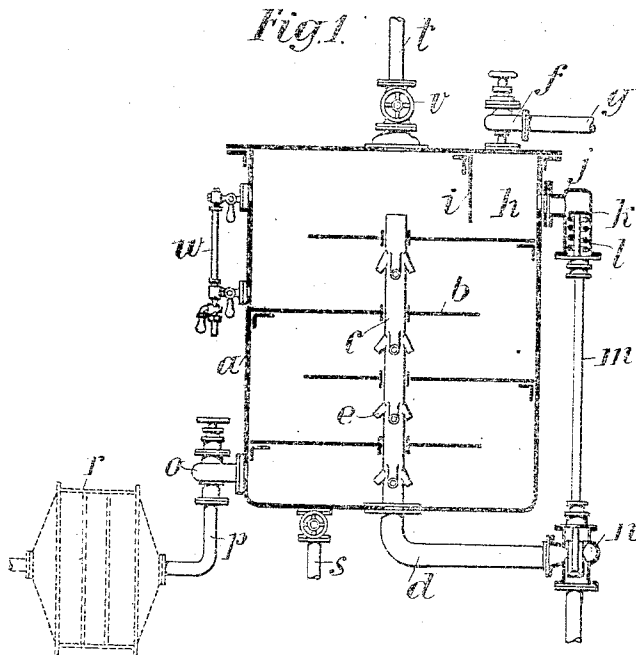


T. BRÁZDA, E. RICHTER & A. SCHÜCKHER.  
 APPARATUS FOR PREVENTING THE FORMATION OF BOILER SCALE.  
 APPLICATION FILED MAR. 5, 1912.

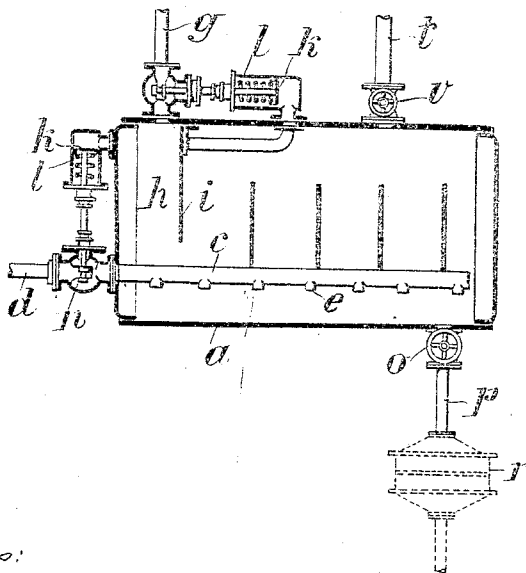
1,059,430.

Patented Apr. 22, 1913.

4 SHEETS—SHEET 1.



*Fig. 2.*



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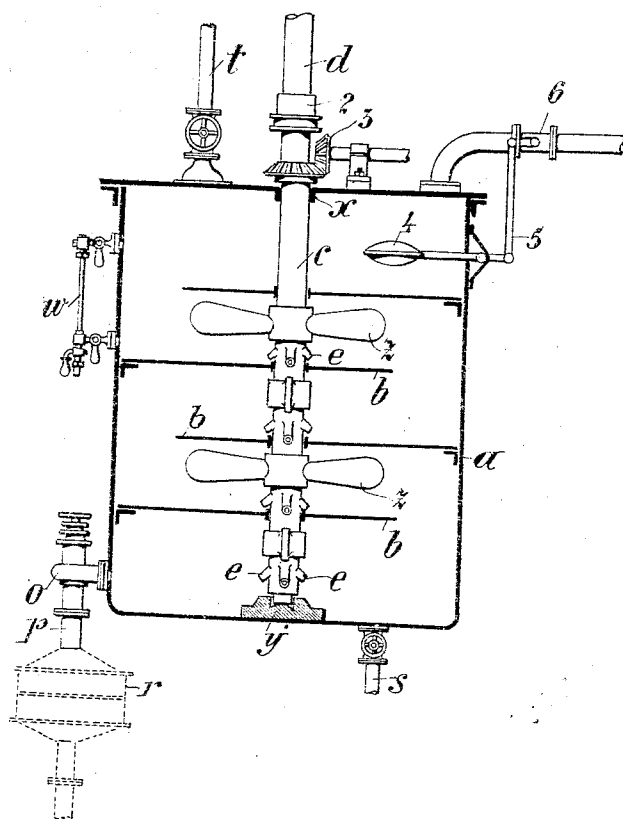
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4 SHEETS-SHEET 2.

Fig. 5.



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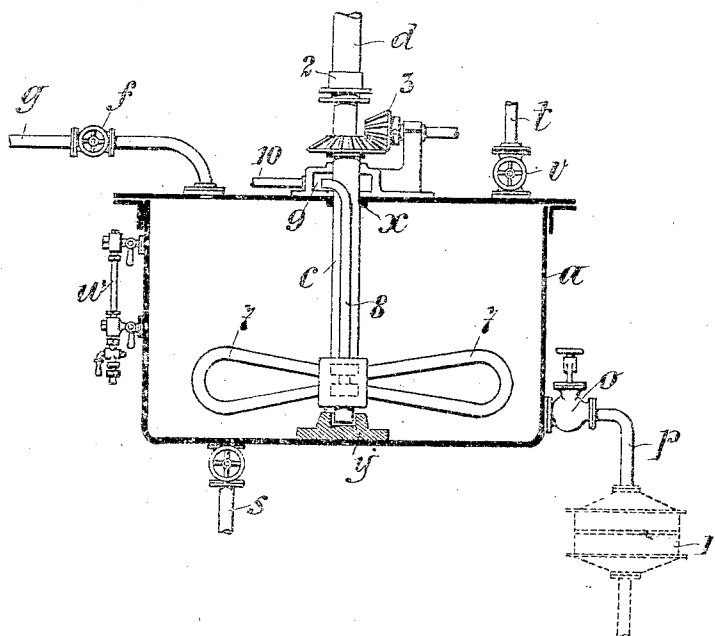
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1,059,430.

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4 SHEETS—SHEET 3.

Fig. 4



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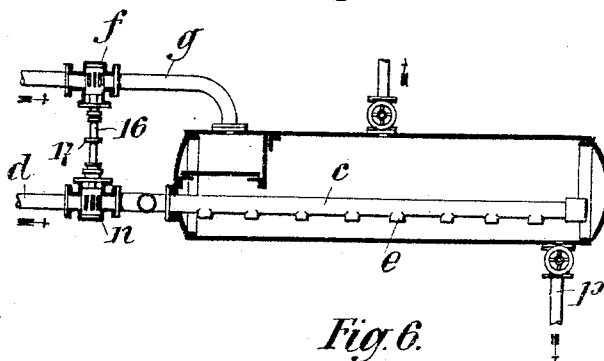
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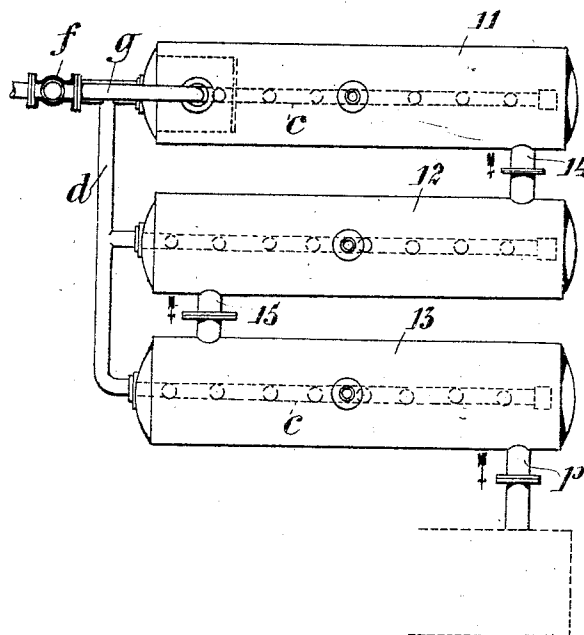
Patented Apr. 22, 1913.

4 SHEETS—SHEET 4.

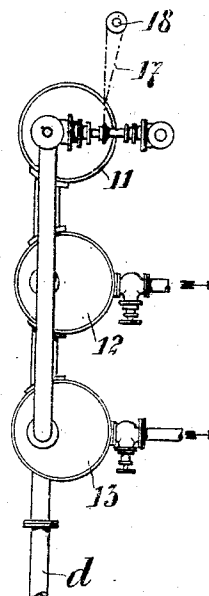
*Fig. 5.*



*Fig. 6.*



*Fig. 7.*



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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR PREVENTING THE FORMATION OF BOILER-SCALE.

1,059,430.

Specification of Letters Patent.

Patented Apr. 22, 1913.

Application filed March 5, 1912. Serial No. 681,802.

*To all whom it may concern:*

Be it known that we, THEODOR BRÁZDA, a subject of the Austro-Hungarian Emperor, residing at Pilsen, Bohemia, Austria-Hungary, and EMIL RICHTER and ALBERT SCHÜCKHER, subjects of the Austro-Hungarian Emperor, residing at Vienna, Austria-Hungary, have invented certain new and useful Improvements in Apparatus for Preventing the Formation of Boiler-Scale, of which the following is a specification.

The object of the American Patent 925,283 is a process for preventing the formation of boiler scale in which the feed water, without addition of chemicals, is boiled with simultaneous vigorous stirring in a container which is not quite filled, which is closed on all sides and does not stand under the pressure of the feed pump or the boiler, with the object of precipitating part of the substances causing hardness in the form of a fine mud, suspended in the water, when the feed water is introduced into the boiler with this suspension or the precipitate obtained therefrom alone. The necessary energetic motion of the water during boiling can be effected either by the steam alone or with the aid of mechanical stirrers. This process is based on the fact that the micro-crystalline precipitate which results in this treatment is capable, on account of its particular condition, of preventing deposition on the walls of boilers and the like, because the precipitate which commences to crystallize out in the boiler at increasing concentration forms no boiler scale under the influence of the suspension which has been added. On the contrary these precipitates are also of great fineness and mobility, they follow all the movements of the water and at a certain over-concentration form a soft, pasty sludge, which can be removed by periodic drawing off from the boiler.

It was originally attempted, to attribute the surprising action of the process to the easily mobile fine particles of the suspension suspended in the boiler water continually rubbing on the walls of the boiler and on the deposits in course of formation in the boiler, whereby these deposits were not allowed to lie still and were thus hindered from becoming solid.

Another more plausible attempt at explanation is that these most finely divided crystals previously present in the boiler

water serve in a certain manner as crystallization points or crystal nuclei for the substances causing permanent hardness, which separate out later in the boiler. The suspensions precipitated by boiling the water with vigorous stirring mainly consists of bicarbonates. The substances causing the permanent hardness, in which sulfates are principally concerned, in consequence of their great solubility first begin to separate out, when the solution has attained the corresponding degree of concentration by evaporation and enrichment in consequence of fresh addition of water containing sulphates. The small crystals of carbonate introduced into the boiler water, which take part in all the movements of the same, attract to themselves the sulfates, which crystallize out in somewhat the same manner as sugar begins to crystallize out from a saturated solution on to a crystal which is hung therein. Thus by the excessively fine carbonate crystals suspended in all parts of the boiler water the sulfates are actively prevented from forming a solid deposit on the walls of the boiler.

The present invention has for object a further development of this process and devices for carrying out the same.

The further development of the original process aims first at carrying out by the simplest possible means the process of boiling the water with energetic stirring during continuous working. To this end according to the present invention, the water which is to be treated, is added continuously, or intermittently at short time-intervals, to a closed container, which is not wholly filled, and is led from the container in the same manner, and as it flows is boiled and kept in motion so vigorously that the precipitate settles out in the desired fineness. The water is usually led in by a pump or by a suitably high reservoir. The boiled water can be likewise led from the container to the boiler by a pump unless it is preferred to feed the water into a collector and to feed it to the boiler therefrom.

In treatment in continuous working in order to secure the deposition of the precipitate in the required microcrystalline condition and fine division, on which indeed the working of the whole process depends, it is advisable to conduct this treatment of the water in several consecutive phases. To

this end the process can be carried out in a single container in which suitably formed baffle-plates are disposed which force the water during the energetic stirring to run in a current to heating places situated one after another. But several containers, placed one after the other can also be employed.

The energetic stirring of the water, which is essential for the process, can be obtained in various ways, as was mentioned at the beginning. If the source of heat is outside the container the vigorous movement of the water is effected by the aid of mixing wheels, stirrers or the like, disposed inside the container. If the heating of the water is effected by allowing steam to pass directly into it, this steam, by means of suitable devices, can simultaneously serve to bring about the requisite energetic motion.

Devices have been previously proposed to effect the prior warming of the water by direct admixture of steam with the feed water, (for example, by leading in the steam in fine jets, or with the so-called noiseless heaters), but these have always been concerned only with an improvement in giving up heat to the water. To ascribe directly to the steam the function of a stirring medium has first been proposed toward the solution of the problem of generating, by intensely dashing the water particles together, a precipitate of microcrystalline condition, whose finest particles are, first rendered distinctly visible on considerable magnifications, which turbidity, whether suspended in the boiler water or added as such to the boiler water, forms an active means for preventing the formation of boiler scale.

As a further development of the process it has proved advantageous to cause the admission into the water container of the steam or water or both to take place in intermittent puffs. (pulsating). The pulsating, in comparison to the continuous, steam inflow results in an increased agitation of the water. The pulsating, in comparison of the continuous, inflow of water causes the pressure variations in the container to take place within wider limits, whereby the pulsation of the current of steam is essentially increased. This pulsating inflow of steam or water can be effected either with the aid of mechanical means or it can be brought into play by the pressure variations occurring in the container. The flow of the steam into the container in puffs can also be effected by the streaming of the water run into or out from the container; for example by arranging in the in- or out-flow a wheel with vanes or the like, whose movement is transmitted to a cut-off or regulating device inserted in the steam pipe. To make the stirring of the

water sufficiently active there is still available the method of increasing the stirring action of the steam flowing into the water by combination with mechanical stirring means, in that the steam pipe fixed in the container is provided with stirring vanes and arranged as a stirring axle.

The gases chemically bound in the water and evolved in the precipitation process are driven out by boiling the water under vigorous stirring, the principal quantity of which collecting in the upper part of the container above the level of the liquid and can thereupon be blown out of the container. There is distinct importance in this action in the process, for it avoids the attack on the material of the boiler which otherwise takes place and avoids the origination of corrosion. Now it has been found advantageous, especially in carrying out the process in continuous working, to allow this blowing off of the gases to occur periodically, *i. e.* in puffs. In this way the gases which are not immediately at the blow-off opening and those which are in the deeper layers are carried off by the puffing action, so that the water passes into the boiler completely freed from air and gases. The periodic blowing-off can be effected by hand or automatically by suitable devices at the requisite time-intervals.

In the accompanying drawings several forms of devices are illustrated which serve to carry out the process in continuous working.

Figure 1 illustrates in vertical section one embodiment of the invention. Fig. 2 is a similar view of a modification. Fig. 3 is a sectional view illustrating another form of apparatus embodying the invention. Fig. 4 illustrates a slightly modified form of the type of apparatus shown in Fig. 3. Figs. 5, 6 and 7 illustrate, in section, plan and end elevation, another apparatus embodying the invention.

In the forms represented in Figs. 1 and 2 the boiling of the water is effected under energetic stirring by direct in-flow of steam into the water. To this end there leads into the container *a* a steam-pipe *c*, *d* which is provided with a number of suitably formed exits *e*. By intermediate walls or baffle-plates *b* the untreated water flowing from the pipe *g* through the valve *f* above, into the container *a*, is forced to traverse a number of chambers in series, which prevents a part of the water leaving the container after having been insufficiently boiled.

To allow the entry of the steam to take place by puffs or pulsations the untreated water is run into a space *h* which is separated from the other space of the container *a* by a wall *i* leaving a suitable connection between. To this space *h* there is attached a casing *j* containing a piston *k* which on

the one hand stands under the pressure prevailing in the space *h* and on the other hand is loaded by a spring *l* or by a weight. A rod *m* leads from this piston to the cut-off device *n* (piston-valve) of the steam in-flow *d*. If so much steam has collected above the water that the prevailing pressure has reached a certain value, the pressure acts so strongly on the piston *k*, that this is moved against the action of the spring *l* and the cut-off *n* is closed. If steam is condensed in the space *h* by the in-flowing water the pressure rapidly diminishes there, so that the action of the spring *l* predominates and the cut-off *n* is opened. By making the space *h* separated from the rest of the container and proportionately small, a quicker action of the water on the steam is attained to bring about a frequent change of pressure, and thereby also a sufficiently rapid pulsation of the steam. It is self-evident that instead of the piston *k* a membrane can be connected with the cut-off or regulating device *n* arranged in the steam in-flow pipe.

The boiled water leaves the container *a* at the lower end through the pipe *p* provided with a cut-off device *o*. A filter *r* or the like can be inserted to hold back the precipitated suspension. It is also advisable to provide a mud-cock *s*. A pipe *t* with a cut-off *v* serves to blow off the gases collecting in the upper part of the container. Finally there is a gage-glass *w* attached to the container.

In the form shown in Fig. 2 not only the steam but also the water, in-flow is pulsating. The arrangement described in Fig. 1 consisting of a piston *k* and a spring *l* is provided here both for the steam cut-off *n* as well as for the water cut-off *f*, so that both the steam valve *n* and the water valve *f* are regulated by the pressure prevailing at the time in the chamber *h*. This regulation takes place in such manner that with a predetermined reduction in pressure in the chamber *h* the steam valve *n* is opened and with a corresponding increase in pressure the water valve *f* is opened. By the pulsating in-flow not only of steam but also of water, an especially intensive agitation of the water is attained, as has been already mentioned.

In Figs. 3 and 4 forms are shown in which the stirring action of the steam blowing into the water is assisted by a mechanical stirrer. The steam pipe *c* with the exits *e* forms at the same time the stirring axle in that it is rotatably mounted in the bearings, *x*, *y* and is provided with stirring vanes *z*. The connection of the rotatable steam pipe *c* with the fixed steam supply pipe *d* is effected by a stuffing-box 2 while the driving of the steam-tube *c* is effected by any shafting, for example by a conical wheel drive 3. In this

form a device is provided which makes the supply of the water dependent on the level prevailing inside the container. This device consists of a float 4 which is connected by a rod 5 with a throttle valve 6 provided in the water supply pipe *g*. This throttle valve closes more as the water level rises and opens more as the level falls.

In the form shown in Fig. 4 direct heating by steam is employed in combination with a mechanical stirrer. The steam supply pipe *d* is connected by a stuffing-box 2 with the steam pipe *c* which is rotatably mounted in the container at *x* and *y*, and is rotated by any shafting, for example, by a conical wheel drive 3 and possesses one or several stirring vanes 7 formed of tubes. The steam flows through the pipe *c* into the stirring vane 7 and finally passes through the backward leading pipe 8 arranged in the steam-pipe to a fixed chamber 9 from which it is drawn off with the condensed water through a pipe 10. In this form the stirring vanes 7 serve simultaneously to warm the water, since steam passes through them, and to stir it energetically.

In the form shown in Figs. 5, 6 and 7 in longitudinal section, plan and cross section, three horizontal containers 11, 12 and 13 are so connected with one another by pipes 14 and 15 that the water boiled in the first container must then pass into the second and third containers. Into the first container 11 opens the supply pipe *g* for the untreated water, into which is inserted the cut-off *f* which in this case is formed as a revolving tap. The outflow pipe *p* leads from the last container 13. In each container there is a horizontal steam pipe *c* with suitably constructed exits *e*. All these steam pipes possess a common supply pipe *d* in which is inserted a cut-off *n*, for example again a rotating tap. The cut-off devices *f* and *n* for water and steam are connected by a shaft 16 which is coupled with a shaft 18 by driving means 17. By this arrangement both the cut off devices are simultaneously actuated by which means the in-flow openings are alternately opened and closed. Thereby a continual pulsating, i. e., puff-like in-flow of both water and steam is attained by mechanical means. By the mechanical regulation of both cut-off devices it is possible to cause the pulsations to take place quicker or slower.

The method of carrying out the original process for preventing the formation of boiler-scale by boiling the feed water with simultaneous vigorous stirring which forms the object of the present invention represents an important advance on the original process. Quite apart from the great advantage which is attained by being able to conduct the boiling during continuous working the methods of operation described in

themselves yield a finer division of the precipitate and a more thorough removal of gases from the water. At the same time they effect a more thorough precipitation of bicarbonates than was previously the case. As a result, in the case when the water to be treated is known to contain more substances causing temporary hardness than is necessary for preventing the formation of boiler scale, the whole precipitate must not be introduced into the boiler with the feed water, but a part of the precipitate can be held back. This microcrystalline mud obtained as by-product can itself find application as a means for preventing boiler scale.

No claim is herein made to the improved method described in the foregoing specification as it forms the subject-matter of the divisional application, Serial No. 721,281, filed September 19, 1912.

Having thus described the invention what is claimed and desired to be secured by Letters Patent is:

1. In an apparatus for treating boiler feed water by precipitating the scale-forming substance in finely divided form, the combination of a receptacle adapted to contain the feed water, means for simultaneously admitting water to and drawing it off from said receptacle causing a circulation therethrough, a suitable port for the admission of steam to heat the water, and means for producing a rapid pulsation of the fluid entering the receptacle through one of said admission ports to vigorously agitate the particles of water as the entire body of water flows through said receptacle.

2. In an apparatus for treating feed water for boilers to prevent the formation of boiler scale, the combination of a receptacle means for simultaneously admitting water to and drawing it off from said receptacle causing a circulation therethrough, means for simultaneously heating and agitating substantially all of the particles of water within the receptacle, comprising a conduit for discharging steam into the receptacle, and means for rapidly and intermittently inter-

rupting the flow of steam and water to the receptacle.

3. In an apparatus for treating feed water for boilers to prevent the formation of boiler scale, the combination of a receptacle means for simultaneously admitting water to and drawing it off from said receptacle causing a circulation therethrough, means for simultaneously heating and agitating substantially all of the particles of water within the receptacle, comprising a conduit for discharging steam into the receptacle, and means controlled by variation in the pressure within the receptacle for rapidly and intermittently interrupting the flow of steam to the receptacle.

4. In an apparatus for treating feed water for boilers to prevent the formation of boiler scale, the combination of a receptacle means for simultaneously admitting water to and drawing it off from said receptacle causing a circulation therethrough, means for simultaneously heating and agitating substantially all of the particles of water within the receptacle, comprising a conduit for discharging steam into the receptacle, and means controlled by variation in the pressure within the receptacle for rapidly and intermittently interrupting the flow of steam and water to the receptacle.

5. In an apparatus for treating feed water for boilers, the combination of a suitable container having ports for the admission and discharge of water, means for heating and agitating water within the container comprising a conduit for discharging steam into the container, and means for rapidly and intermittently interrupting the flow of steam to the container.

In testimony whereof we have affixed our signatures in presence of two witnesses.

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EMIL RICHTER.

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents Washington, D. C."