(No Model.) 3 Sheets—Sheet 1.

B. F. FIELD.

SELF PURIFYING SUPERHEATING STEAM GENERATOR.

No. 488,519. Patented Dec. 20, 1892.

Fig. 1.

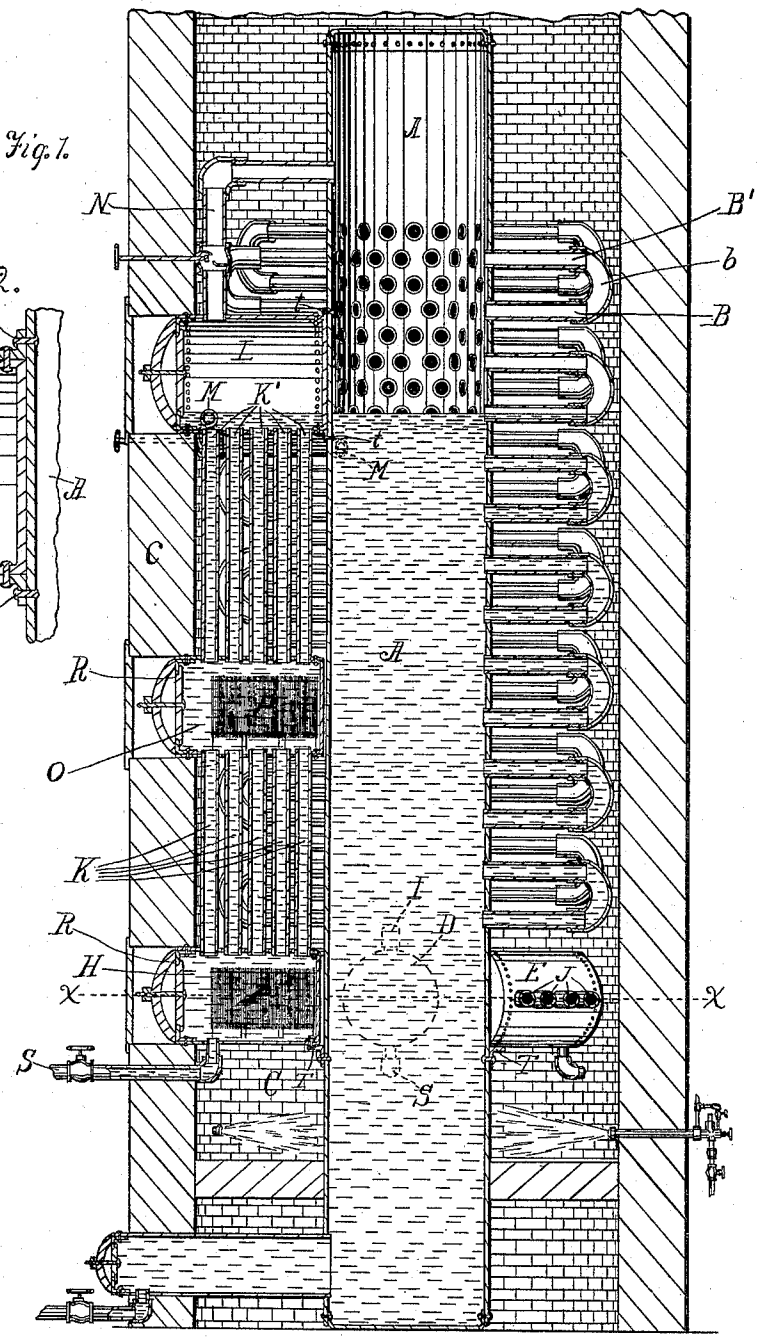
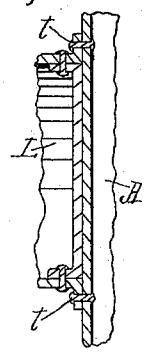


Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

B. F. FIELD.

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No. 488,519. Patented Dec. 20, 1892.

Fig. 3.

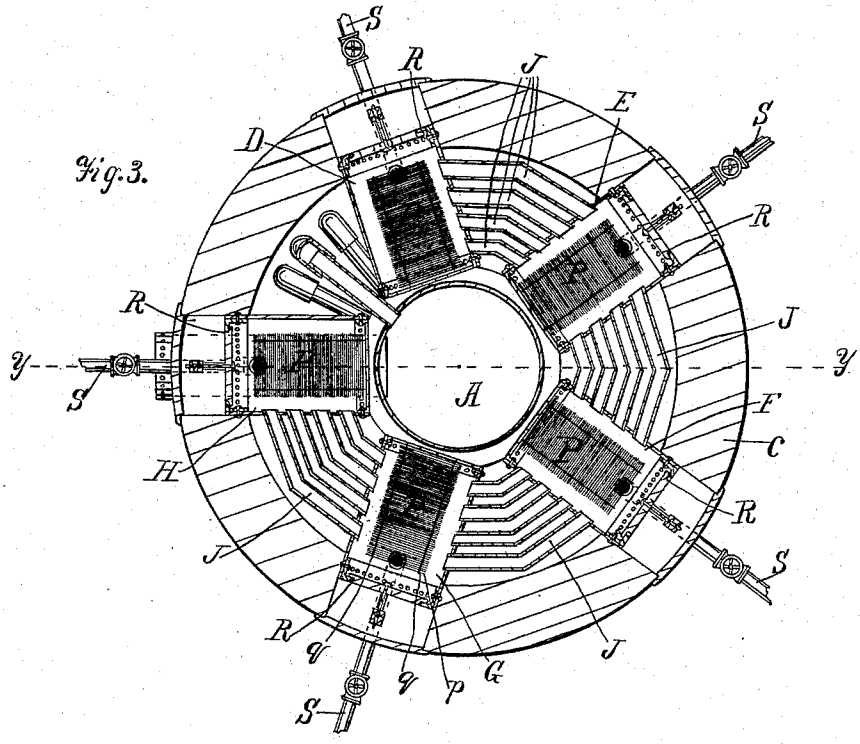

Fig. 4.

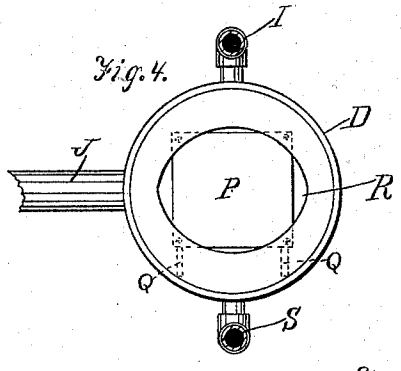

Fig. 5.

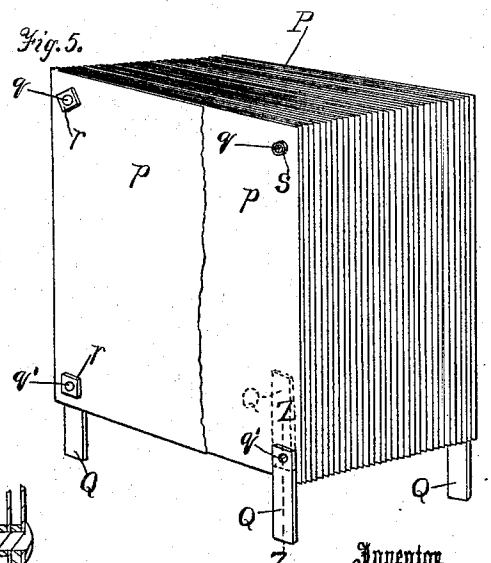

Fig. 6.

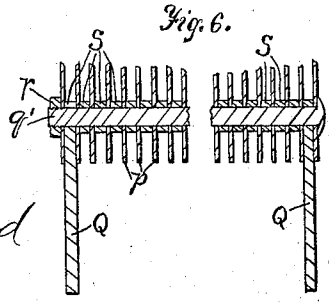

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Fig. 7.

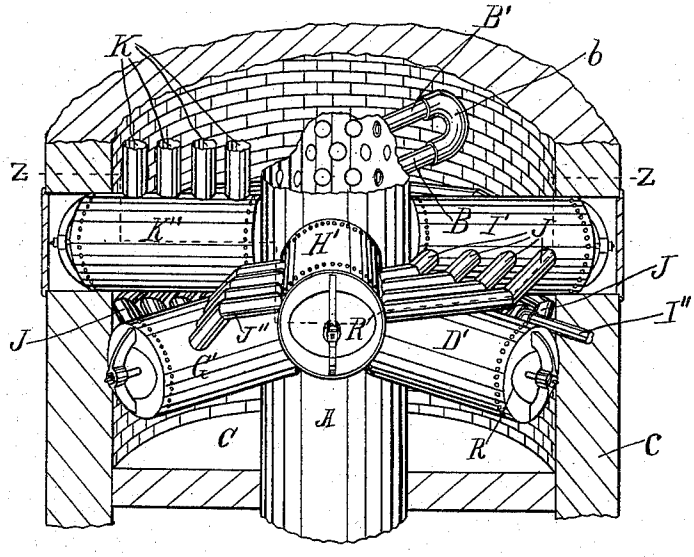
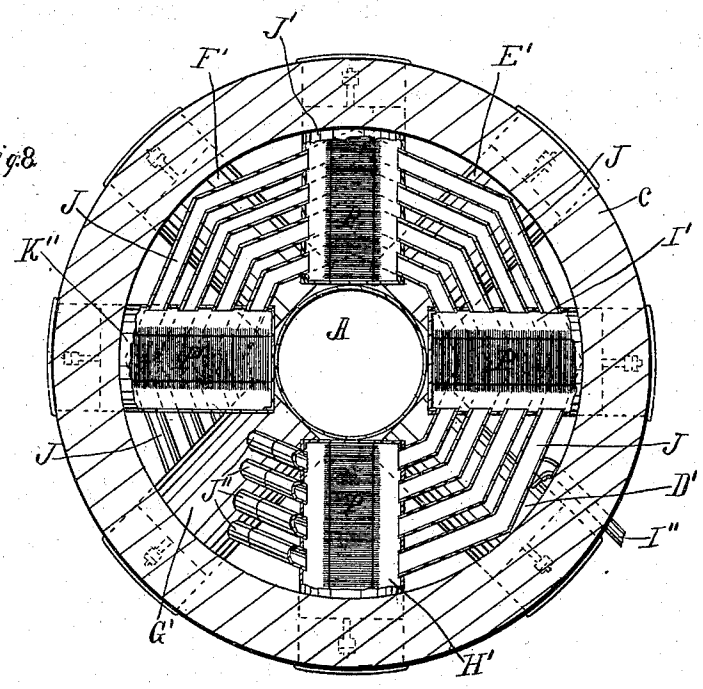


Fig. 8.



Witnesses.

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UNITED STATES PATENT OFFICE.

BENJAMIN F. FIELD, OF CHICAGO, ILLINOIS.

SELF-PURIFYING SUPERHEATING STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 488,519, dated December 20, 1892.

Application filed February 23, 1892. Serial No. 422,381. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN F. FIELD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Self-Purifying Superheating Steam-Generator, of which the following is a specification.

My invention relates to that class of steam-generators provided with numerous tubes in which the water or the water and steam are heated and of which steam generators, the porcupine or radial-tube boiler is a type. In such generators, as heretofore constructed, great difficulty has been encountered by reason of the liability of the tubes to become covered with scale whenever refractory water is used in the boiler.

The object of my invention is to provide a steam generator of this class which will prevent the scale-forming substances contained in the feed-water from entering the main body of the generator and the tubes thereof.

It is my purpose in this invention to collect the scale upon suitable scale-collecting surfaces arranged for this purpose at points easy of access and where the accretions of scale will not seriously impair the efficiency of the generator. In steam-generators of the ordinary construction, the heat causes the water to rise from the bottom to the top of the boiler, thus carrying the impurities of the feed-water to every immersed part of the boiler and tubes.

My invention embraces the combination in a steam generator of means for superheating the water, arranged at the lower part of the generator; scale-collecting devices arranged at the lower part of the generator and means for preventing the water or steam from rising to the upper part of the generator until it has been fully acted upon by the superheater.

One of the important features of my invention consists in providing means within the generator arranged to prevent the water and steam from rising to the upper part of the generator until the water has become superheated and has deposited its impurities upon suitable scale-collecting surfaces arranged at the lower part of the boiler to receive such deposit.

Another feature consists in the combination in a steam-generator, of the furnace, the main body of the generator arranged to receive the heat of the furnace, inter-communicating chambers or drums arranged in horizontal series to receive heat from the furnace, and communicating at one end of the series with the feed-water, and at the other end of the series with the main body of the generator near the water-line.

It also comprises the combination of the furnace, the main body of the generator, such series of inter-communicating chambers or drums, a water-line chamber communicating with such inter-communicating chambers and arranged in the furnace to extend above and below the water-line, a steam-pipe leading from above the water-line in such chamber to the steam-space of the main body of the generator, and a water-pipe leading from below the water-line in such chamber to below the water-line in such main body.

It also comprises other features and combinations of parts hereinafter more particularly set forth.

The accompanying drawings illustrate my invention applied to a vertical radial-tube steam-generator.

Figure 1 is a vertical mid-section of a vertical radial-tube steam-generator embodying my invention. Line *y*—*y* Fig. 3 indicates the line of section. Fig. 2 is a detail fragmentary view showing the water-line chamber secured to the main body of the generator. Fig. 3 is a horizontal section on line *x*—*x* Fig. 1. Fig. 4 is an end view of one of the inter-communicating chambers with the manhole open to expose the scale-collecting plates or sheets. Fig. 5 is a perspective view of a bundle of such sheets. Fig. 6 is a sectional detail of the same. Fig. 7 is a perspective view of another arrangement of the lower inter-communicating chambers, showing eight chambers arranged in two horizontal planes and in alternating positions around the main body of the generator. Fig. 8 is an irregular section through a portion of the top series of such chambers and through the main body of the generator. Line *z*—*z* Fig. 7 indicates the line of section.

A indicates the main body of the generator, which in this form is vertical.

B indicates the radial tubes projecting from the boiler into the furnace.

C indicates the furnace.

D, E, F, G, H indicate the lower horizontal series of drums or chambers.

I indicates the feed-water pipe entering the first chamber D of the series.

J, J, indicate pipes arranged to connect the chambers of the lower horizontal series.

K, K′ indicate tubes or pipes arranged to connect the last chamber H of the horizontal series with the water-line chamber L which communicates with the main body A of the generator through the water pipe M (opening below the water-line from the water-line chamber L into the main body A.) and through the steam-pipe N arranged above the water-line to connect the water-line chamber with the main body.

O is an intermediate chamber arranged intermediate the tubes K K′ between the horizontal series and the water-line chamber to collect impurities which may pass the horizontal series of chambers and the connecting pipes J.

P, P, indicate bunches or bundles of scale-collecting plates of sheet iron or other suitable metal arranged within the scale-collecting chambers.

For convenience of handling, the plates *p* are secured together by rods *q* passed through the plates and nuts *r* screwed on such rods: small washers *s* are arranged upon the rods and inter-posed between the plates to hold them about a quarter of an inch apart.

Q, Q are legs pivoted upon the lower rods *q′* and arranged to serve to support the bundles of plates above the bottom of the chambers. It is designed to insert the bundles of plates into the chambers and remove them therefrom through the manholes R and in order that this may be done, the legs may be turned up as indicated in dotted lines in Fig. 5. The plates and bundles as shown are of such size that they must be turned edgewise to pass them through the manhole. It is designed that the area of the exposed surfaces of the plates will be several times in excess of the interior surface of the shell and tubes A B of the main body of the generator.

Each chamber is provided with a suitable blow off pipe S for blowing off the impurities from such chambers.

The water-line chamber L is fixed by means of rivets *t* to the main body A and the other chambers are detached from such main body so that the contraction and expansion of the metal will not wrench the parts. The outer ends of the several chambers are supported by the wall *c* of the furnace and the inner ends of the lower horizontal series of chambers are supported on the brackets or flanges T provided for that purpose and fixed to the shell of the main body of the generator.

In practice the feed-water is introduced into the generator through the feed-water pipe I and passes thence through the several chambers and connecting pipes J of the horizontal series to the vertical pipes K and thence through the pipes K′ into the water-line chamber L, and thence into the main body of the generator. In its passage from the feed-water pipe to this point the water has become heated to a very high degree and the scale forming impurities have become separated from the water and attached to the plates, the chambers and the connecting pipes. The horizontal arrangement of the lower series of chambers and their connecting pipes J prevents the water from ascending to the top of the generator until it has become thoroughly heated to a high degree, passing alternately through the large chambers through which it passes with slight current, and then through the pipes J through which it passes with a greater current and where it is more rapidly heated than it is within the chambers. The ascending tubes K, K′ are respectively arranged above the chambers H and O and so do not receive the direct heat of the flame. The bundles of plates in H and O are in the path of the water passing into and through such pipes and the ebullition is but slight until the water reaches the chamber L at which point it is practically pure and to a large extent expands into steam. A portion of it, however, flows down through the water pipe M into the main body of the generator and into the radial tubes B, B′ which project from the body of the generator into the furnace and are arranged in pairs one above the other and which communicate with each other through a return elbow or bend *b* connecting the outer ends of the tubes. The upper tube B′ of each pair is in a degree protected from the direct heat by its lower tube B which is directly beneath it so that the heat upon the lower tube is sufficiently greater than that upon the upper tube to induce a circulation of water therethrough. Periodically the manholes R are opened and the plates are removed and cleaned at leisure, clean plates being substituted for them in the meanwhile. When the plates are removed preparatory to substituting new, an operator enters the chambers and removes from them and from the connecting pipes and tubes the scale which has collected thereon. The chambers and connecting tubes and pipes are made of such size as to enable the cleansing to be done conveniently.

In Figs. 7 and 8 the two horizontal series of chambers are arranged to receive a greater proportion of the direct heat of the flame than is received by the horizontal series shown in Fig. 3. In these figures the several chambers of the horizontal series are lettered D′, E′, F′, G′, H, I′, J′ and K″ and the feed-water pipe is lettered I″. The pipes J″ connect the last chamber G′ of the lower series with the first chamber H′ of the next series. The pipes J J J″ which connect the several chambers of the horizontal series are arranged to enter the chambers at right angles thereto and are straight throughout except that they are bent midway of their length so as to admit of

ready cleansing by tools inserted from the chambers.

The chambers are made as small as will conveniently admit the operator for building and cleaning them.

Now having described my invention, what I claim as new and desire to secure by Letters Patent is,

1. In a steam generator, the combination set forth of means for superheating the water arranged at the lower part of the generator; scale-collecting plates arranged at the lower part of the generator, and means for preventing the water or steam from rising to the upper part of the generator until it has been fully acted upon by the superheater.

2. In a steam generator, the combination of the furnace: the main body of the generator arranged to receive the heat of the furnace: inter-communicating chambers arranged in horizontal series to receive heat from the furnace and communicating at one end of the series with the feed water, and at the other end of the series with the main body of the generator near the water-line, and the series of scale-collecting plates arranged within such chambers substantially as and for the purpose set forth.

3. In a steam generator, the combination of the scale-collecting plates; the rods passed through such plates; the washers arranged upon such rods between such plates; the legs Q pivoted upon the lower rods q' q' and the nuts screwed upon such rods.

4. In a steam generator, the combination set forth of the metal plates; the rods q connecting such plates; the washers s arranged upon such rods between such plates; and the nuts r screwed upon such rods.

5. In a steam generator, the combination set forth of the furnace; the vertical main body A of the generator; the inter-communicating scale-collecting chambers arranged in horizontal series within the furnace; the water-line chamber fixed to and communicating with the main-body of the generator and extending above and below the water-line: the tubes K, K′ connecting the water-line chamber with the horizontal series of chambers; the intermediate chamber arranged intermediate the tubes K, K′; scale-collecting plates arranged in the intermediate chamber and in the chambers of such horizontal series; and the feed-water pipe communicating with the first chamber of such series.

6. In a steam generator, the combination of the furnace; the main body of the generator; the feed-water pipe; a series of chambers arranged in the furnace intermediate the main body of the generator and a series of scale-collecting plates arranged within such chambers and having a combined scale-collecting surface several times in excess of the heating area of the shell and tubes of the main body of the generator.

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