparent that small bubbles moving concurrently toward the outlet from the area over the crown sheet are brought into coalescing engagement. The combination of the actions of the horizontal suppressor 9 and the vertical suppressor 27 provides effective elimination of the passage of foam to the dry pipe of the locomotive.

In order that the area over the crown sheet may be reached from the area below the steam dome, the suppressor 27 is hinged so that it may be swung downwardly out of the way, a plurality of hinges 31 being provided to secure the frame member 29 to the strip 25 of the rearmost angle iron 15. The suppressor 27 may be held in its normal upright position by any suitable device such as a spring pressed catch 32.

During the operation of locomotive boilers, the tendency to the formation of foam increases with increased concentration of substances dissolved in the water. In the construction illustrated, when the bubbles rise through the water, they pass through the slots in the lower layer of the suppressor partition and small bubbles are forced into coalescing engagement; the bubbles are again brought together on passing through the upper layer of suppressor recesses and further coalescing action takes place. The larger bubbles tend to burst upon reaching the surface and the formation of foam is minimized. It will be noted that the majority of the bubbles rising from the lower suppressor members must move laterally from their line of vertical ascent when they enter and pass upwardly through the upper layer of suppressors. This lateral movement has been found to increase the effectiveness of the coalescing action; lateral movement obviously may be attained by different arrangements of the position of the upper suppressor recesses with respect to the lower ones; for example, the upper strips might be arranged to run parallel to the lower strips but with the outlet slots of the upper recesses staggered with respect to the slots of the lower recesses. Bubbles rising through the water above the fire box tend to produce foam which may move forward toward the area below the steam dome; however, these bubbles must pass through the suppressor 27 and are thereby coalesced and the passage of the foam to the area below the steam dome is minimized. There is little or no tendency toward the formation of foam at the forward end of the boiler, and it will thus be apparent that the suppressors 9 and 27 in combination effectively prevent the passage of foam to the steam dome and thence through the dry pipe to the cylinders of the locomotive.

While the invention has been described with particular reference to its use in a locomotive boiler, other applications will readily be apparent to those skilled in the art. Various modifications may be made within the spirit and scope of the invention and it is intended by the appended claims to cover all such modifications.

What I claim and desire to secure by Letters Patent is:

1. In apparatus for retarding foam and froth formation in boilers and pressure vessels inclusive of a container for a body of liquid subject to evaporating influences and having foam

producing bubbles rising therethrough, the improvement which comprises means within the body of liquid under treatment in the boiler providing a plurality of elongated horizontal recesses of upwardly decreasing width providing narrow slits along the top thereof for the escape of fluid moving upwardly therethrough whereby bubbles rising concurrently through said body of liquid enter said recesses and are brought into coalescing engagement as they approach said slits.

2. In apparatus for retarding foam and froth formation in boilers and pressure vessels inclusive of a container for a body of liquid subject to evaporating influences and having foam producing bubbles rising therethrough, the improvement which comprises means located within the body of liquid under treatment in the boiler providing a plurality of elongated horizontal recesses of upwardly decreasing width providing narrow slits along the top thereof for the escape of fluid moving upwardly therethrough whereby bubbles rising concurrently through said body of liquid enter said recesses and are brought into coalescing engagement as they approach said slits, and a second similar means also within the body of liquid providing a plurality of similar horizontal recesses above said first mentioned means for further facilitating the coalescing of the bubbles rising from said first mentioned means.

3. In apparatus for retarding foam and froth formation in boilers and pressure vessels inclusive of a container for a body of liquid subject to evaporating influences and having foam producing bubbles rising therethrough, the improvement which comprises a partitioning member supported in the liquid body in a substantially horizontal position, said partitioning member including a plurality of flat strips of metal arranged with their edges substantially parallel and with adjacent strips in oppositely inclined planes to provide a plurality of inverted troughs of V-shaped cross section, adjacent top edges of said strips being spaced a small distance to provide slits along the peaks of said troughs whereby bubbles rising concurrently through said body of liquid enter said troughs and are brought into coalescing engagement as they approach said slits.

4. In apparatus for retarding foam and froth formation in boilers and pressure vessels inclusive of a container for a body of liquid subject to evaporating influences and having foam producing bubbles rising therethrough, the improvement which comprises a pair of partitioning members supported in the liquid body in substantially horizontal positions, one of said members being supported above the other, each of said partition members including a plurality of flat strips of metal arranged with their edges substantially parallel and with adjacent strips in oppositely inclined planes to provide a plurality of inverted troughs of V-shaped cross section, adjacent top edges of said strips being spaced a small distance to provide slits along the peaks of said troughs whereby bubbles rising concurrently through said body of liquid enter said troughs and are brought into coalescing engagement as they approach said slits, the strips of said one member being so positioned with respect to those of the other member below it that the majority of the bubbles rising from the slits in said other member must move laterally to reach the slits in said one member.

5. In apparatus for retarding foam and froth formation in boilers and pressure vessels inclusive of a container for a body of liquid subject to evaporating influences and having foam producing bubbles rising therethrough, the improvement which comprises a pair of partitioning members supported in the liquid body in substantially horizontal positions, one of said members being supported above the other, each of said partition members including a plurality of flat strips of metal arranged with their edges substantially parallel and with adjacent strips in oppositely inclined planes to provide a plurality of inverted troughs of V-shaped cross section, adjacent top edges of said strips being spaced a small distance to provide slits along the peaks of said troughs whereby bubbles rising concurrently through said body of liquid enter said troughs and are brought into coalescing engagement as they approach said slits, the strips of said one member being positioned with their longitudinal axes transverse to those of the strips of the other member.

6. In apparatus for retarding foam and froth formation in boilers and pressure vessels inclusive of a container for a body of liquid subject to evaporating influences and having foam producing bubbles rising therethrough, the improvement which comprises a pair of partitioning members supported in the liquid body in substantially horizontal positions, one of said members being supported closely above the other, each of said partition members including a plurality of flat strips of metal arranged with their edges substantially parallel and with adjacent strips in oppositely inclined planes intersecting at angles of approximately sixty degrees to provide a plurality of inverted troughs of V-shaped cross section, adjacent top edges of said strips being spaced a small distance to provide slits along the peaks of said troughs whereby bubbles rising concurrently through said body of liquid enter said troughs and are brought into coalescing engagement as they approach said slits, the strips of said one member being positioned transversely of the strips of the other member.

7. In apparatus for retarding foam and froth formation in boilers and pressure vessels inclusive of an elongated container for a body of liquid subject to evaporating influences and having foam producing bubbles rising therethrough and outlet means near the top of the container and intermediate the ends thereof for the discharge of vapor, the improvement which comprises a substantially horizontal partition member composed of inverted substantially V-shaped troughs supported in the liquid body below the outlet means and having openings therein arranged for inducing a coalescing engagement of bubbles rising through the liquid, and a vertically extending transverse partition member supported in the container adjacent said horizontal member and between one end of the container and the outlet means and having openings therein for inducing coalescing engagement of bubbles moving therethrough toward the outlet.

8. In apparatus for retarding foam and froth formation in boilers and pressure vessels inclusive of an elongated container for a body of liquid subject to evaporating influences and having foam producing bubbles rising therethrough and outlet means near the top of the container and intermediate the ends thereof for the discharge of vapor, the improvement which comprises a substantially horizontal partition member com-

posed of inverted substantially V-shaped troughs supported in the liquid body below the outlet means and having top openings therein arranged for inducing a coalescing engagment of bubbles rising through the liquid, and a vertically extending transverse partition member supported in the container adjacent said horizontal member and between one end of the container and the outlet means for inducing coalescing engagement of bubbles moving therethrough toward the outlet, said vertical member comprising a plurality of parallel strips supported alternately in oppositely inclined planes to form V-shaped troughs opening laterally toward said end of the container and being spaced to form slits along the side adjacent said outlet means, said vertical member being hinged for swinging movement to afford access to said end of the container from above said horizontal member.

9. In apparatus for retarding foam and froth formation in boilers and pressure vessels inclusive of an elongated container for a body of liquid subject to evaporating influences and having foam producing bubbles rising therethrough and outlet means near the top of the container and intermediate the ends thereof for the discharge of vapor, the improvement which comprises a substantially horizontal partition member composed of inverted substantially V-shaped troughs supported in the liquid body below the outlet means and having openings therein arranged for inducing a coalescing engagement of bubbles rising through the liquid, and a vertically extending transverse partition member supported in the container adjacent said horizontal member and between one end of the container and the outlet means for inducing coalescing engagement of bubbles moving therethrough toward the outlet, each of said members comprising a plurality of parallel strips secured in juxtaposition and in alternate oppositely inclined planes to provide a plurality of troughs and spaced apart along their

sides toward the outlet to provide passages of decreasing cross section having narrow slots for the escape of liquid and bubbles moving toward said outlet.

10. In apparatus for retarding foam and froth formation in boilers and pressure vessels inclusive of an elongated container for a body of liquid subject to evaporating influences and having foam producing bubbles rising therethrough and outlet means near the top of the container and intermediate the ends thereof for the discharge of vapor, the improvement which comprises a substantially horizontal partition member composed of inverted substantially V-shaped troughs supported in the liquid body below the outlet means and having top openings therein arranged for inducing a coalescing engagement of bubbles rising through the liquid, and a vertically extending transverse partition member supported in the container adjacent said horizontal member and between one end of the container and the outlet means and having openings therein for inducing coalescing engagement of bubbles moving therethrough toward the outlet, said vertical member being mounted for movement away from the vertical to afford access to said end of the container from above said horizontal member.

WALTER B. LEAF.

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