Oct. 20, 1936. H. J. KERR 2,058,239

STEAM WASHER

Original Filed Jan. 18, 1930 2 Sheets-Sheet 1

Fig. 1

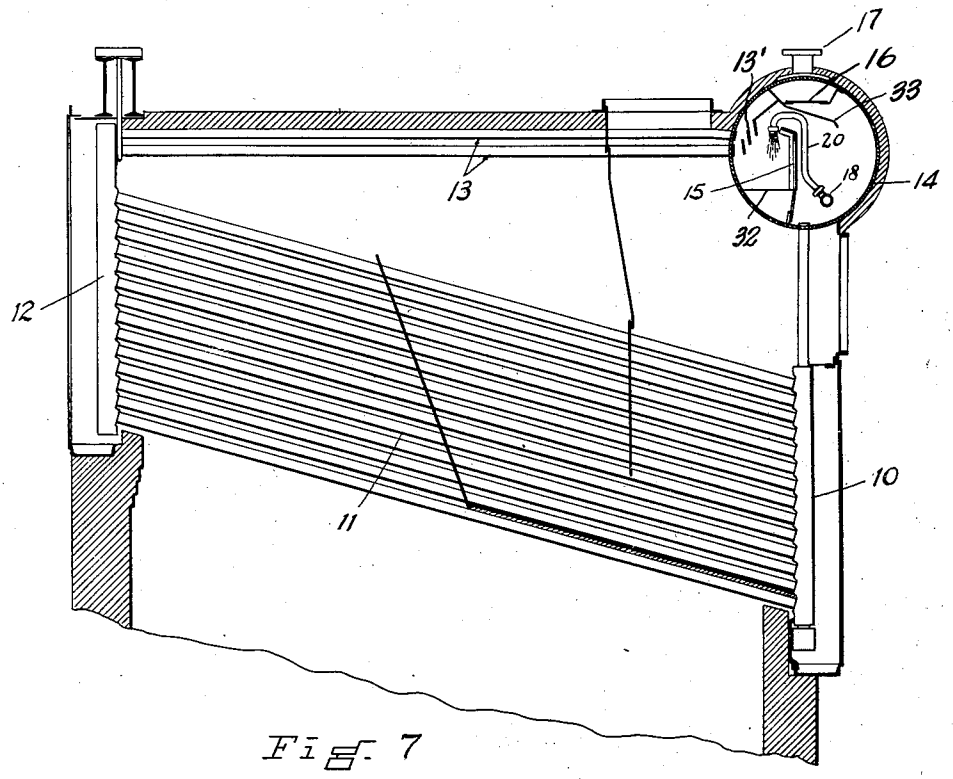


Fig. 7

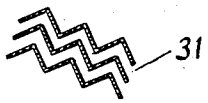
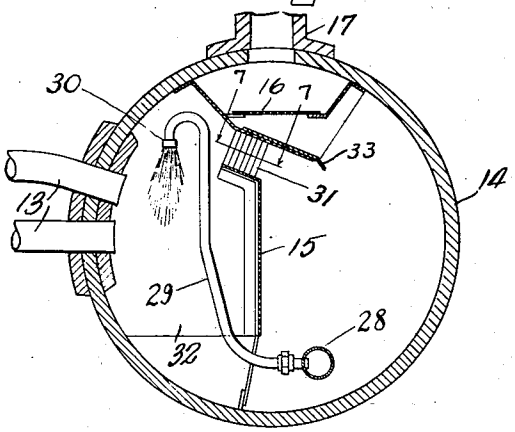


Fig. 6



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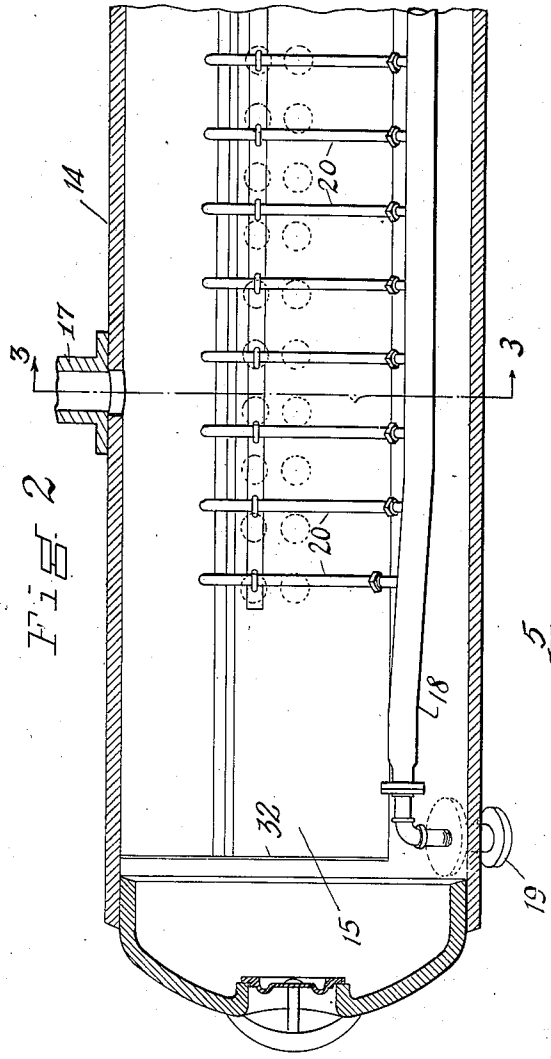


Fig. 2

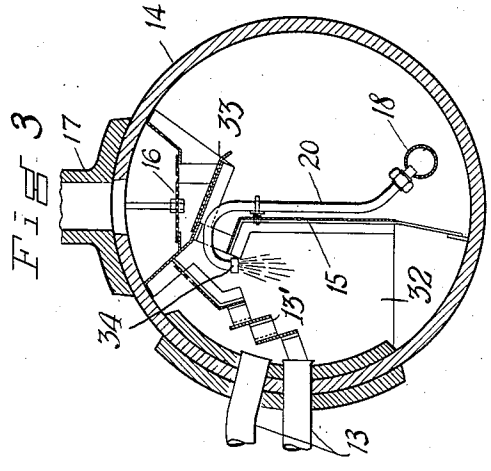


Fig. 3

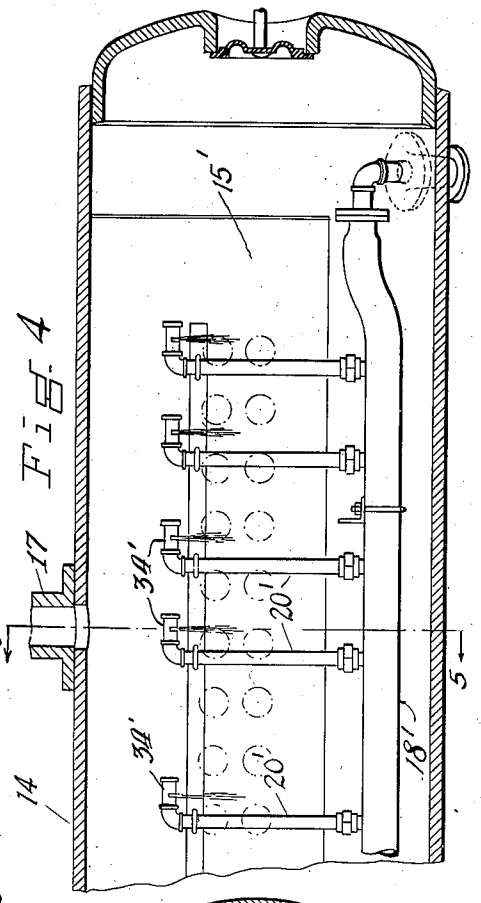
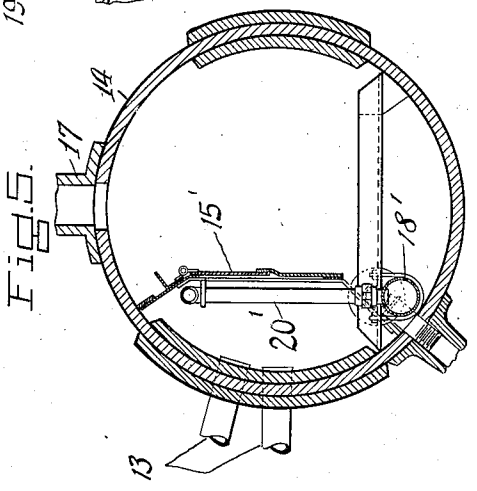


Fig. 4



Figs. 5.

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UNITED STATES PATENT OFFICE

2,058,239

STEAM WASHER

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Application January 18, 1930, Serial No. 421,619
Renewed October 25, 1934

18 Claims. (Cl. 122—459)

This invention relates to steam boilers and more particularly to a steam washing device for use in connection therewith.

An object of this invention is to provide a steam boiler of such construction and arrangement that all steam withdrawn from the boiler is subjected to a washing action for removing or reducing the solid impurities in solution in the moisture suspended in the steam.

A further object is to provide a device for utilizing the feed water entering a boiler drum for washing the steam therein.

These and other objects which will be apparent to those skilled in this particular art are accomplished by means of the invention illustrated in the accompanying drawings in which

Fig. 1 is a transverse sectional view through one type of boiler provided with a steam and water drum constructed in accordance with one embodiment of this invention.

Fig. 2 is a longitudinal sectional view through a part of the drum illustrated in Fig. 1.

Fig. 3 is a transverse sectional view on the line 3—3 of Fig. 2.

Fig. 4 is a view similar to Fig. 2 of a modified arrangement especially adapted for marine boilers.

Fig. 5 is a transverse sectional view on the line 5—5 of Fig. 4.

Fig. 6 is a view similar to Figs. 3 and 5 illustrating a further modification, and

Fig. 7 is a transverse sectional view on the line 7—7 of Fig. 6.

In the drawings is illustrated a steam boiler of a well known type having provisions in accordance with my invention for subjecting the wet steam generated to a washing or purifying action within its steam and water drum. As illustrated, the incoming feed water is advantageously employed as the washing liquid and introduced as a spray into the steam space of the drum and through which the wet steam must pass before leaving the drum. The resulting intimate contact between the moisture suspended in the steam and the descending feed water causes the concentration of solids in solution in the suspended moisture to be substantially reduced, since the solid concentration of the feed water is substantially less than that of the suspended particles of boiler water. While some of the moisture mixed or suspended in the steam may be separated by gravity in or prior to the washing section, a subsequent steam and water separating action is advantageously incorporated to insure steam of the desired purity and quality leaving the boiler.

The steam boiler shown includes downtake headers 10, a bank of steam generating tubes 11, uptake headers 12, and rows of horizontally extending circulators 13 connecting the uptake headers with a steam and water drum 14 along one side thereof. In the drum construction illustrated in Figs. 1, 2, and 3, the circulators 13 discharge streams of steam and water into the drum against a series of inclined plates forming a shutter baffle 13', forming a separator by which much of the entering water is separated and directed downwardly into the pool in the bottom of the drum. The wet steam leaving the separator 13' passes into the adjacent drum space in front of a longitudinally extending vertical baffle 15 arranged with its lower edge extending below the normal level of the pool in the drum, its ends terminating short of the ends of the drum, and its top portion bent forwardly and upwardly towards the circulator side of the drum. The ends of the drum space so defined are closed by end plates 32 extending from the baffle 15 to the drum wall. The bent top portion of the baffle is arranged below and substantially parallel to an inclined baffle plate 33, which forms an extension of one side wall of a dry pipe 16 closing the top of the drum space between the shutter baffle 13' and the adjacent wall of the drum. The plate 33 extends below the perforated bottom of the dry pipe 16 and thus prevents steam from entering the dry pipe directly from the drum space in front of the baffle 15.

The feed water for the boiler enters the drum 14 through a distributing pipe 18 which extends along the bottom of the drum from a supply connection 19, and a plurality of longitudinally spaced branch pipes 20 extending upwardly from the pipe 18 at the rear of and projecting over the inclined top portion of the baffle 15. Each pipe 20 terminates in a spray nozzle 34. The spray nozzles are positioned to deliver relatively closely spaced sprays of feed water into the drum space between the baffle 15 and the shutter baffle 13'. The wet steam leaving the shutter baffle 13' can escape from the washing section of the drum, i. e., the drum space between the baffle 13' and 15 only by passing upwardly over the top of the baffle 15. In so passing, the steam must ascend through the sprays of feed water. The descending feed water contacts with the particles of boiler water suspended in the steam and being of greater purity causes the concentration of solids in solution in the suspended moisture to be substantially

reduced. While the consequent increase in mass may cause some of the original suspended moisture to separate by gravity, the wet steam leaving the washing section is advantageously subjected to a further steam and water separating action which will decrease the moisture content of the steam and correspondingly reduce the solid concentration of the steam passing out of the steam outlet 17 of the drum. In the embodiment shown, this separating action is of the inertia type. For this reason the wet steam passing over the top of the baffle 15 is directed rearwardly and downwardly by the baffle plate 33 and caused to make an abrupt change in direction before reaching the perforated dry pipe 16. A further moisture separating action takes place when the steam enters the perforated bottom of the dry pipe 16.

The wet steam discharged by the circulators 13 is thus subjected to a series of moisture separating actions, between two of which the steam is washed by feed water in a manner which will insure dilution of the suspended moisture by relatively pure feed water. This washing action intermediate two stages of moisture separation is specifically disclosed and claimed in my copending application, Serial No. 655,607, filed Jan. 26, 1933.

The modification illustrated in Figs. 4 and 5 is especially adapted for marine boilers and in this construction a longitudinal vertical baffle 15' is positioned closer to the circulators 13 than the baffle 15 in Figs. 1—3 and arranged with its inclined top portion in contact with the adjacent drum wall above the circulators and closing the top of the drum space between the baffle and the drum wall. The only exit for the steam from this space is around the ends of the baffle 15'. The feed water distributing pipe 18' and branch pipes 20' are positioned in front of the baffle 15' and the discharge openings in the spray nozzles 34' arranged as shown in Fig. 4 to provide a series of longitudinally spaced sprays across the space between the baffle and circulators. The steam and water discharged by the circulators 13 impinges on the baffle 15' which action causes much of the water to separate and drop into the pool in the bottom of the drum. The wet steam then passes longitudinally of the drum space in front of the baffle 15' and is subjected to successive washing actions as described above during its passage. The abrupt change in direction of the steam leaving the washing section around the ends of the baffle 15' causes moisture to be separated by inertia and correspondingly reduces the solids in the steam delivered to the drum outlet 17.

The modified drum construction illustrated in Figs. 6 and 7 is generally similar to that shown in Figs. 1—3, except that the shutter baffle 13' is omitted and the feed water distributing pipe 28 is provided with a plurality of vertical branch pipes 29 extending in front of the baffle 15 and terminating in downwardly directed spray nozzles 30 which are positioned substantially opposite the passage between the top portion of the baffle 15 and the inclined baffle plate 33. A steam and water separator occupies the passage between the two baffles and consists of a series of parallel corrugated plates 31 extending transversely of the drum, as shown in Figs. 6 and 7, on which moisture is separated from the steam flowing through the sinuous channels formed therebetween.

With this construction there will be an initial separation of the entering steam and water partly due to the sudden decrease in velocity thereof in the washing section and partly to impingement on the baffle 15. The separated moisture drops into the pool in the bottom of the drum, while the wet steam is deflected upwardly by the baffle 15. During the upward passage of the steam between the baffle 15 and the drum wall, the steam comes into intimate contact with the descending sprays of feed water, whereby the solid concentration of the moisture suspended in the steam will be substantially reduced. The treated steam passes upwardly and then rearwardly through the passages between the plates 31, where most of the suspended moisture is removed and falls into the drum pool at the rear of the baffle 15. The subsequent passage of the steam and abrupt change of direction around the baffle plate 33 and through the perforated dry pipe 16 causes a further separation of the moisture therefrom.

While in accordance with the provisions of the statutes I have illustrated and described herein the best forms of my invention now known to me, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by my claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

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

1. A steam boiler having in combination a steam and water drum, steam and water circulators connected to said drum for delivering wet steam thereto, a flow directing baffle positioned in the path of the wet steam entering said drum, means for spraying feed water into the space between said baffle and said steam and water circulators, and a steam outlet from said drum at the opposite side of said baffle.

2. A steam boiler having in combination a steam and water drum, steam and water circulators connected to said drum for delivering wet steam thereto, a flow directing baffle positioned in the path of the wet steam entering said drum, a feed water pipe extending longitudinally of said drum and nozzles spaced along said pipe and arranged to establish a steam washing spray of feed water between said baffle and said steam and water circulators.

3. In a steam boiler, a steam and water drum, steam and water circulators connected to said drum for delivering wet steam thereto, a flow directing baffle located therein and positioned in the path of the wet steam entering said drum, and means for spraying the wet steam while in the space between said circulators and baffle with water having a solid concentration substantially lower than the solid concentration of the moisture suspended in the steam.

4. In a steam boiler, a horizontally arranged drum, conduits connected along the length of said drum and arranged to deliver thereto wet steam containing solids in solution in the suspended moisture, steam and water separating means extending longitudinally of said drum and positioned in the path of the wet steam entering said drum, and means for spraying the incoming wet steam with relatively pure feed water before the steam passes through said steam and water separating means.

5. In a steam boiler, a horizontally arranged steam and water drum normally containing a body of water having a high solid concentration, a bank of steam generating tubes connected thereto along one side thereof and above the water level therein and arranged to deliver wet

steam containing solids in solution in the suspended moisture, a baffle system extending longitudinally of said drum above the water level therein and positioned in the path of the wet steam entering said drum, said baffle system being arranged to divide said drum into sections and having an opening therein for the passage of steam, means for spraying relatively pure feed water into the drum section between the incoming steam connections thereto and said baffle system, steam and water separating means positioned in said opening, and a steam outlet from said drum section at the opposite side of said baffle system.

6. In a steam boiler, a substantially horizontal drum having a purified steam outlet in the upper portion thereof and an inlet for wet steam containing solids in the suspended moisture at one side of said outlet, steam and water separating means extending longitudinally of said drum and positioned in the path of steam flow between said inlet and outlet, and means for creating a curtain of relatively pure feed water in the path of steam flow between said inlet and the discharge side of said separating means.

7. In a steam boiler, a substantially horizontal steam and water drum normally containing a pool of water in the bottom thereof and having a purified steam outlet in the upper portion thereof and an inlet for wet steam containing solids in the suspended moisture at one side of said outlet, steam and water separating means extending longitudinally of said drum and positioned in the drum space above said water pool in the path of steam flow between said inlet and outlet, and means for creating a descending curtain of relatively pure feed water above said water pool in the path of steam flow between said inlet and outlet and prior to the discharge of steam from said separating means.

8. In a steam boiler, a substantially horizontal steam and water drum normally containing a pool of water in the bottom thereof having a purified steam outlet in the upper portion thereof and an inlet for wet steam containing solids in the suspended moisture at one side of said outlet, a baffle extending longitudinally of the drum space above said water pool and having its upper end terminating short of the upper side of said drum to form a path of steam flow between said inlet and outlet over the upper end of said baffle, means for discharging relatively pure feed water into the path of steam flow between said inlet and said baffle, and a second baffle in said drum arranged to effect a change in direction of the steam after passing over the upper end of said first baffle.

9. In a steam boiler, a substantially horizontal steam and water drum normally containing a pool of water in the bottom thereof and having a purified steam outlet in the upper portion thereof and an inlet for wet steam containing solids in the suspended moisture at one side of said outlet, a baffle structure extending longitudinally of the drum space above said water pool and having its ends terminating short of the ends of said drum to form paths of steam flow between said inlet and outlet around the ends of said baffle structure, and means for creating descending curtains of relatively pure feed water above said water pool and transversely of the space between said inlet and said baffle structure.

10. In a steam and water drum having steam and water circulators connected thereto along one side thereof, and a steam outlet in its upper side, a baffle plate structure extending from the drum wall intermediate said circulators and outlet to a level below the normal water level in said drum and having an opening therein above the normal water level, a steam and water separator positioned in said opening and comprising a plurality of side-by-side plates arranged to form narrow channels therebetween, each of said plates being formed with a series of corrugations extending transversely of the general direction of flow between said circulators and outlet, the corrugations of adjacent plates being relatively arranged to form undulating channels, and means for washing the wet steam in said drum with water of greater purity than the moisture carried by the steam.

11. In a steam and water drum having steam and water circulators connected thereto along one side thereof, and a steam outlet in its upper side, a baffle plate structure extending from the drum wall intermediate said circulators and outlet to a level below the normal water level in said drum and having an opening therein above the normal water level, a steam and water separator positioned in said opening and comprising a row of moisture-collecting plates arranged side-by-side and spaced to form narrow elongated steam flow channels between moisture collecting surfaces thereof, and means for washing the wet steam in said drum with water of greater purity than the moisture carried by the steam.

12. A steam generator comprising a casing normally containing a pool of water in the bottom thereof and having a wet steam space above said water pool, a steam outlet from said steam space, steam and water separating means positioned in the steam space in the path of steam flow to said steam outlet and comprising a plurality of side-by-side moisture separating plates arranged to form narrow channels therebetween, each of said plates being formed with a series of corrugations extending transversely of the general direction of steam flow through said channels with the corrugations of adjacent plates being relatively arranged to form undulating channels, and means in said steam space for washing the wet steam therein with water of greater purity than the moisture carried by the steam.

13. The method of purifying steam in a steam and water drum of a boiler installation which includes substantially continuously introducing feed water for the boiler into the steam space of the drum in finely subdivided form, whereby the feed water is widely distributed as it descends toward the surface of the water in the drum, and causing substantially all the steam produced to intermingle and intimately contact with the feed water in the steam space above the water level in the drum.

14. The method of operating a boiler having a steam and water drum with a steam offtake in an upper portion thereof, which method includes introducing feed water into the steam space in the drum above the water level therein, the feed water being introduced in and substantially across the entire path of flow of steam to said offtake and being in sufficiently subdivided form to intimately intermingle with substantially all the steam passing from the drum to said offtake.

15. In combination with a steam boiler drum having means for withdrawing steam at a point toward the top of the drum, downcomer tubes communicating therewith at the bottom of the drum and return circulation tubes communicat-

ing therewith at a point intermediate the top and the bottom of the drum; a group of closely spaced baffle-like members presenting extended surface area for contact with steam in the drum, said group being extended lengthwise of the drum in a region intermediate said return circulation tubes and the steam withdrawal means whereby the steam is caused to pass therethrough in being withdrawn from the drum; and means for distributing feed water for the boiler across the path of flow of the steam through the steam space of the drum in washing relation with substantially all of the steam passing through the drum.

16. The method of reducing the solid concentration of wet steam generated in a steam generator having a drum normally containing a body of water of relatively high solid concentration to be evaporated and a space above said water arranged to receive the steam generated and having a steam outlet from the steam space above the normal water level in said drum, which comprises distributing feed water for the steam generator having a lower solid concentration than the moisture suspended in the steam across the path of flow of the wet steam through the steam space of the drum to the drum outlet in washing relation with substantially all of the steam passing to said outlet and so as to descend upon the surface of the water in the drum, and mechanically separating suspended moisture from the steam during its passage through said steam space.

17. In a steam boiler having a steam generating section and a steam and water drum arranged to receive the steam generated and having a steam outlet above the normal water level therein, means for distributing feed water for said steam generating section having a lower solid concentration than the moisture suspended in the steam entering the steam space of said drum across the path of flow of the steam through said steam space to said steam outlet in washing relation with substantially all of the steam passing to said steam outlet and so as to descend upon the surface of the water in the drum, and moisture separating means arranged to separate suspended moisture from the steam during its passage through said steam space.

18. In combination, a horizontally arranged drum having inlets connected thereto along the length of said drum for delivering wet steam having a relatively high solid concentration in the suspended moisture, a steam outlet from said drum spaced from said inlets, steam and water separating means extending longitudinally of said drum and positioned in the path of steam flow between said inlets and outlet, and means for distributing water having a lower solid concentration than the moisture carried by the steam across the path of flow of the steam between said inlets and said separating means in washing relation with substantially all of the steam passing through said drum.

HOWARD J. KERR.

CERTIFICATE OF CORRECTION.

Patent No. 2,058,239. October 20, 1936.

HOWARD J. KERR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, after line 3, insert the following paragraph:

> Steam and water separating devices disposed within steam and water drums of steam generating systems remove a great deal of the water from the mixture of steam and water in its passage from a steam generating system to the steam outlet in a drum, but in practice it is virtually impossible to supply perfectly dry steam from a drum. The moisture that is mixed with such steam is of course the water of the steam generating system, and hence due to the amount of evaporation that has taken place it has a high content of dissolved solid matter and solid particles in suspension. This invention contemplates a manner of removing the concentrated or dirty moisture associated with the steam by spraying the moist steam with fresh water as it passes from a steam and water inlet to a steam outlet within a drum and thus replacing the dirty moisture associated with the steam with fresh water.;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of April, A. D. 1937.

Henry Van Arsdale
(Seal) Acting Commissioner of Patents.