

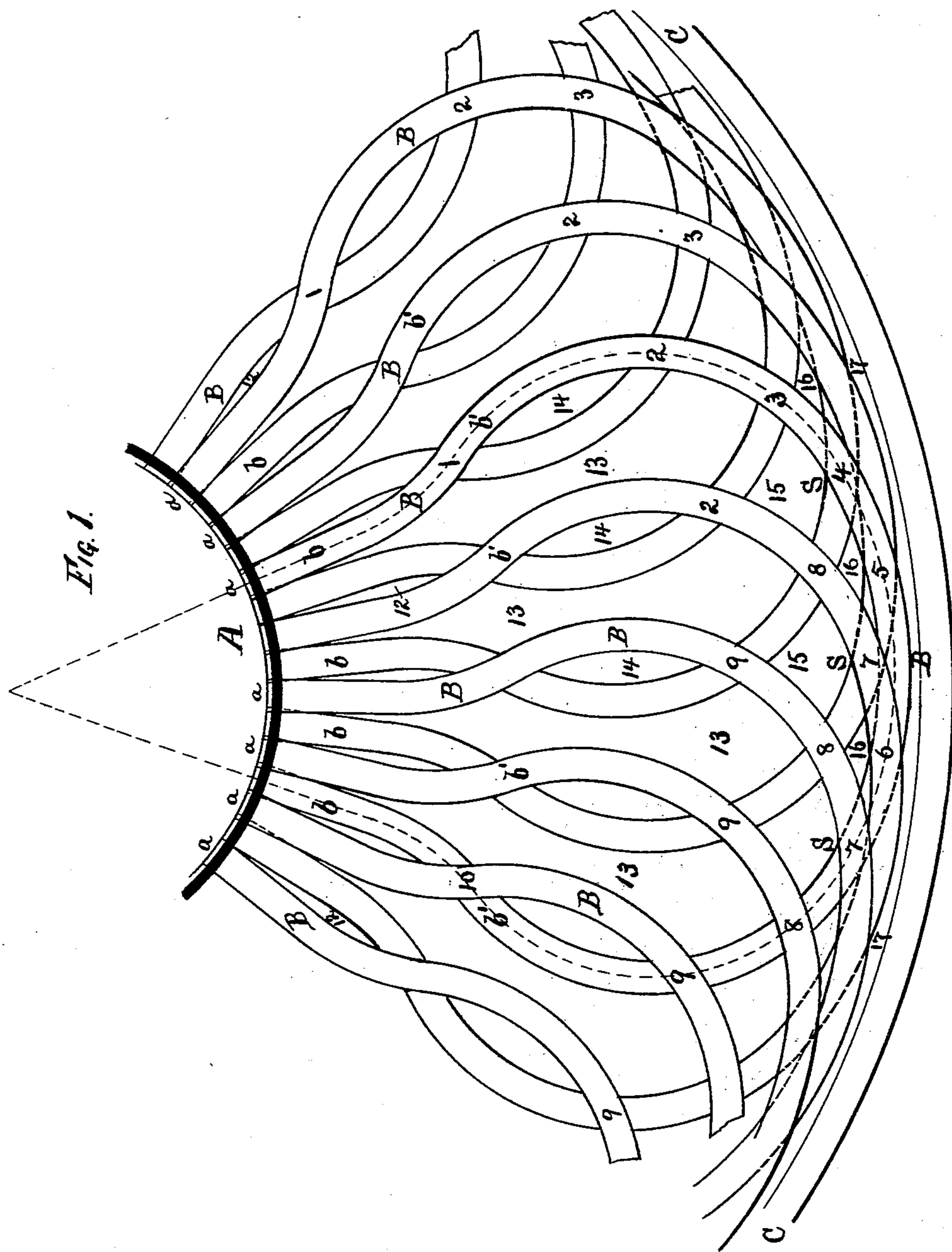
(No Model.)

2 Sheets—Sheet 1.

W. H. WEIGHTMAN.
BOILER AND STEAM GENERATOR.

No. 562,993.

Patented June 30, 1896.



WITNESSES:-

Thos. Toombs
H. Clay Pumprey

INVENTOR:-

Wm. H. Weightman

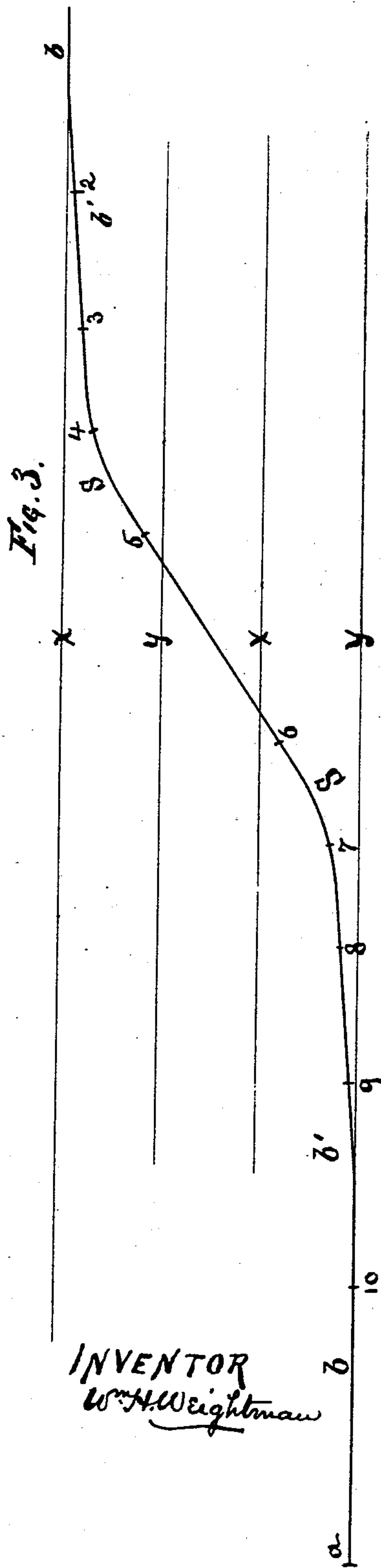
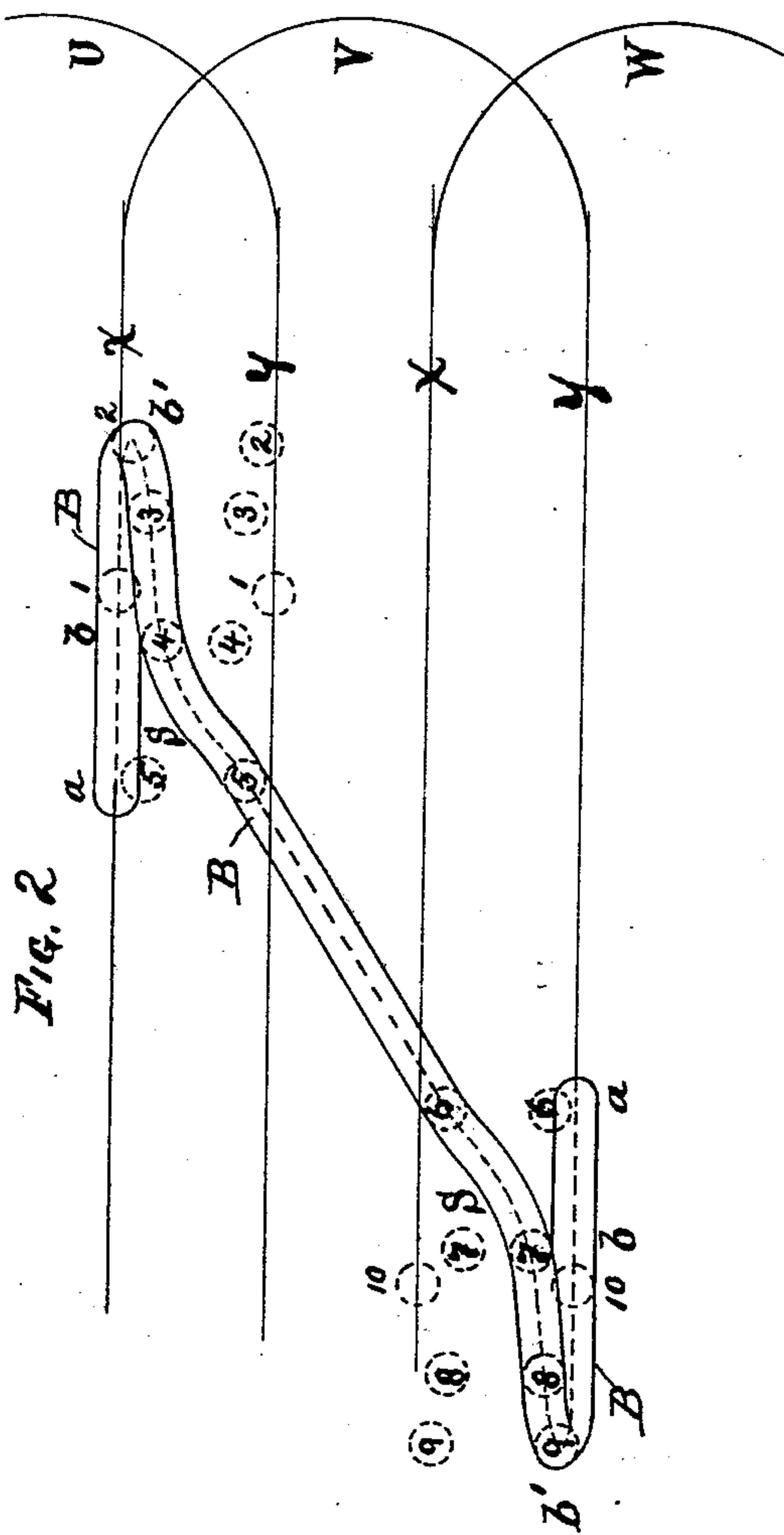
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BOILER AND STEAM GENERATOR.

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Patented June 30, 1896.



WITNESSES:-

Thos. West
H. Clay Trumbull

INVENTOR
Wm. H. Weightman

UNITED STATES PATENT OFFICE.

WILLIAM H. WEIGHTMAN, OF BROOKLYN, NEW YORK.

BOILER AND STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 562,993, dated June 30, 1896.

Application filed February 21, 1896. Serial No. 580,197. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. WEIGHTMAN, a citizen of the United States, residing in Brooklyn, Kings county, and State of New York, have invented certain new and useful Improvements in Boilers and Steam-Generators, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates specially to the improvement of that class of boilers and steam-generators wherein water-tubes project from and return to a central shell, thereby forming a loop, both ends of which are expanded and fastened into holes provided in the body metal of the central shell, through which tube-loop the water circulates while making steam.

The object of my invention is to improve the efficiency and general economy of such boilers by providing a plurality or mass of tubes of such shape, design, bend, and relationship with each other that the following results are accomplished: a readiness and ease of original bending, a freedom of examination, both internal and external, when in place, a readiness of outward cleansing and removal when necessary, a readiness of internal cleansing due to large radial sweeps and reversal of the curves in the proper place, and at the central portion due to the brisk and decided angle of drop and rise, a maximum of passing and re-passing of the tubes to form flue-passages to control the movement and action of the heat and gases as well as an undulating attrition and reaction circulation of the gases and heat of combustion, effecting a maximum exposure of the tube and shell surfaces to the heat for evaporative purposes.

A further object of my invention is to so improve the shape, rise, and bend of the several tubes that an assured and reliable circulation of the contained steam and water will prevail, due to the free movement of the water in its circulation through the curves of large radius and easy reverse bends, also due to the quick drop and rise of the central portion of the tube encouraging the circulation rise of the water as it becomes heated at the lower portion, in the one upward and necessary direction. The curves in the tubes at the ends are made the same, so as to insure

among other things, the reversibility and interchangeability of the tubes. The practical objections to all boilers of this class have been the difficulty of assembling the parts without the aid of a skilled mechanic who has had special training and experience on each individual make of this general type of boiler. This saves the time and labor otherwise consumed in fitting each tube end in its especial position, and obviates the danger of a mistake, which even a skilled mechanic is liable to make. My tube is of such form that any mechanic familiar with the art of putting in boiler-tubes could put these in without any knowledge of the principles or construction of my boiler. Again, the fact of my tubes being reversible and interchangeable does away with the time and labor involved in examining and marking each separate tube so as to determine the proper end to expand in a given hole; and, lastly, should an error occur, as is liable in the ordinary form of tube, and the wrong end of the tube be expanded into the shell it would necessitate the cutting out of the tube and its consequent destruction, also impairing the roundness and general utility of the tube-hole in the boiler-shell, a mistake which the peculiar form of my tube renders it impossible to make.

In the drawings, Figure 1 represents a plan view showing a round central shell with the relative positions of the several tubes, looking from above or below. Fig. 2 represents a side view of one complete single tube and its clearances with reference to passing other tubes, sections of associate tubes being shown in their regulation positions. Fig. 3 represents a developed view of the tube for measurement and construction purposes.

Similar letters of reference designate like parts in all the figures.

Letter A designates the central boiler-shell into which the tubes are expanded at *a a a*, &c.

Letter B designates the loop-shaped tubes, and the crossing-points of the tube as drawn are marked numerically as they occur by figures 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

Letter C designates the casing about the tubes, to confine the boiler proper and the gases of combustion, said casing being lined with fire-brick or non-conducting material

and taking the place of brick walls as used ordinarily for the same purpose.

As may be noticed upon an examination of the accompanying drawings, the several tubes
5 are curved or bent to the same easy shape, radius, and quick angular drop or rise, on each side of the central point M.

The central shell is bored to receive the tubes with holes at zigzag centers to provide
10 for a maximum of tubes and of strength of shell, each row of holes breaking centers with the row above and below. In their extension toward or from the central shell at each end, the tubes have a portion *b* kept preferably
15 true to a radial line from the center of shell, to provide for a ready admission of the tube ends into the shell-holes, and a ready alignment of the tubes with each other when in place. At *b'* an outwardly-extending curve
20 of large radius is made, so that the tubes shall each quickly cross at points 1 and 10 (see Fig. 1) to the right or left of the zigzag rows above and below. They each next have an inward-extending curve of large radius, causing
25 them to recross the same tubes as before at points 2 and 9, forming the gas-passages 14. They each next by this inwardly-extending curve are caused to cross at points 3 and 8 the tubes of associate zigzag holes, above
30 and below, forming the heat and gas passages 13, the outer portion of which is in the larger-size boilers of moderate manhole size, readily permitting any one of ordinary size passing through from top to bottom of boiler.
35 This arrangement and associate relation of the tubes bend the movement of the heat and gases, giving them an undulating movement about the tubes at and near the shell, hindering and overcoming a bad feature of present
40 construction, that of the majority of the heat and gasses passing close to and along the outer walls of the boiler casing or inclosure. The tubes are next caused at S with an easy curve of large radius to drop or rise rapidly
45 and parallel for each half to the center of tube length at M, crossing at reverse sides the upper and lower lines of tubes at points 4, 5, and 6, the several tubes changing places with each other at and between points 4 and
50 5 and 6 and 7.

The side curves U V W indicate the general up-and-down movement of the tubes from hole to hole, the tubes moving out from the shell at top lines X and in toward the shell
55 at bottom on lines Y. At the points of crossing 4, 5, 6, and 7, the tubes move parallel with each other and at free and ample clearance distances, and at S the tube takes a quick passing curve, of large radius however, for a
60 horizontal return to the central shell, swing in to cross mating tubes at points 8, 9, and 10, as already defined by cross-points 1, 2, and 3. All tubes are reversible and interchangeable. Fig. 2 shows the relative vertical positions of
65 tubes in section for the several crossing-points 1 to 10 of the tube shown complete.

The circumference of the central water-

shell is divided, as shown in Fig. 1, into a sufficient number of portions to provide for admission-holes for the tube ends, and leave
70 reliable strength of metal between them.

Each horizontal row of tubes is preferably designed to break centers or stagger with its neighbor above and below, so that the center
75 of any one tube-hole is vertically located centrally between those of the rows above and below. The openings or passages for heat and products of combustion are designated by the numbers 12, 13, 14, 15, and 16, with a general surrounding space at 17 between the
80 tube-nest as a whole and the non-conducting casing about the tubes.

The tubes passing and repassing each other so break the continuity of the movement of the gases that every portion of the circum-
85 ference of the tubes is impinged upon by the heat and gases, and the surfaces made as efficient as possible for the transmission of heat to the contained water in the tubes.

The construction object of the curves of
90 long radius is to overcome a buckling of tube metal on the inner portion of shorter radius, and to obtain the greatest length of surface for heat contact in the least possible space. The object of the similarity of both portions
95 of the tubes on each side of its longitudinal center point M is to enable the fixing of the tube at its center M, and bending both directions at once, and this portion of the tubes being parallel and ranging one above the other
100 to form a heat-confining wall, and encouraging and guiding the hot gases to move up through the flue-spaces 13 14 15 16, formed, as already stated, by the special shaping, bending, location, and passing of the tubes. Con-
105 siderable trouble has heretofore been experienced with all water-tubes attached to boilers, from the fact that when horizontal, or nearly so, the water would not circulate from end to end of tubes, but from that portion most ex-
110 posed to the heat to and through both ends of tubes, the water entering again as best it could in uncertain quantities. Hence the object of the quick rise devised in my improved tubes, the heat striking the bottom
115 portion of tubes, the immediate tendency of the water is to rise, passing and circulating readily up and through the central portion of tube and out at the top portion into the
120 main shell.

I am fully aware that the bent tube in connection with the water-shell of both flat and round sides is of long standing, but under no condition and in no case have the tubes been
125 shaped, designed, and associated, as herein shown and described, to present the greatest possible heating-surface exposure in the least possible space or volume, and at the same time so pass and repass each other to form the flue-spaces in direct vertical line close to
130 and about the shell, by such means keeping the heat and gases of combustion in the closest possible proximity with the shell and its projecting tubes; nor is there any mass of tubes

presenting any such drop or rise within the tubes for assisting in a reliable water circulation.

5 What I claim as new, and desire to secure by Letters Patent, is—

1. A double-branched obliquely-arranged generator-tube, the branches of which are oppositely compound curved and in the same degree.

10 2. A steam-generator having a generator-cylinder provided with tiers of double-branched, radial obliquely-arranged generating-tubes both branches of which are oppo-

sitely compound curved and in the same degree.

15 3. A steam-generator having a generator-cylinder provided with tiers of double-branched radial obliquely-arranged generating-tubes, both branches of which are oppositely curved and in the same degree, each of said tubes crossing and recrossing the tubes immediately above and below. 20

WILLIAM H. WEIGHTMAN.

Witnesses:

H. CLAY TRUMPER,
THOS. F. SCOTT.