(No Model.) 3 Sheets—Sheet 1.

G. ENGEL.

SECTIONAL STEAM BOILER.

No. 496,153. Patented Apr. 25, 1893.

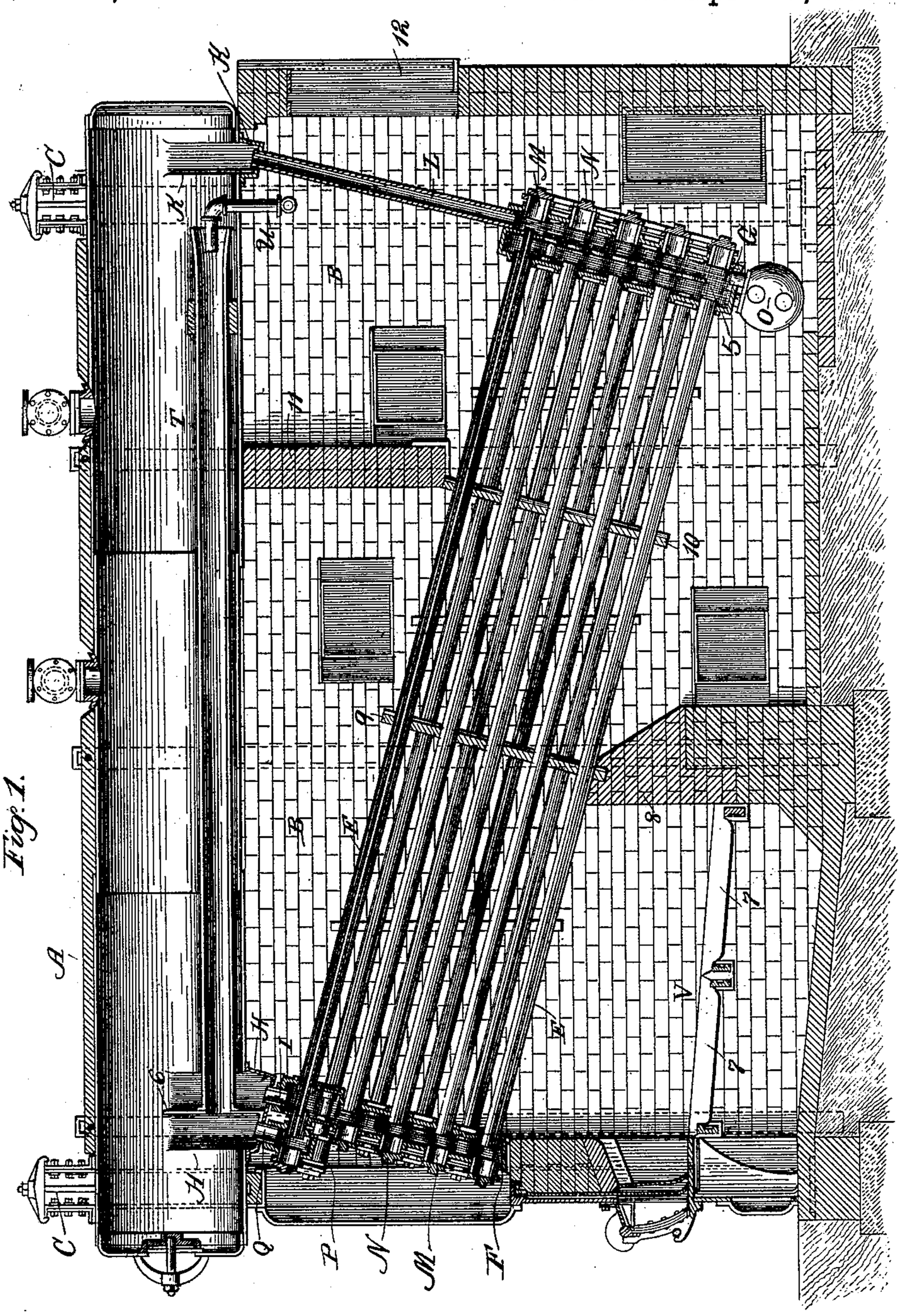

Fig. 1.

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(No Model.)

3 Sheets—Sheet 2.

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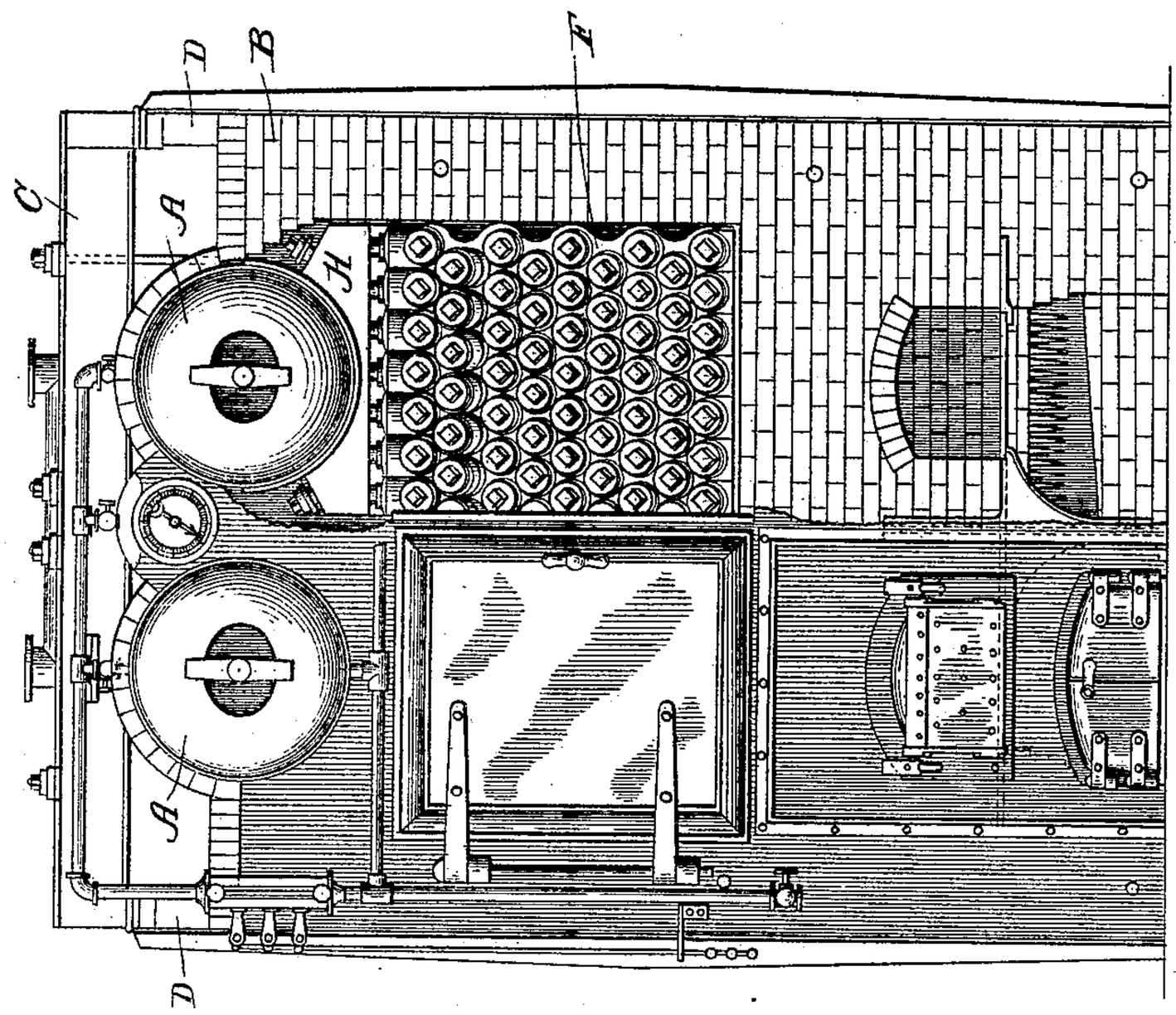

Fig. 2.

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(No Model.)

3 Sheets—Sheet 3.

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Fig. 3.

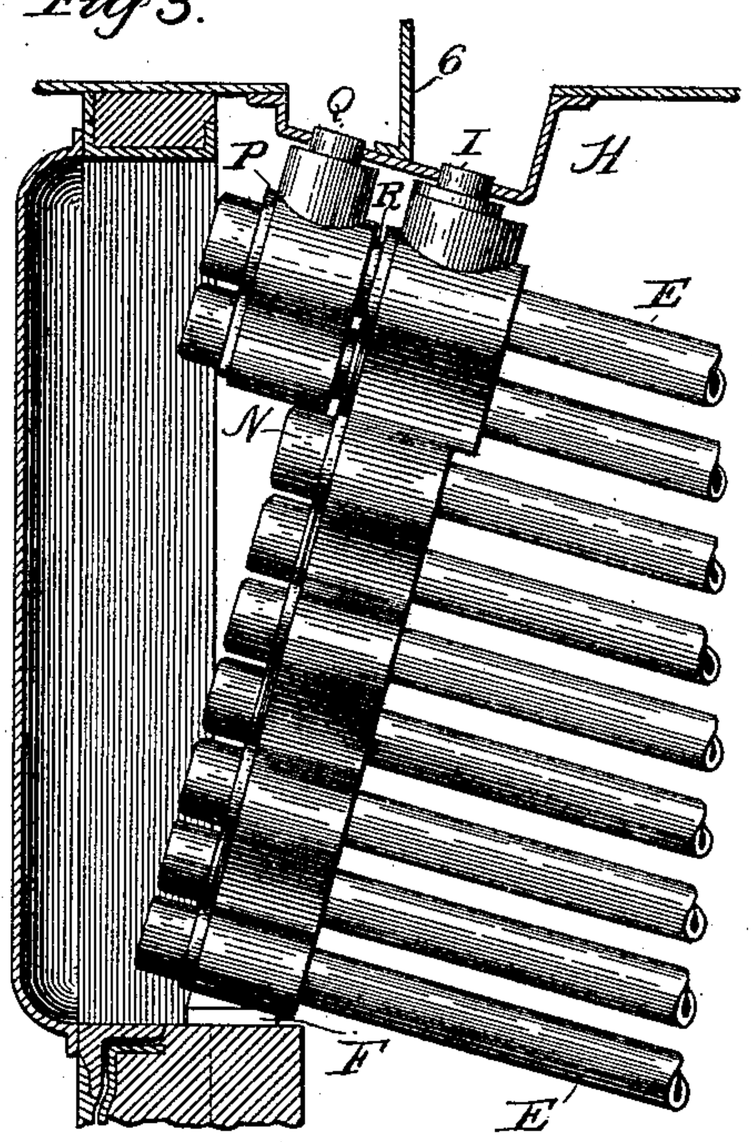


Fig. 4.

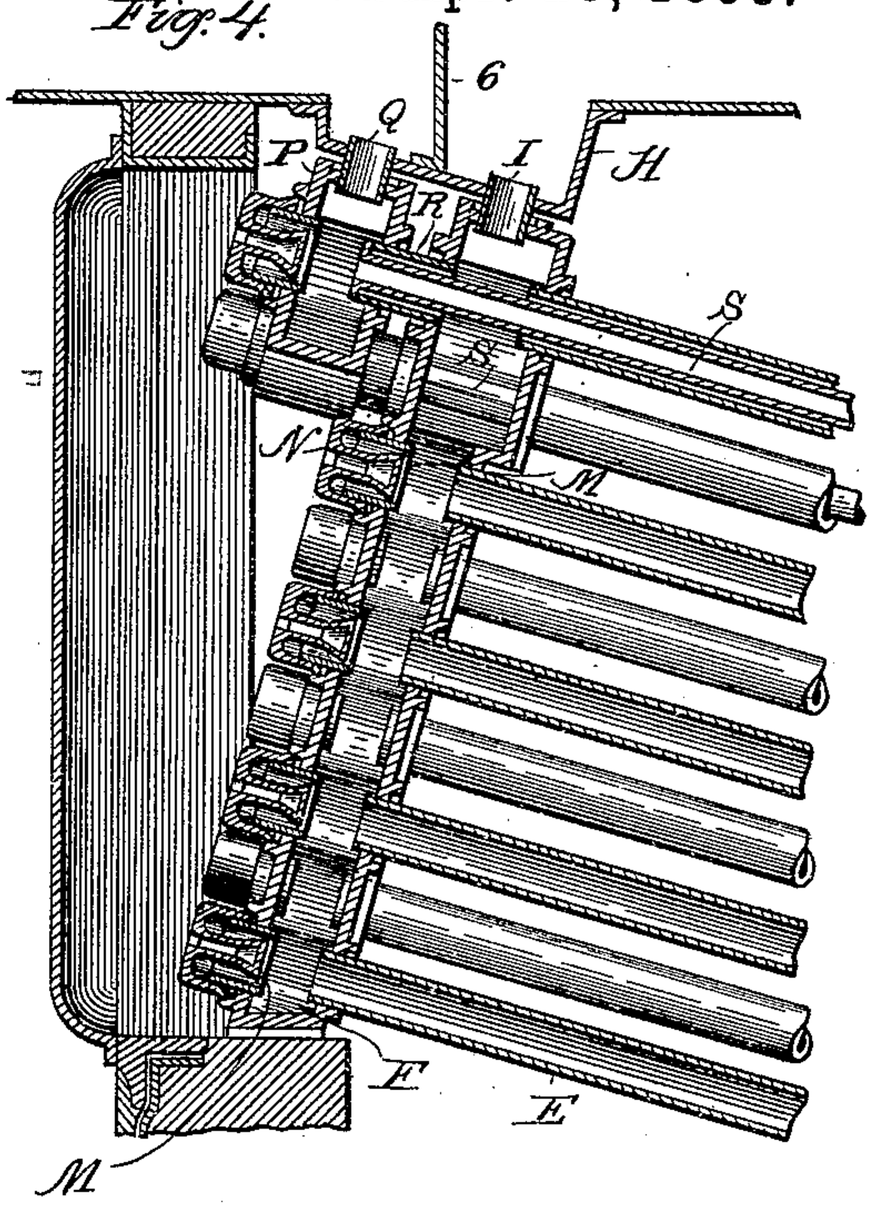


Fig. 5.

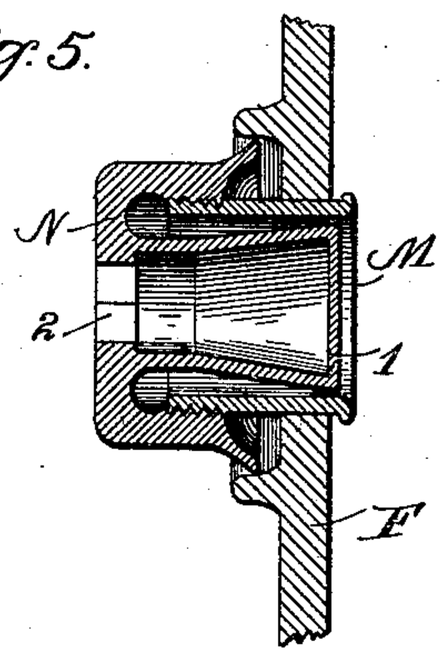
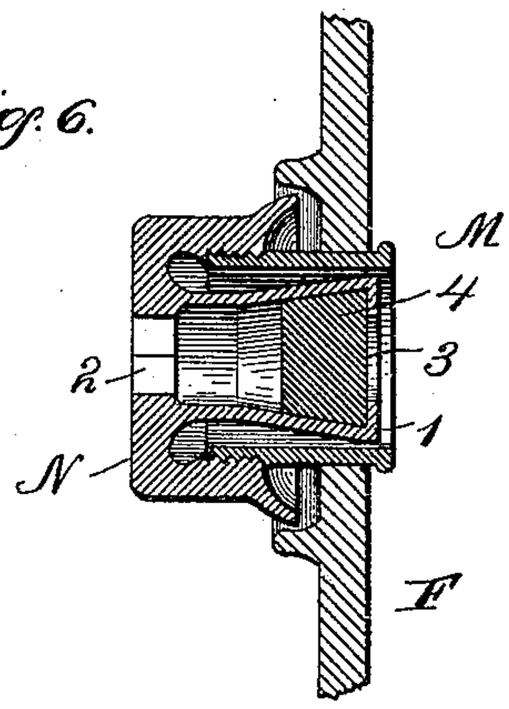


Fig. 6.



Witnesses.
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H. M. Marble

Inventor.
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UNITED STATES PATENT OFFICE.

GODFREY ENGEL, OF SOUTH BALTIMORE, MARYLAND.

SECTIONAL STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 496,153, dated April 25, 1893.

Application filed November 21, 1892. Serial No. 452,719. (No model.)

To all whom it may concern:

Be it known that I, GODFREY ENGEL, a citizen of the United States, residing at South Baltimore, in the county of Anne Arundel and State of Maryland, have invented certain new and useful Improvements in Sectional Steam-Boilers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to boilers and to that class of sectional steam boilers in which a horizontal steam and water drum is suspended over a suitable furnace, and inclined generating tubes are arranged in series under said drum, being connected with the drum by suitable pipes or headers, so that water from the drum circulates through these inclined generating tubes, around which the furnace gases are caused to pass on their way to the stack; and my invention relates particularly to a method of securing a more thorough and efficient circulation of the water within such boilers, and it consists in the novel means employed for thoroughly heating the feed water of the boiler before it is permitted to mingle with the main body of water contained within the steam and water drum, in the means employed for causing a rapid circulation of the water within the boiler, and in the means employed for producing a thorough precipitation and deposition of all sediment carried by or incrusting salts held in solution in the feed water, into a suitable mud drum.

The objects of my invention are: first, to provide means for insuring a more efficient and thorough circulation of the water contained in boilers of the class above mentioned, thereby increasing their efficiency, promoting regularity in action, and preventing priming; second, to provide for the introduction of feed water into the boiler in such a manner that it may become thoroughly heated before it is brought into contact with the water within the steam and water drum, thereby avoiding the dangerous and troublesome local stresses due to feeding cold water directly into such steam and water drum, as is quite commonly the practice with boilers of this class, without the use of a separate feed water heater; third, to insure the thorough precipitation and deposition within a suitable mud drum of all sediment, solids, and incrusting salts contained within the water, so that incrustation of the generating tubes may be avoided. These objects are attained in the boiler herein described and illustrated in the drawings which accompany and form a part of this application, in which the same reference letters and numerals indicate the same or corresponding parts, and in which:—

Figure 1 is a vertical longitudinal section of a boiler embodying my improvements. Fig. 2 is a front end view of a double drum boiler, the iron front on the right half of the boiler being broken away so as to show the brick setting of the boiler, the headers which connect the inclined generating tubes with the steam and water drum, and the saddle-shaped box with which the headers are directly connected. Fig. 3 is a detail side elevation of the front headers and generating tubes, showing particularly the auxiliary headers to which the circulating tubes, to be hereinafter mentioned, are connected, and showing the means employed for closing the apertures in the fronts of the headers. Fig. 4 is a similar view, in which, however, the headers are shown as sectioned vertically. Fig. 5 is a sectional view showing the screw-cap and nipple closure which I adopt in this boiler for closing the apertures in the fronts of the headers. Fig. 6 is a similar view showing a modification in the screw-cap used by which I am able to use a fusible plug in connection with the screw-caps, which will fuse in case of overheating of the tubes and headers and relieve the pressure in the boiler, thus preventing accident.

In the drawings, A is the horizontal steam and water drum, of which in Fig. 2 there are two.

B is the brick setting of the boiler.

The drum A is hung from suitable girders C, C, extending transversely across the boiler, which girders may rest on the brick setting B, or, as is more commonly the case, may be supported from columns D, D, walled in within the brick setting. Below the steam and water drum A are the inclined generating tubes E, E, which are so placed, as will be seen, that the furnace gases circulate around and between these tubes on their way to the stack.

These tubes are arranged in vertical series, the alternate tubes of each series being staggered, as shown in Fig. 2, and all the tubes of each vertical series are expanded into apertures of a zig-zag header which is common to them all. There are two of these headers for each vertical series of tubes, one at the front of the boiler, lettered F, and another at the rear of the boiler, lettered G. The construction and arrangement of these headers are the same as that of a type of boilers commonly in use, and known as the Babcock and Wilcox type, so that no particular description of these headers is here necessary.

To the bottom of the steam and water drum A, at a point opposite the tops of the front headers, is attached a saddle shaped box H, which is placed in communication with the interior of the drum A either by cutting away or by perforating the shell of the drum at the point of connection of the saddle. To this saddle the headers F, F, are connected by pipe-nipples I, shown in Figs. 1, 3, and 4, the pipe-nipples being expanded into apertures in the saddle and headers.

To the rear end of the drum A, at a point opposite the tops of the rear headers, G, is secured a saddle K, similar to the saddle H, and the rear headers are connected to this saddle, and so to the drum A, by means of nearly vertical pipes L, which are likewise expanded into apertures of the headers G and saddle K. By means of these pipe-nipples I and pipes L the front and rear headers and the generating tubes are suspended from the drum A, care being taken in erecting the boiler that these tubes and headers do not come in contact with any portion of the boiler setting, so that all the parts of the boiler may be free to expand and contract with changes of temperature.

In the front faces of the headers F, and in the rear faces of the headers G, at points opposite the ends of the generating tubes E, E, are apertures so situated as to permit of access to the generating tubes for the purpose of cleaning and repairs. Into these apertures are expanded pipe-nipples M, M, having an internal diameter somewhat greater than the external diameter of the generating tubes, and these pipe-nipples are closed by screw-caps N, N. These screw-caps and nipples, together form what are in effect plugs for closing the openings in the headers. Inasmuch as the nipples are somewhat larger than the generating tubes E, E, it is possible through these nipples to gain access to the tubes for the purpose of cleaning or for removing defective tubes and replacing others. Screw-caps of the ordinary character may be used for closing the nipples, as shown in Fig. 1, but I prefer to use a special form of screw-cap shown in Fig. 5, or the modified form shown in Fig. 6. This form of screw-cap has an inwardly extending portion 1, having a length substantially the same as that of the nipple which the screw-cap closes, and with a closed end of a diameter nearly as great as that of the nipple. This inwardly extending portion is preferably hollow, as it is then not only lighter, but more able to withstand changes of temperature. In the outer end of the screw-cap is a square hole, 2, into which may be inserted an end wrench when it is desired to tighten or loosen the screw-cap. The advantage derived by using this form of screw-cap with the inwardly extending portion 1 is that by this means the inner surface of the header is kept practically smooth, so that there are no depressions tending to form eddies, which will obstruct the circulation, or in which dead water may collect. Still another important advantage of this form of screw-cap is that it admits of the ready introduction of fusible plugs into the headers of sectional boilers, a screw-cap provided with a fusible plug being shown in Fig. 6, in which the end of the inward projection 1 of the screw-cap has in it an aperture 3, while within this inward projection 1 and closing the aperture 3 is a plug, 4, of some fusible alloy, which will fuse at a temperature higher than that of the steam at the pressure at which it is designed to use the boiler, but lower than that at which the parts of the boiler begin to weaken to a dangerous degree. In boilers of the sectional class, because of the small amount of water contained within the steam-and-water drum in proportion to the area of heating surface, considerable changes in the water level of the boiler occur with comparatively great rapidity. If, then, the boiler does not receive the proper attention the water level is liable to fall below the limit of safety, and overheating of the generating tubes and headers occurs. By the use of this fusible plug 4 inserted in the screw-cap N, however, I remove all danger of explosion due to overheating of the headers and generating tubes, inasmuch as before the headers and tubes can have become so overheated as to be in a dangerous condition, these fusible plugs will melt and allow the escape of the steam within the boiler, at the same time giving the attendant warning of the dangerous condition of the boiler. It will likewise be observed that the form of the screw-cap and the position of the fusible plug within it are such that the furnace gases do not come in contact with the surface of the fusible plug. This is important, as it frequently happens where furnace gases are permitted to come into contact with the fusible plugs of boilers, that the physical characteristics of the metal are so altered that its melting point is raised to a very considerable degree, and it ceases to afford any security whatever.

Within each rear header, G, is a partition, 5, extending from the top of the header nearly to the bottom. This partition is perforated, at points opposite the ends of the generating tubes, to correspond with the openings in the end of the header, so that access may be had through these openings to the tubes. These openings in the partition may if desired be

closed by plugs, or in any other suitable way, though it is not necessary that the openings be closed tightly, or even that they shall be closed at all, since the partition merely serves the purpose of aiding circulation.

Below the rear headers G, and communicating with them by suitable pipe-nipples, is a mud drum, O, of suitable construction. This mud drum is suspended from the rear headers by the pipe-nipples which connect it with the headers, and does not come in contact with the boiler foundation. Suitable hand-holes, not shown, are provided for removing the sediment which collects in this mud drum.

The saddle H is divided into two chambers by a vertical transverse partition 6. Where the shell of the drum A is cut away to place the saddle in communication with the drum, as shown in Figs. 3 and 4, this partition is preferably riveted to the saddle, and extends up into the drum A to a point above the normal water level. Where, however, the shell of the drum A is merely perforated instead of being cut away, as described above, the partition 6 may be most readily cast with the saddle, and within the drum is placed another partition, forming practically a continuation of the partition 6, and rising, as before, to a point above the normal water level. Where it is desirable in order to secure strength of the saddle casting, there may be cast in it webs, either transverse or longitudinal, or both, connecting and tying together the walls of the saddle.

The rear portion of the saddle H is connected to the headers F by pipe-nipples I, as before stated. In front of the headers F is another series of headers, P, which are connected to the front portion of the partition H by pipe-nipples Q, which are expanded into the headers P and saddle H. The headers P and F are connected by pipe-nipples, R, in line with the generating tubes E, E. The openings in the front of the headers P are closed by nipples and screw-caps, as with the openings in the headers F.

Through the generating tubes E, E, which correspond to the apertures in the headers P, P, are inserted inner tubes, S, S, which may be termed circulation tubes. These circulation tubes extend from the headers P, through the pipe-nipples R, headers F, and through the generating tubes E to and through the apertures in the partitions 5 of the rear headers G, thus connecting with the spaces behind the partitions. The front ends of the circulation tubes S, S, are provided with flanges which prevent the tubes from sliding down through the tubes E, and at the same time prevent water from passing from the headers P directly to the headers F. It is not necessary that the joint between the tubes S and the nipples R be absolutely water tight, since all that is necessary is that enough water shall not leak through to interfere with the circulation of the boiler.

Extending lengthwise of the drum A is a large circulation pipe T, connected at its front end to the partition 6, which is apertured at this point. The pipe is supported at the rear end by a collar riveted to the bottom of the shell of the drum A, and fitting loosely over the pipe, so that expansion and contraction of the latter are not impeded. Into the rear end of the pipe T runs a pipe U, through which the feed water is admitted to the boiler. The feed water passes through this pipe T into the space in front of the partition 6, and then downward through the pipe-nipples Q and headers P into the circulation tubes S, S, then into the headers G, and around the bottom of the partition 5 into the generating tubes E, and thence upward through these tubes into the headers F and then through the pipe-nipples I into the steam and water drum A. The rear end of the pipe T is open, so that the colder water in the drum A will likewise pass into this pipe T, mixing with the feed water as it does so, and will circulate with the feed water in the manner just described; and not only is the efficient circulation of the water within the boiler thereby assured, but there is no danger that when the feed water is shut off the circulation tubes S, S, and the generating tubes E, E, through which they run, will become overheated.

V is the boiler furnace, 7 the grate bars, and 8 the fire wall. The products of combustion pass upward from the grate bars and are then caused by a fire wall 11 to pass downward between baffle-plates 9 and 10 supported by the tubes E, and then up again, passing out through the flue 12 to a suitable stack.

The operation of my boiler is as follows:—When the fire is started upon the grate bars 7, the water contained within the generating tubes E becomes heated, and circulation commences, the heated water within these tubes rising into the headers F, and then into the steam and water drum A. To replace the heated water which has thus risen water from the rear of the drum A will flow downward through the pipes L into the rear headers G, and around the bottoms of the partitions 5 in those headers, into the pipes E, and then, becoming heated, this water will rise still farther into the headers F, and in this way the circulation will continue. At the same time water from the drum A, mingled with the feed water if any water is being fed into the boiler, will pass into the pipe T and then into the headers P, through the circulation tubes S into the rear headers G, and then around the partitions 5 into the tubes E, and up into the drum A. It will be seen that the two currents of water unite without conflicting in any way. By this means I secure a very rapid circulation, resulting in a very uniform and rapid heating of the water. For this reason the temperature of the water and the pressure of the steam may be raised very rapidly without danger of straining the boiler through the unequal expansion of its parts. When feed water is admitted through the pipe U into

the pipe T, it travels along said pipe, mixing with the colder portion of the water in the drum A, which naturally tends to collect within this pipe, and passes into the headers P, then into the circulation tubes S, through the tubes S into the headers G, thus passing through the hottest furnace gases, so that the feed water is heated very rapidly indeed. As the water thus becomes heated it tends to deposit any sediment or incrusting salts which it contains, but inasmuch as the water flows with considerable rapidity through these pipes S the sediment will not lodge within these pipes, but is carried along by the current into the headers G, and there settles into the mud drum O, none of the sediment being carried up into the pipes E. It is in this respect that this boiler differs from other boilers of its class, which depend for their circulation upon tubes corresponding to the tubes L in the rear portion of my boiler, and the feed water is admitted to the steam and water drum in such a manner that it passes almost immediately into these pipes L, and thence downward into the rear headers and up into the inclined generating tubes, and so back to the steam and water drum. It is intended that in passing downward through the pipes L the feed water will become so heated, inasmuch as the furnace gases pass around and between these tubes L, on their way to the stack, that all sediment and incrusting salts carried by the water will be deposited before the water passes into the inclined generating tubes, and will so collect in the mud drum. But in practice it is found that since the furnace gases by the time they reach the pipes L are comparatively cold the feed water is not sufficiently heated by the time it reaches the rear headers G to deposit all or more than a portion of such sediment and incrusting salts, the remainder of this sediment and incrusting salts passing with the water into the tubes E, where, since the water there becomes highly heated, all of this matter is deposited. But in order to reach the mud drum this sediment must now move in a direction contrary to that of the currents of water in the tubes E, which it cannot do to any considerable extent, so that the sediment accumulates in these tubes, and by the action of the fire is baked upon the inner surfaces of the tubes, thus not only obstructing the circulation within the tubes, but tending to resist the passage of heat through the sides of the tubes to the water therein, and thus lowering the efficiency of the boiler.

In my boiler I rely principally for circulation upon the circulation tubes S, and might entirely dispense with the tubes L, the number of circulation tubes S being proportioned so as to afford all the circulation required by the boiler. But in boilers of this type it is important that the tubes, headers, and mud drum shall swing clear of the boiler foundation and setting, so that they may be free to expand and contract with changes of temperature, and for this reason I retain the tubes E, the principal function of which in this boiler is merely to support the rear ends of the tubes E, the headers G, and the mud drum O, and the purpose of causing water from the drum A to circulate through these tubes is primarily to prevent overheating and consequent wasting away of these tubes, the part which they play in the circulation of the water within the boiler being only incidental. For this reason the pipes L may with advantage be made smaller than the tubes E, and smaller than it is customary to make them in other boilers.

Having thus completely described the construction and operation of my improved boiler, what I claim, and desire to secure by Letters Patent, is—

1. In a sectional steam boiler, the combination with a steam and water drum, inclined generating tubes arranged below said drum, and headers connecting the ends of said tubes and communicating with the steam and water drum, of circulation tubes connected at their upper ends with the steam and water drum and communicating at their lower ends with the headers at the lower ends of said generating tubes, and adapted to conduct the feed water from the steam and water drum downwardly over the grate to the headers at the lower ends of the generating tubes, substantially as described.

2. In a sectional steam boiler, the combination, with a steam and water drum, inclined generating tubes arranged below said drum, headers connecting the ends of said tubes and means for connecting the headers at the upper ends of said generating tubes with the steam and water drum, of circulation tubes communicating at their lower ends with headers at the lower ends of the generating tubes at their upper ends, and adapted to conduct the cold water from the steam and water drum over the grate to the headers at the lower ends of the generating tubes and auxiliary headers connecting the circulation tubes with the steam and water drum, substantially as described.

3. In a sectional steam boiler, the combination, with a steam and water drum, inclined generating tubes arranged below the said drum and headers connecting the ends of said generating tubes, of means for connecting the headers at the upper ends of said tubes with the steam and water drum, the auxiliary headers P, and the circulation tubes S connecting therewith and likewise communicating with the lower ends of said generating tubes, substantially as described.

4. In a sectional steam boiler, the combination, with a steam and water drum A, inclined generating tubes E, headers G connecting the lower ends of said tubes, headers F connecting the upper ends of said tubes and communicating with the drum A, of the auxiliary headers P likewise communicating with the steam and water drum, and the inclined cir-

culation tubes S communicating with said headers P and likewise connecting with the said headers G, substantially as described.

5. In a sectional steam boiler, the combination, with the steam and water drum A, the inclined generating tubes E, headers G connecting the lower ends of said tubes, and headers F connecting the upper ends of said tubes and communicating with said steam and water drum A, of the auxiliary headers P likewise communicating with said steam and water drum, and circulation tubes S inclosed within certain of said tubes E, communicating with said headers P and likewise communicating with headers G, substantially as described.

6. In a sectional steam boiler, the combination, with a steam and water drum A, inclined generating tubes E, arranged below said drum, and headers F connecting the upper ends of said tubes and communicating with said steam and water drum A, of headers G connecting the lower ends of said tubes, partitions 5 within said headers G and means for admitting the colder water from the drum A in rear of said partitions and near the tops of the headers, whereby the water is caused to pass down and around said partitions, substantially as described.

7. In a sectional steam boiler, the combination, with a steam and water drum A and inclined generating tubes arranged below said drum, and communicating therewith, of headers G connecting the ends of said tubes and partitions 5 within said headers and perforated to admit of access to the tubes, substantially as described.

8. In a sectional steam boiler, the combination, with a steam and water drum A, inclined generating tubes E arranged below said drum, and headers F connecting the upper ends of said tubes and communicating with the drum A, of headers G connecting the lower ends of said tubes and provided with partitions 5, auxiliary headers P likewise communicating with the drum A, and circulation tubes S communicating with said headers P, and likewise communicating with the spaces behind the partitions 5 in the headers G, substantially as described.

9. In a sectional steam boiler, the combination, with a steam and water drum, inclined generating tubes arranged below the same, headers G connecting the lower ends of said tubes and headers F connecting the upper ends of said tubes, of a vertical partition 6 within said drum A, means for connecting said headers F to the space in rear of said partition, auxiliary headers P, circulation tubes S communicating with the headers P and likewise communicating with the headers G, means for connecting said headers P with the space in front of the partition 6, and means for admitting feed water to the space in front of said partition 6, substantially as described.

10. In a sectional steam boiler, the combination, with a steam and water drum A, inclined generating tubes E, headers G connecting the lower ends of said tubes and headers F connecting the upper ends of said tubes, of a vertical partition 6 within said drum A, means for connecting said headers F to the space in rear of said partition, auxiliary headers P communicating with the space in front of said partition, circulation tubes S communicating with said headers P and likewise communicating with said headers G, a circulation pipe T extending lengthwise of the drum A and communicating with the space in front of said partition, and a feed water pipe U communicating with said pipe F, substantially as described.

11. In a sectional steam boiler, the combination, with a steam and water drum A, inclined generating tubes E, headers G connecting the lower ends of said tubes, a vertical partition 6 within said drum A, means for connecting said headers F with the space in rear of said partition, auxiliary headers P, means for connecting said headers P to the space in front of said partition 6, circulation tubes S communicating with headers P and likewise communicating with said headers G, a circulation pipe T extending lengthwise of the drum A, and communicating with the space in front of said partition 6, a feed water pipe U communicating with said pipe T, and tubes L connecting the drum A with the headers G and supporting the said headers, substantially as described.

12. In a sectional steam boiler, the combination, with a steam and water drum, generating tubes arranged below the same, and headers connecting the said tubes with the steam and water drum, of apertures in the said headers opposite the ends of said generating tubes, nipples M secured in said apertures, and screw-caps N for closing said nipples provided each with an inwardly projecting boss having substantially the diameter and length of of the nipples, substantially as described.

13. In a sectional steam boiler, the combination, with a steam and water drum, generating tubes arranged below the same, and headers connecting said tubes with the said steam and water drum, of apertures in the external surfaces of said headers opposite the ends of said tubes, nipples M secured in said apertures, screw-caps N for closing said nipples, each provided with an inwardly extending boss 1, a recess 3 in the interior of said boss provided with passages communicating with both the interior of the header and with the external air, and a plug of an easily fusible alloy or metal for closing one of said passages, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

GODFREY ENGEL.

Witnesses:
W. N. WARMSLEY,
WM. H. JONES.