March 15, 1927. 1,621,289

H. J. STERNBERG

FEED WATER HEATER

Filed Aug. 12, 1922 2 Sheets-Sheet 1

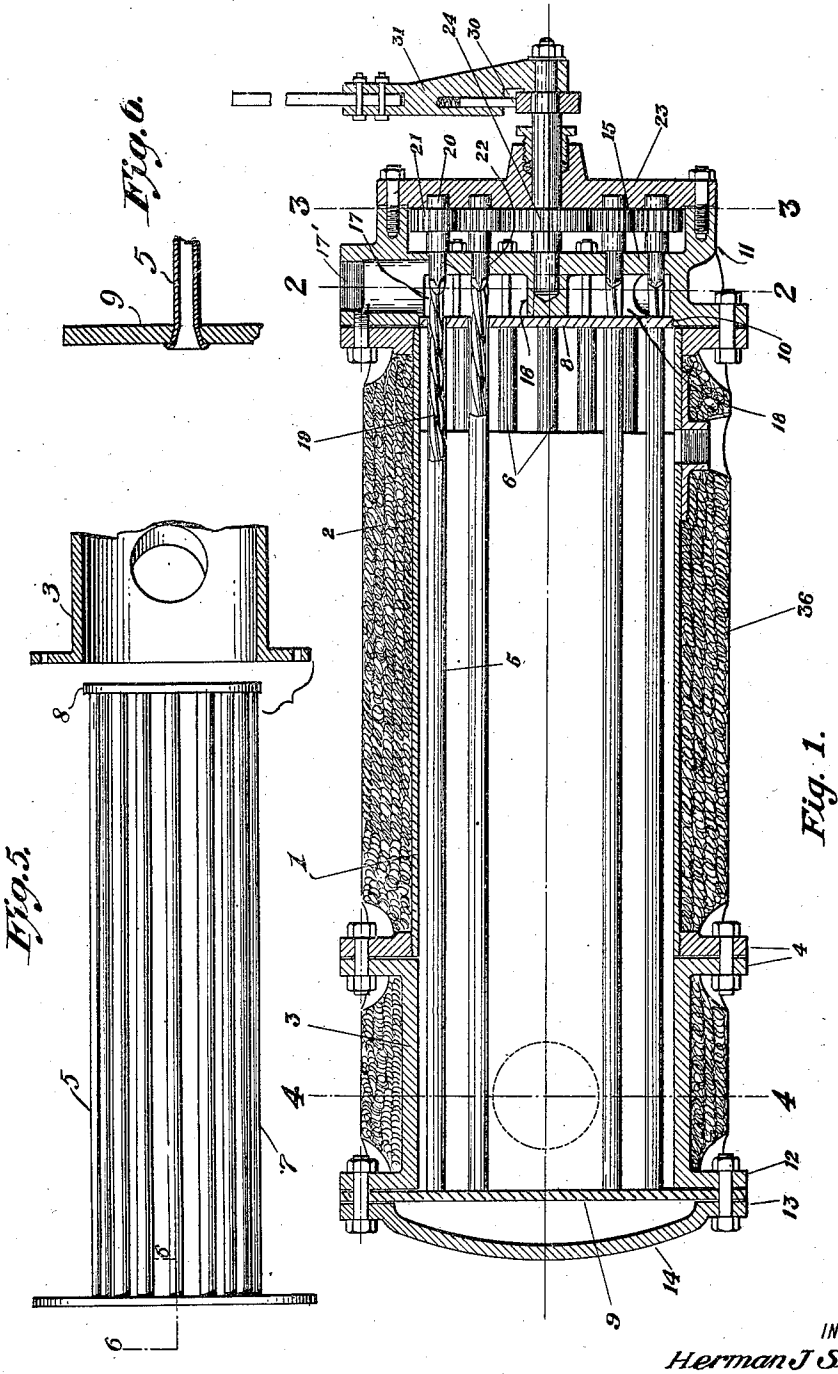


Fig. 1.

Fig. 5.

Fig. 6.

INVENTOR

Herman J Sternberg

BY

Elliott & Munson

ATTORNEYS

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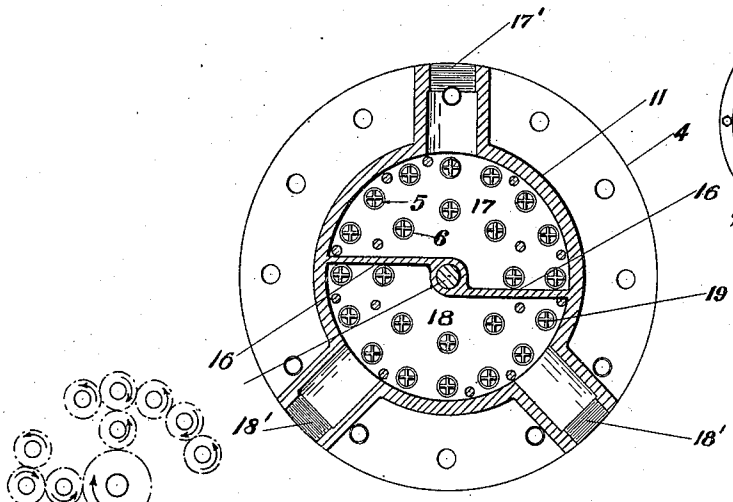


Fig. 2

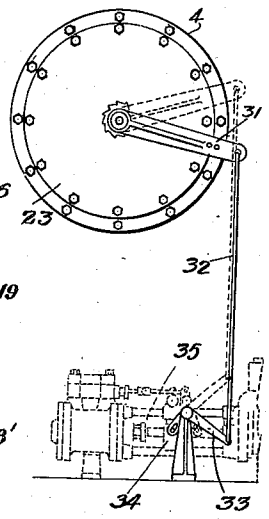


Fig. 7.

Fig. 8.

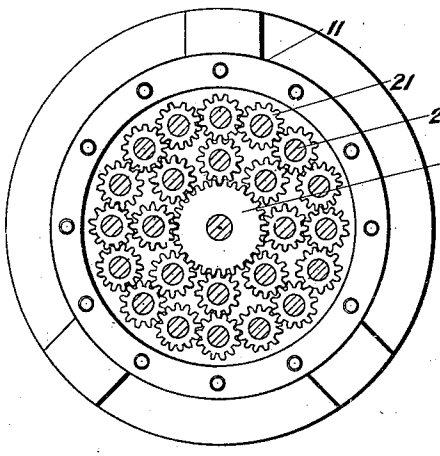


Fig. 3.

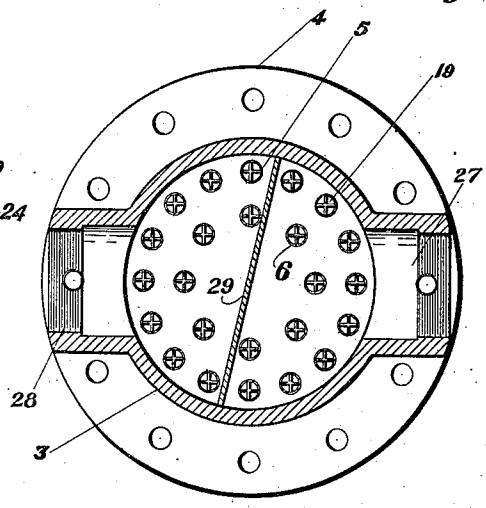


Fig. 4.

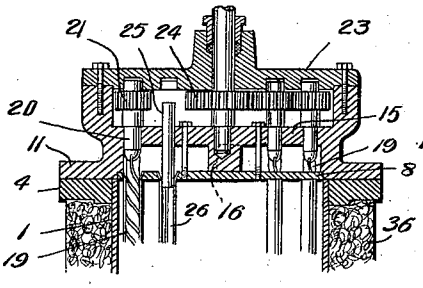


Fig. 9.

INVENTOR

Herman J. Sternberg.

BY

Elliott Thurmon

ATTORNEYS

Patented Mar. 15, 1927. 1,621,289

UNITED STATES PATENT OFFICE.

HERMAN J. STERNBERG, OF ST. LOUIS, MISSOURI.

FEED-WATER HEATER.

Application filed August 12, 1922. Serial No. 581,416.

This invention relates to feed-water heaters. One of the difficulties arising in the use of feed-water heaters is that unless the feed-water is very pure, scale and sediments deposit in the tubes of the heater and materially interfere with its efficiency. The general object of this invention is to overcome this difficulty and provide a feed-water heater of simple construction in which the tubes are mounted in such a way as to enable the entire bank or set of tubes to be removed bodily from the purifier, when desired, in order to make repairs. I am aware that rotary cleaners have been used in tubes of feed-water heaters to prevent the deposit or formation of scale, but with the usual arrangements for driving these cleaners, the driving pinions of all the cleaners must remain in place. One of the objects of my invention is to provide an improved arrangement of the tubes which will facilitate driving the cleaners or scrapers lying within them, and which will also facilitate the plugging of any tube which becomes leaky; at the same time, the arrangement of the driving pinions is such as to enable the leaky tube and its cleaner to be thrown out of use without interfering with the effective driving of the cleaners in the remaining tubes. By reason of the presence of these scrapers, the formation of deposit or scale is prevented and the heater can operate continuously for a great length of time without being overhauled or repaired. A further object of the invention provides simple means for effecting the continuous driving of the cleaners, and in such a way that the movement of the cleaners varies automatically or proportionally with the amount of feed-water being used. Another object of the invention is to provide a construction which will facilitate the removal of any cleaner in case the tube surrounding it has become leaky, thereby facilitating the plugging of the tube.

Further objects of the invention will appear hereinafter.

The invention consists in the novel features, and in the general combination of parts to be particularly described hereinafter, all of which contribute to produce a simple and efficient feed-water heater. A preferred embodiment of my invention will be particularly described in the following specification while the broad scope of my invention will be pointed out in the appended claims.

In the drawing:—

Figure 1 is a substantially longitudinal vertical section through the feed-water heater but with some of the tubes broken away and shown in section;

Figure 2 is a vertical section through the main head taken about on the line 2—2 of Figure 1;

Figure 3 is a vertical section through the main head taken about at the line 3—3 of Figure 1;

Figure 4 is a cross-section taken about on the line 4—4 of Figure 1;

Figure 5 is a side elevation of the tube nest or bank representing the same as in the act of being slid into the end of the shell, a portion of the latter being shown in vertical section;

Figure 6 is a section taken about on the line 6—6 of Figure 5 and illustrating the connection between the tube sheet and a tube;

Figure 7 is an end elevation of a feed-water heater and illustrating the means which I provide for driving the cleaners from a feed-water pump;

Figure 8 is a diagrammatic view illustrating the arrangement of driving pinions which enables all of the cleaners in effective tubes to be driven although many of the tubes may be leaky and not in use;

Figure 9 is a horizontal section taken through the main head and illustrating the manner in which a defective tube may be plugged.

Referring more particularly to the parts, 1 represents the shell of the heater which may consist of a body section 2 and a ring section 3 bolted together at flanges 4. The tubes through which the feed-water circulates comprise an outer set of tubes 5 and an inner set of tubes 6 which are disposed circumferentially around the axis of the shell. These tubes are all connected together so as to form a tube nest 7 (see Figure 5), comprising an inner tube sheet 8 and an outer tube sheet 9, the former of which is of smaller diameter than the bore of the shell, so as to enable the entire tube nest to be slid longitudinally into place.

The inner tube sheet 8 comes against a seat or counterbore 10 which is formed on the inner face of a main head 11 (see Figure

1). The outer tube sheet 9 is clamped between the flanges 12 and 13 of the shell ring 3 and a secondary head 14. These heads 11 and 14 are constructed so as to co-operate to effect a circulation of the feed-water through the tubes, the function of the secondary head 14 being merely to maintain communication between the outer ends of the tubes, that is to say, the ends of the tubes which are remote from the main head 11. In order to effect circulation of the feed-water in this way, the main head 11 is provided with a wall 15 which is disposed at some distance from the tube sheet 8, and the space between the tube sheet and the wall 15 is divided by a transverse web 16 into an inlet chamber 17 and an outlet chamber 18, one of said chambers having an inlet port 17′ and the other two outlet ports 18′ to which pipe connections can be attached for leading the feed-water in and out of the heater.

I provide a plurality of cleaners which correspond respectively to the different tubes, and each cleaner has a twisted scraper 19 which lies in the tube. On the main head 11, are mounted a plurality of driving shafts 20, each having a driving pinion 21, and these driving shafts are arranged in sets concentric with the different tubes, and are arranged like the tubes circumferentially around the axis of the shell as a center. Each shaft 20 connects with its corresponding scraper 19. Each shaft 20 is mounted rotatably in a bearing opening 22 in the wall 15 of the main head, and these bearing openings are slightly larger than the diameter of the scrapers 19 so that if desired, any pinion may be removed and its shaft and corresponding scraper 19 pulled out of the heater.

In order to facilitate this operation, the head is provided with a cover plate or guard 23 which if desired, may form an outer bearing for the shafts 20.

The inner set of pinions all mesh with a center driving gear 24 and the inner set of pinions also mesh with the outer set of pinions, so that when the center gear 24 is driven, all of the pinions 21 will rotate in unison, that is to say, the inner set of pinions will transmit the rotary motion to the outer set. There may be as many of the inner and outer tubes as desired, and which can be conveniently placed around in the interior of the shell. With this arrangement of driving pinions and tubes, it will be evident that if any tube should become leaky, it will not be necessary to make a repair at once. In order to effect a temporary repair, it is simply necessary to remove the cover plate 23 and the pinion and shaft of the leaky tube and then, to drive a plug 25 through the bearing opening in the wall 15 and into the mouth of a leaky tube, such as the tube 26 (see Figure 9). The other end of the tube may be closed in a similar manner by removing the head 14.

Even if a considerable number of tubes in the inner set should become leaky, motion can always be transmitted from the pinions of some of the remaining effective tubes. This result is illustrated in Figure 8 diagrammatically where all of the inner set of tubes are supposed to be defective except three. These remaining three however, enable the cleaners of all the remaining outer tubes to be continuously driven.

In order to pass hot gases or steam through the heater, the ring section 3 is provided with an inlet opening 27 and an outlet opening 28 (see Figure 4). Although these openings are opposite to each other, a baffle plate 29 is provided which extends diametrically across the shell in a nearly vertical position. One end of this baffle plate is disposed against the tube sheet 9, while the other end terminates short of the tube sheet 8, so that the steam will have to pass toward the head 8 and turn the edge of the baffle before it can flow back to the outlet connection.

In order to drive the cleaners continuously, I provide simple means for rotating the center gear 24. This may consist of a ratchet and pawl device 30 carried on an arm 31 which is connected by a link 32 to an arm 33 carried on a rocker which is actuated from a cross-head 34 of a feed pump 35, indicated in dotted lines in Figure 7.

In the operation of the feed-water heater, the feed-water may enter at the inlet 17′ and pass through the tubes above the web 16 to the outer end of the feed-water heater, where it arrives at the secondary head 14; from this point, it flows back through the lower half of the tubes and finds outlet through the outlet ducts or necks 18′.

The steam which heats the water passes to and fro on each side of the baffle plate 29, as described above.

If desired, the walls of the shell 1 may be provided with a non-conducting or asbestos packing 36.

It is understood that the embodiment of the invention described herein is only one of the many embodiments my invention may take, and I do not wish to be limited in the practice of my invention nor in my claims, to the particular embodiment set forth.

What I claim is:—

1. In a feed-water heater, the combination of a cylindrical shell, a pair of tube sheets, a plurality of tubes connecting said tube sheets and co-operating therewith to constitute a tube nest, one of said tube sheets being of smaller diameter than the shell so as to permit the tube nest to be slid longitudinally into the shell, a removable head attached to each end of the shell, one of said

heads having means for circulating feed water through the tubes and receiving and supporting the smaller of said tube sheets, and means for circulating a heating medium through the shell and around the tubes.

2. In a feed-water heater, the combination of a cylindrical shell, a pair of tube sheets, a plurality of tubes connecting said tube sheets and co-operating therewith to constitute a tube nest, one of said tube sheets being of smaller diameter than the shell so as to permit the tube nest to be slid longitudinally into the shell, a main head removably attached to the casing having a seat receiving the smaller tube sheet, and having a wall spaced from the sheet, said wall having a transverse web seating against the smaller tube sheet and dividing the space between the head and sheet into two chambers communicating with the interior of the tubes, said head having an inlet opening communicating with one of said chambers and an outlet opening communicating with the other chamber to enable feed water to be circulated through said tubes, a secondary head secured to the other end of the shell and maintaining communication between the tubes at that end of the shell, and means for circulating a heating medium through the shell and around the tubes.

3. In a feed-water heater, the combination of a cylindrical shell, a pair of tube sheets, a plurality of tubes connecting said tube sheets and co-operating therewith to constitute a tube nest, one of said tube sheets being of smaller diameter than the shell so as to permit the tube nest to be slid longitudinally into the shell, a main head removably attached to the shell with a seat receiving the smaller tube sheet and having chambers for effecting the circulation of the feed water through the tubes, a secondary head at the other end of the shell for maintaining communication of the tubes with each other, a plurality of rotary cleaners having driving shafts rotatably mounted in the main head and having bodies lying within the tubes for scraping the walls thereof, said main head having a chamber on its outer side, a plurality of pinions carried by said shafts, and a driving gear meshing with the pinions for driving the same, all of said gearing being located in said chamber, said main head including a guard covering said gear and pinions, means for rotating said gear, and means for circulating a heating medium through the shell and around the tubes.

4. In a feed-water heater, the combination of a cylindrical shell, a pair of tube sheets, a plurality of tubes connecting said tube sheets and co-operating therewith to constitute a tube nest, one of said tube sheets being of smaller diameter than the shell so as to permit the tube nest to be slid longitudinally into the shell, a main head removably attached to the shell with a seat receiving the smaller tube sheet, and having a wall spaced from the sheet, said wall having a transverse web seating against the smaller tube sheet and dividing the space between the head and sheet into two chambers communicating with the interior of the tubes, said head having an inlet opening communicating with one of said chambers and an outlet opening communicating with the other chamber to enable feed water to be circulated through said tubes, a secondary head secured to the other end of the shell and maintaining communication between the tubes at that end of the shell, a baffle plate extending transversely across the interior of the shell with one end disposed against the larger tube sheet, said baffle plate being shorter than the interior of the shell, said shell having an inlet opening and an outlet opening at the end thereof adjacent the secondary head and co-operating with the said baffle plate to circulate steam to and fro through the shell and around the said tubes.

5. In a feed-water heater, the combination of a cylindrical shell, a pair of tube sheets, a plurality of tubes connecting said tube sheets, disposed in circumferential rows around the axis of the shell and co-operating with the tube sheets to constitute a tube nest removable from the shell, a main head removably attached to the casing having a seat receiving one of said tube sheets and being divided into chambers for effecting the circulation of the feed water through the tubes, a secondary head at the other end of the shell for maintaining communication of the tubes with each other, said main head having a chamber on its outer side, a plurality of rotary cleaners having driving shafts rotatably mounted in the main head and having bodies lying within the tubes for scraping the walls thereof, an outer set of pinions carried by said shafts and disposed circumferentially about the axis of the shell to correspond with the arrangement of said tubes, a driving gear, a second set of pinions arranged circumferentially about the driving gear and meshing with the other pinions to drive the same, means for rotating said gear, and means for circulating a heating medium through the shell and around the tubes.

6. In a feed-water heater, the combination of a cylindrical shell, a pair of tube sheets within the shell, a plurality of tubes connecting said tube sheets, a main head removably attached to the casing having a seat receiving the adjacent tube sheet and having ducts for effecting circulation of the feed water through the tubes, a secondary head at the other end of the shell for maintaining communication of the tubes with each other, a plurality of rotary cleaners having driving

shafts rotatably mounted in bearing openings in the main head, and having scrapers lying within the tubes for scraping the walls thereof, the said scrapers being of small enough diameter to enable any driving shaft and its scraper to be pulled outwardly from its corresponding tube to enable the tube and the bearing opening in the main head corresponding to the shaft, to be plugged, pinions carried by said shafts, means for driving said pinions to rotate the cleaners, and means for circulating a heating medium through the shell and around the tubes.

7. In a feed-water heater, the combination of a cylindrical shell, a plurality of tubes disposed circumferentially about the axis of the shell, a main head and a secondary head secured to the ends of the shell and co-operating to effect circulation of the feed water through the tubes, a plurality of cleaners having shafts rotatably mounted in the main head and having scrapers received in the tubes, said shafts being circumferentially disposed about the axis of the shell as a center and registering with the said tubes, pinions carried respectively by the shafts, a center gear, pinions connecting the center gear with the first named pinions to enable the center gear to drive the pinions, means for rotating the center gear, and means for circulating steam through the shell and around the tubes.

8. In a feed-water heater, the combination of a cylindrical shell, an outer set of tubes disposed circumferentially about the axis of the shell, an inner set of tubes disposed circumferentially about the axis of the shell, a main head and a secondary head secured to the ends of the shell and co-operating to effect circulation of the feed water through the tubes, and a plurality of cleaners having shafts rotatably mounted in the main head and having scrapers received in the tubes, said shafts being circumferentially disposed about the axis of the shell as a center and registering with said tubes, an outer set of pinions and an inner set of pinions corresponding to the sets of tubes, carried by the shafts, the pinions corresponding to the inner set of tubes meshing with the pinions corresponding to the outer set of tubes, a center gear meshing with the inner set of pinions for driving the same, means for rotating the center gear, and means for circulating steam through the shell and around the tubes.

In testimony whereof, I have hereunto set my hand.

HERMAN J. STERNBERG.