C. E. EMERY.

3 Sheets--Sheet 1.

Steam-Boilers.

No. 165,990.

Patented July 27, 1875.

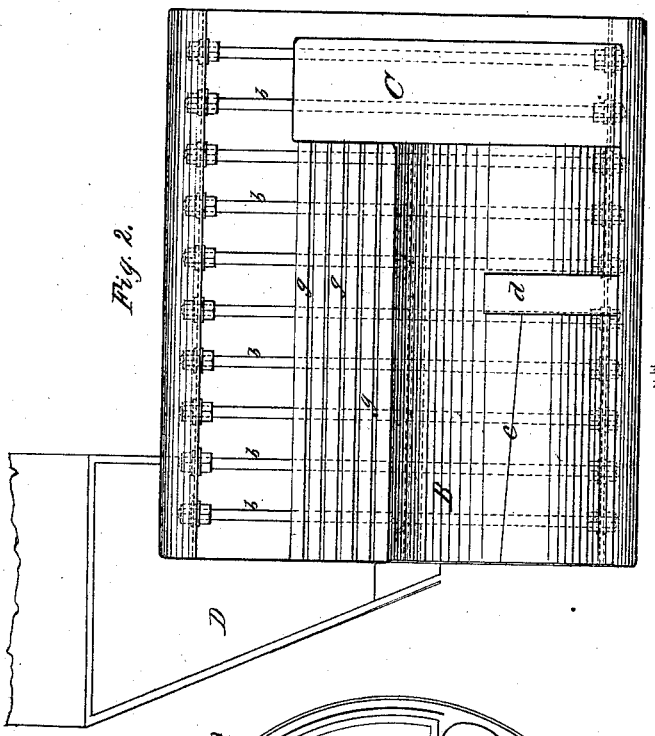

Fig. 2.

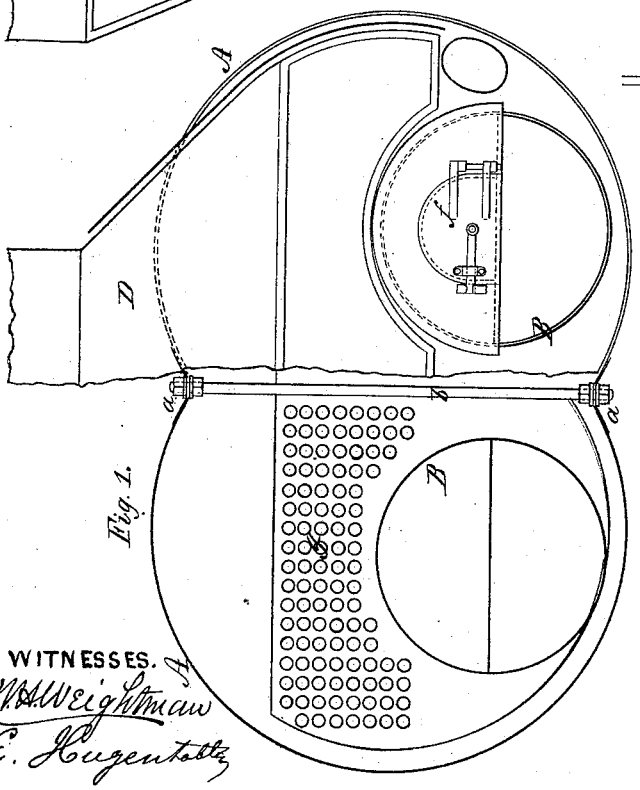

Fig. 1.

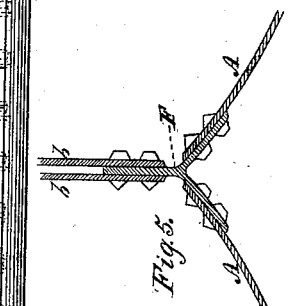

Fig. 5.

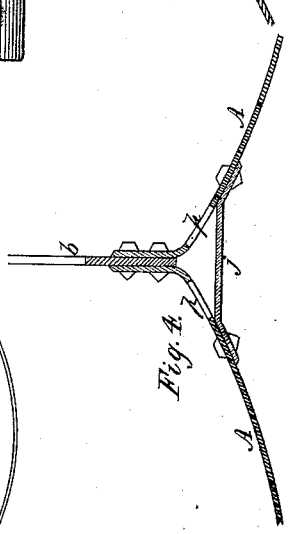

Fig. 4.

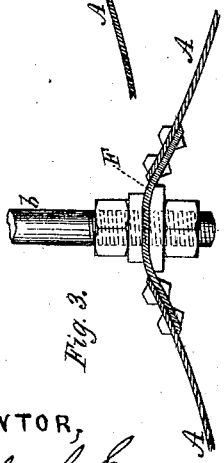

Fig. 3.

WITNESSES.

W. A. Weightman

E. Hugentobler

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3 Sheets--Sheet 2.

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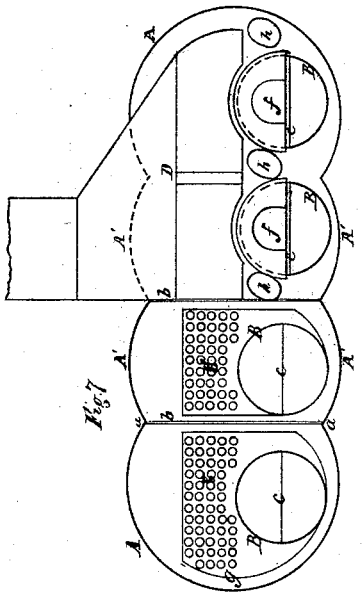

Fig. 7

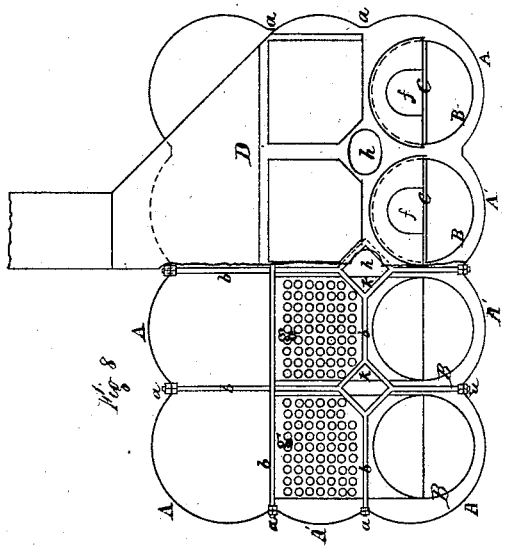

Fig. 8

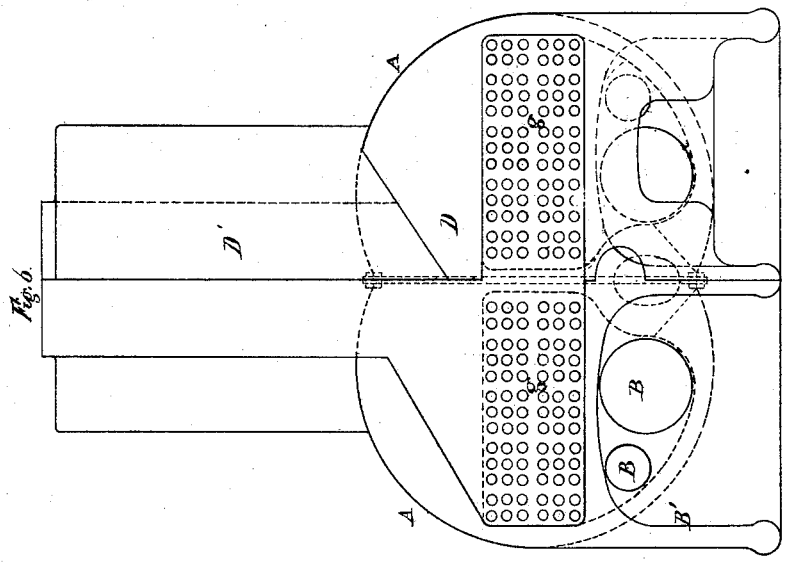

Fig. 6.

Witnesses;
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3 Sheets--Sheet 3.

C. E. EMERY.

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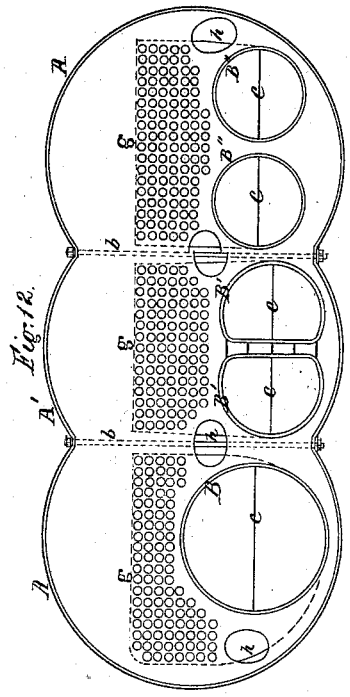

Fig. 12.

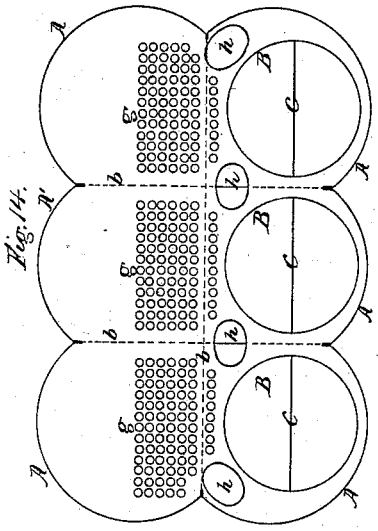

Fig. 14.

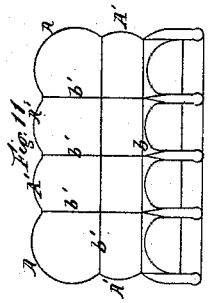

Fig. 11.

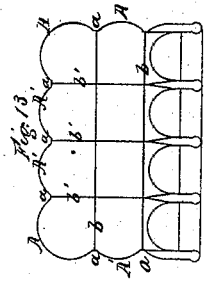

Fig. 13.

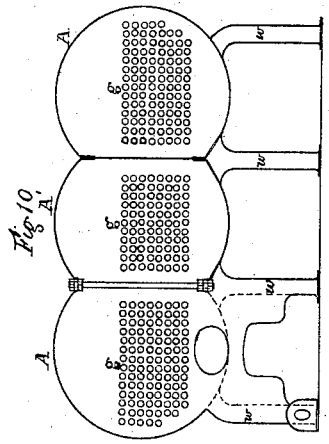

Fig. 10.

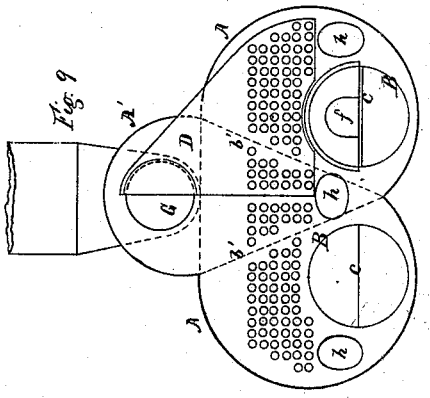

Fig. 9.

Witnesses;
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E. Hugentabler

Inventor;
Chas. E. Emery

UNITED STATES PATENT OFFICE.

CHARLES E. EMERY, OF BROOKLYN, NEW YORK.

IMPROVEMENT IN STEAM-BOILERS.

Specification forming part of Letters Patent No. **165,990**, dated July 27, 1875; application filed April 9, 1874.

To all whom it may concern:

Be it known that I, CHARLES E. EMERY, of Brooklyn, Kings county, New York, (office New York city,) have invented certain new and useful Improvements in Steam-Boilers; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, making part of this specification, in which the same letters refer to corresponding parts.

The object of the invention is to construct steam-boilers of great strength, with the minimum amount of small stays or braces, and in such form as to occupy less room, for a given power, than ordinary cylindrical boilers; also, to obtain, when desirable, a large boiler of moderate height. The object is accomplished by constructing the boiler so that cross-sections of the same will consist of a number of segments of a circle, inclosing, in some instances, rectangular or other shaped spaces, with bracing disposed to support the ends of the arcs.

The general principle of construction is, that the strain transferred to the end of an arc of a circle, when such arc is subjected to pressure, either internal or external, may be resolved into two or more forces—for instance, one acting along the chord of the arc, and the other at right angles thereto; and the construction and arrangement of the parts of the boiler are such that usually the several components of the resolution will be balanced by opposite forces from other arcs, so transferred that the resultant thereof will be opposed to and balance the strain or thrust at the end of the original arc. A mathematical discussion of the principles involved in such combinations, showing various modifications of proportions admissible with safety, will be found in the original specification of this invention, filed in the United States Patent Office, to which, with accompanying diagram, reference is maded.

The nature of the invention is clearly set forth in the claims.

In the drawings, Figure 1 represents, in part, a vertical end elevation, and, in part, a vertical cross-section of a boiler constructed in accordance with one form of the first part of my improvement; and Fig. 2 represents a longitudinal section of same.

A A represent the boiler-shell, made, as shown, in two parts, the section of each being a segment of a circle greater than a semicircle. The two segments are united at *a a* (the termination of the arcs) and the two opposite junctions are tied together by stays *b b*. Within each portion or lobe of the shell thus formed is arranged a furnace-flue, B, in which grate-bars *c* and a bridge-wall, *d*, are placed. A fire-door, *f*, is located in a casting, closing the upper part of the furnace-front. The furnace-flues connect at the rear to the back connection C, and from the upper part of the back connection, above and partially on the sides of the furnaces, the fire-tubes *g g* are carried to the boiler-front. The products of combustion from the furnaces B′ pass over the bridge-wall *d*, through back connection C and tubes *g g*, to any suitable front connection or casing D, connecting to the chimney. The steam formed occupies most of the space above the tubes, as is usual.

It will be observed that the boiler described has the height only of the diameter of each portion, and that, with the two segments united, as shown, the internal capacity of boiler is greater than could be obtained in the same space and height by using a number of boilers with circular shells. Moreover, the arrangement of the heating-surfaces is the same as has been found best suited for marine boilers—that is, the products of combustion first pass to the rear and are returned through horizontal tubes arranged above the furnaces. This insures a tolerably equable distribution of heat and circulation of water in all parts of the boiler, exposes the ends of the tubes for cleaning through front connection-doors, and permits the collection of the escaping gases from a number of boilers in one central chimney.

Fig. 6, Sheet 2, shows a front view, partly in section, of a modification, in which a double segmental ∞-shaped shell is joined to an ordinary rectangular fire-box containing two furnaces, B′ B′. The construction will be understood from the general statement that the flames from furnaces B′ B′ pass through direct flues B B, arranged in lower parts of segments, to a back connection, and from thence through tubes *g g*, &c., above the flues and

furnaces to a front connection, D, the same as in Figs. 1 and 2; but in this case the discharge to the smoke-pipe is shown through the flue of a steam-chimney, D′.

By separating laterally the two portions of the shell A A, Fig. 1, and inserting shorter segments, the width of the boiler may be increased indefinitely without increasing the height. Fig. 7, Sheet 2, shows a combined front view and cross-section of a boiler embodying this modification; the corresponding side view would resemble Fig. 2. A A represent the longer segments, and A′ A′ the shorter ones. All are united together, and stays *b b* put across to tie together the ends of the arcs, as shown. The shorter arcs A′ A′ inclose two additional portions or lobes of the boiler, in each of which is arranged a furnace and return-tubes similar to those in the outer lobes.

The size of furnaces and number of tubes may, if desirable, be modified to suit the area available in the different lobes.

To give access to furnace-crowns, man-holes may be inserted in convenient portions, as is usual.

In Fig. 7 the furnace-flues are placed at unequal distances from the two outer lines of braces *b b*, so that men can enter through man-holes *h h* and reach the furnace-tubes in next lobe through the spaces between the braces.

If desired, however, the flues may be put centrally between the braces, and the return-tubes arranged closely around same to obtain more heating-surface.

In Fig. 7, as well as many of the other figures, the furnaces are shown of a circular form, which saves the complicated system of furnace-crown braces and bars necessary in many cases; and it will be observed, also, that there is a considerable saving of space by using circular furnaces in a boiler with segmental sections, as compared with a number of circular shells, for in the latter there must be much waste space in the spandrels or angles between the circles.

In constructing boilers of this kind care must be taken in securing the ends of the arcs to each other and the connecting-braces.

Figs. 3, 4, and 5, Sheet 1, show, in cross-section, three different plans of making these junctions. In Fig. 3 the two parts of shell are united by a heavy trough-shaped plate, F, called by me a "spandrel," from the shape of the space between the lobes. The two side flanges of this spandrel F are riveted to the respective edges A A of shell, and the cross-bracing fastened to center of spandrel by using, preferably, through-bolts *b b*, with nuts on both sides of the sheet bearing on washers of suitable shape, the outer washers being made long to distribute the bearing. These bolts *b b* run from one junction across the boiler to the one opposite, as shown in Figs. 1 and 2.

This joint is particularly well adapted when the sheets it is desired to connect make quite an obtuse angle with each other. The edges of the spandrel are calked to secure tightness.

Another plan (shown in Fig. 4) is to flange inward the ends of the sheets A A, and rivet same to a tie-plate, *b*, which is extended to the opposite junction. In this case the edges of the plates are calked to secure tightness; or, preferably, a covering-plate, *j*, is placed outside the joint across the angle, riveted to sheets and edges of same, calked. The covering-plate *j* acts also as a tie to prevent the joints between plates A A and the tie-plate *b* from opening, as the rivets securing same cannot be brought out sufficiently to take the direct strain.

When the covering-plate *j* is employed, narrow slots or openings *p p* are preferably made through the shells A A, to admit the boiler-pressure to the inclosed triangular space.

Another plan, (shown in Fig. 5,) a modification of that shown in Fig. 3, is to make the connection with a T-bar, F, the two opposite flanges of same being riveted to the sheets A A, as shown, and the single part to the braces or plates *b b*. When the stays *b b* are made of plates, openings are cut through them to permit water and steam communication between the several parts of the boiler. To save the strength as much as possible the openings are made long and narrow. The rectangular section, or that which gives the maximum capacity in a given space, may be approximated very closely by making the arcs with smaller relative radii than for those previously described, and using two or more vertical and horizontal lobes. Fig. 8, Sheet 2, shows a combined front view and cross-section of such an arrangement. In this case circular furnace-tubes B B B are arranged in the lower lobes, the tubes in the spaces inclosed by the next higher side lobes, and the steam-space in the upper lobes. The ends of the arcs are all stayed to the corresponding junctions on the opposite side, and the products of combustion pass through the boiler in the same manner as in the other boilers described. In order to get into the boiler at the spandrels between the furnaces, the cross and vertical braces may connect to the braces *k*, arranged in lozenge form, which, if constructed so that the lengths of diagonals are proportioned to the strain on braces in line with same, the structure will retain its form under pressure. Fig. 14, Sheet 3, shows a front view of a boiler two lobes in height, with furnaces and a few tubes arranged in lower lobes, and the remaining tubes and the steam-room in the upper lobes. The arrangement of furnace-tubes and heating-surfaces in any of the boilers described may, of course, be varied greatly; for instance, instead of a horizontal fire-tubes, tube-boxes containing ordinary water-tubes may be arranged in the same relative position and combination.

The principal features of construction above described may also be utilized when the press-

ure is applied to the outside of the arcs. Fig. 12, Sheet 3, shows a cross-section of a multiple-segment boiler, with two central segmental furnaces, B′ B′—that is, the two contiguous sides of the furnace-tubes are flattened, and stayed to each other through a separating water-space, and if the strut-braces *l l* at the ends of the arcs be of sufficient strength the thrust of one arch will be balanced by that of the other, and the structure be as stable as though the flues were complete circles. By this means a furnace of larger capacity than a circular one can be put in substantially the same space. Evidently shorter arcs may be placed between the longer ones, in the same manner as was described for the boiler-shells, and the structure be extended laterally at will. In such cases the shell-braces may, if desired, be carried through the separating water-spaces. This form of furnace may, however, be placed inside any form of boiler-shell.

Fig. 12 is intended to show, also, that the size and number of the circular furnaces may be varied at will, there being in one lobe a single circular furnace, B, and in another a pair of circular furnaces, B″ B″.

Fig. 13, Sheet 3, shows a vertical cross-section of a multiple-segment boiler, in which the sides of the furnaces are extended downward to form water-legs. The furnace-arches being semicircles, they have no lateral thrust, and the vertical thrust is met, for the outer sides of outer furnaces, by connection to the adjacent side junctions or equivalent positions, and the other points are supported by the braces *b′ b′*, which are forked at their bottoms, and attached to the sides of the furnaces, the top ends being led to the upper junctions of the arcs of shell. If desired, the braces *b′* may be extended to the bottom of legs.

It is not necessary that the crowns be complete semicircles. They may be any arc, provided, on principles above set forth, the outer furnaces be carried around to the line joining the center of all the arches, as shown in cross-section in Fig. 11, Sheet 3.

Fig. 10, Sheet 3, is a cross-section, and in part a front view, of a boiler on the multiple-segment system, with three lobes, two, A A, being each greater than a semicircle, and one, A′, less than a semicircle; the peculiarity being that the furnaces are placed underneath the shells, between water-walls *w w*, riveted to the shells, the water-spaces being connected by narrow slits in the shells, of insufficient size to reduce the strength materially. The flames from the fuel on the grates pass under the shells to a back connection, and thence through return-tubes *g g*, arranged in the lower part of the shells, to a front connection, as usual.

On the principles above discussed it is possible to make strong boilers in a great variety of shapes suited to location.

Fig. 9, Sheet 3, shows a combined front and sectional view of a boiler, designed so that its sides will come under the deck of a small vessel, but a higher central steam-chamber will project through a hatch amidships. As shown, there are two lower larger lobes, A A, containing each a furnace, B, and return-tubes *g g*, which lobes are capped by a single lobe, A′. The braces *b′ b′* connect the lower junction with the two upper ones, and the tendency to straighten the top arc, after making due allowance for the inclination of the braces *b′ b′*, is counteracted by a cross-brace, *b*, proportioned to the remaining strain. In such a boiler, if desired, the gases, after passing to the front connection D, may be returned through a flue, G, in the steam-space to the main chimney D′ at the rear of the boiler, and thus form a superheater. This plan also admits of extension laterally by multiplying the lobes.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A boiler with section, consisting of two or more segments braced by connections to the ends of the arcs, and provided with direct and return passages for the products of combustion in each portion of the shell, substantially as and for the purposes specified.

2. A boiler-shell with sectional outline of the sides, top, and bottom, composed of a series of connected circular arcs, with cross-braces at junctions, whereby a rectangular or other desired section may be approximated, substantially as and for the purposes specified.

3. A boiler-shell with cross-section formed of connected circular arcs, with braces at junctions, combined with furnaces or furnace-tubes, wholly or partly of circular section, arranged singly or in pairs between the cross-braces, and within the said shell, to secure, with few small braces, strength and adaptability to location, substantially as and for the purposes specified.

4. Two or more furnace-arches, with sections formed in part of circular arcs, connected together by struts at the ends of the arcs, and thus dispensing with the necessity of bracing corresponding portions of contiguous arches to other parts of the boiler, substantially as and for the purposes specified.

5. A trough-shaped plate, combined with the ends of the arcs and the braces supporting the same, substantially as and for the purposes specified.

CHAS. E. EMERY.

Witnesses:
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