

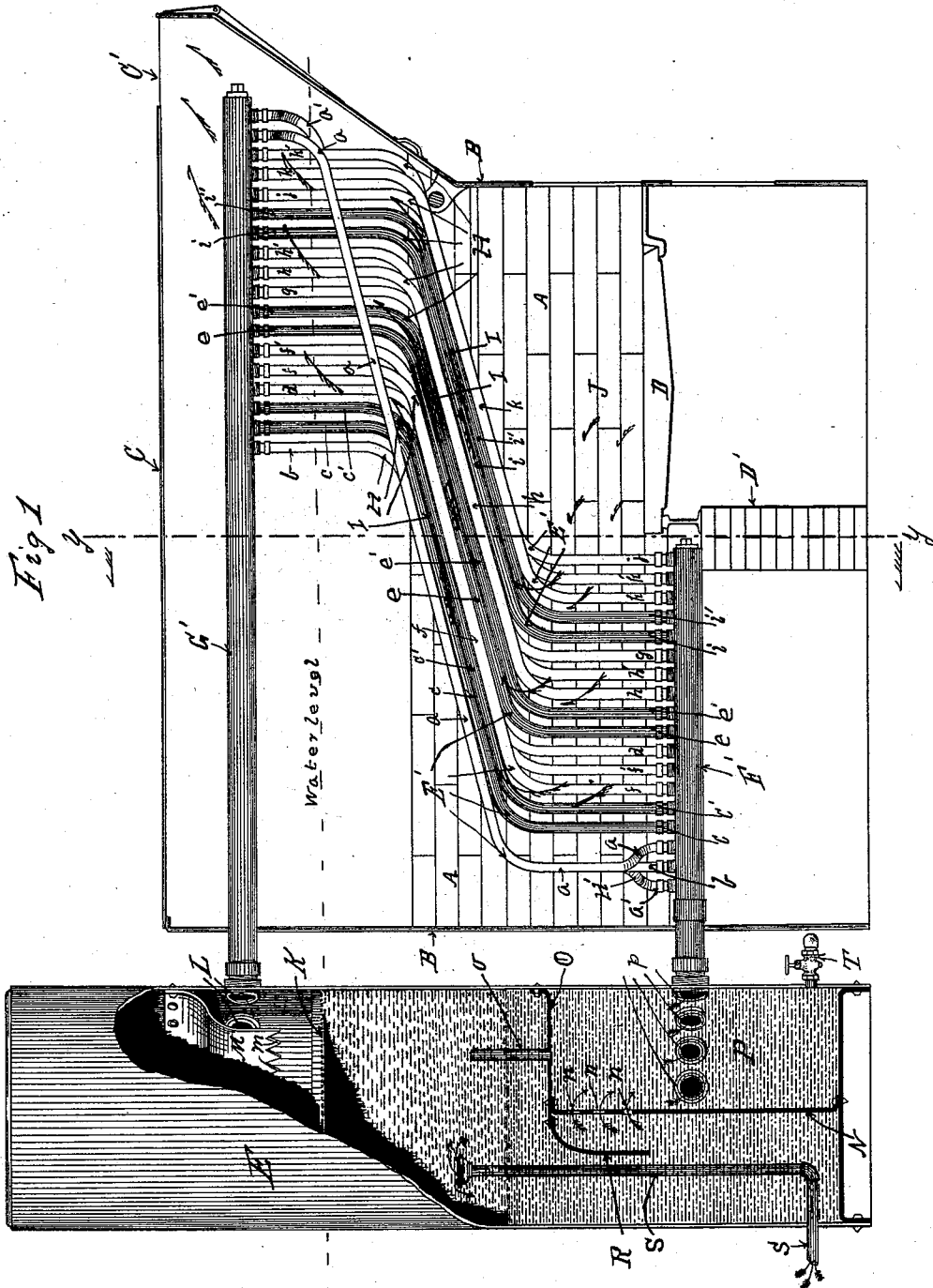
(No Model.)

3 Sheets—Sheet 1.

L. D. DAVIS.
WATER TUBE STEAM BOILER.

No. 521,850.

Patented June 26, 1894.



WITNESSES
F. J. Barnett
A. L. Jackson

INVENTOR
Leonard D. Davis
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(No Model.)

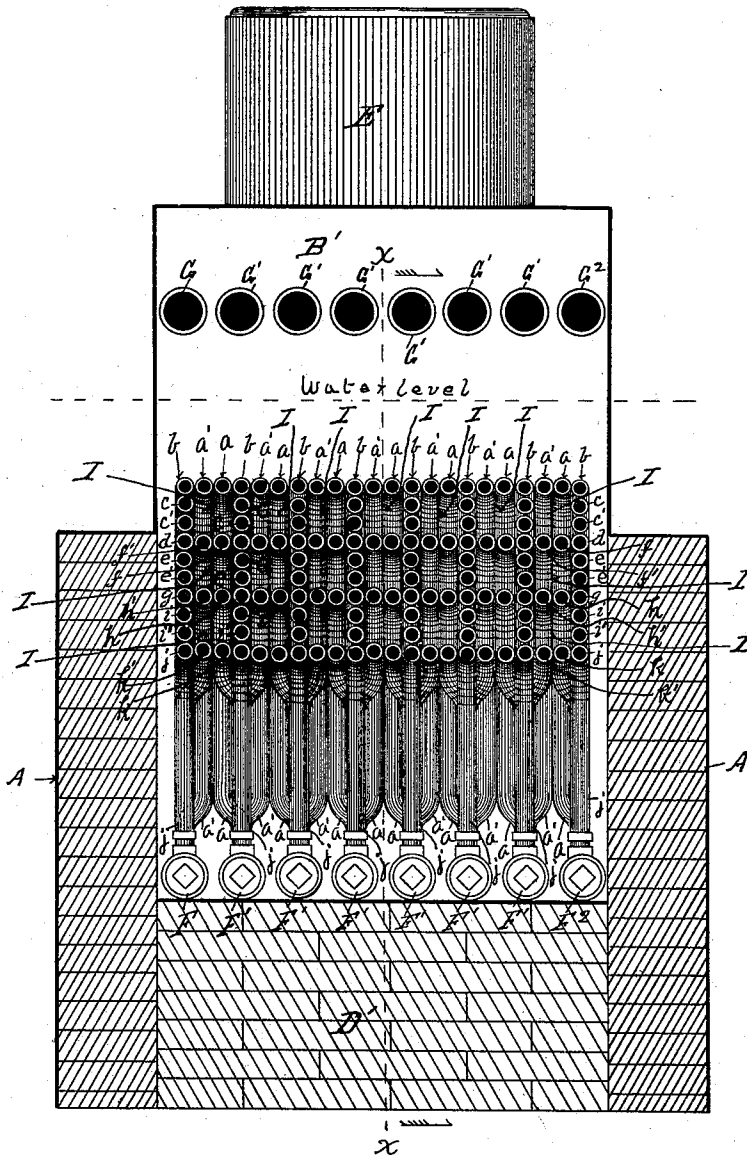
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Fig. 2.



WITNESSES

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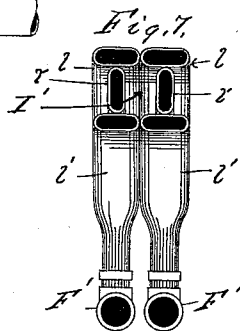
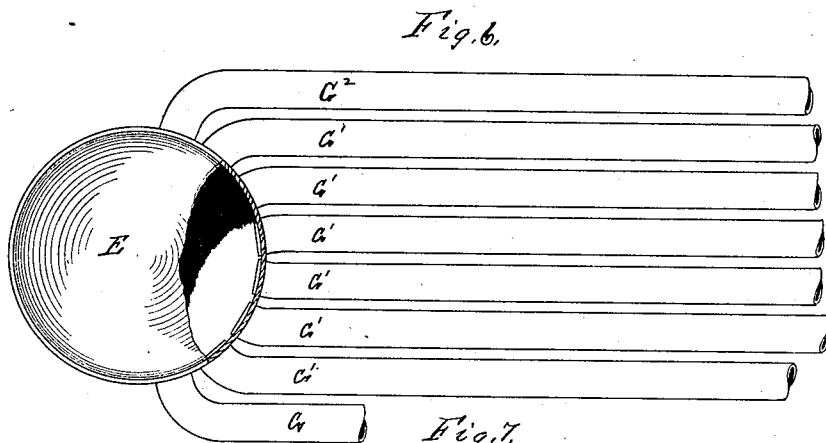
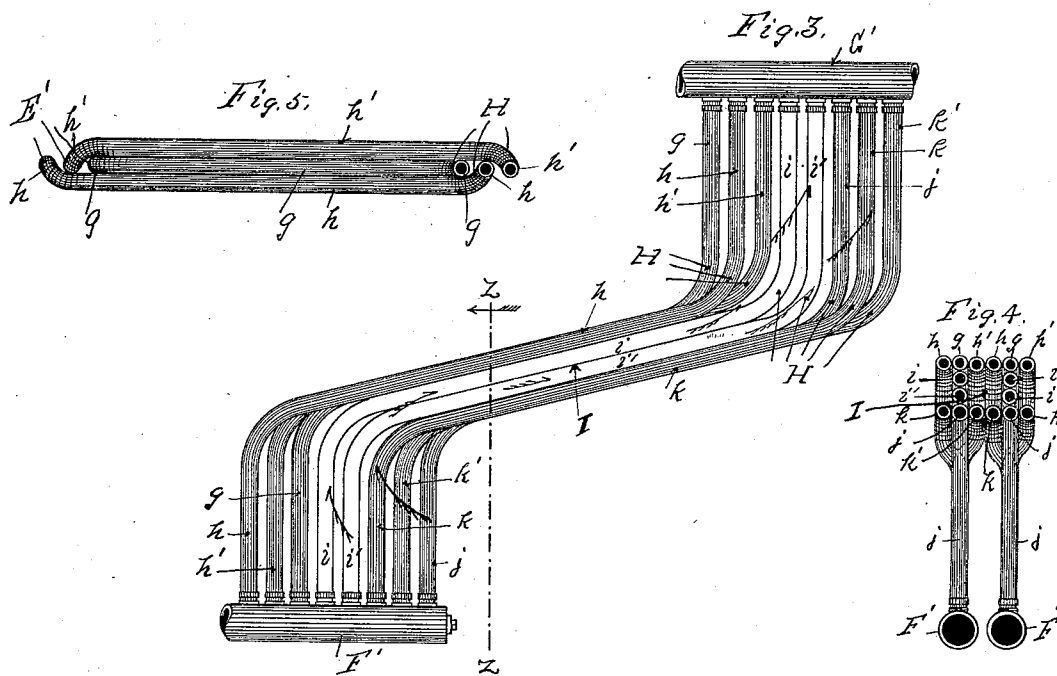
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L. D. DAVIS.
WATER TUBE STEAM BOILER.

No. 521,850.

Patented June 26, 1894.



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UNITED STATES PATENT OFFICE.

LEONARD D. DAVIS, OF ERIE, PENNSYLVANIA.

WATER-TUBE STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 521,850, dated June 26, 1894.

Application filed May 22, 1893. Serial No. 475,170. (No model.)

To all whom it may concern:

Be it known that I, LEONARD D. DAVIS, a citizen of the United States, residing at the city of Erie, in the county of Erie and State of Pennsylvania, have invented certain new and useful Improvements in Water-Tube 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, reference being had to the accompanying drawings, and to the letters of reference marked thereon, forming part of this specification.

My invention consists in the improvements in water tube steam boilers, hereinafter set forth and explained, and illustrated in the accompanying drawings, in which—

Figure 1. is a longitudinal vertical section of my improved watertube steam boiler, on the line *x, x*, in Fig. 2, looking in the direction of the arrow. Fig. 2. is a transverse vertical section of my improved water tube steam boiler, on the line *y, y*, in Fig. 1, looking in the direction of the arrow. Fig. 3. is a detail view of a section of my improved boiler, illustrating the arrangement of the tubes forming the flues thereof. Fig. 4. is a sectional detail view of the same on the line *z, z*, looking in the direction of the arrow. Fig. 5. is a detail view illustrating the arrangement of the tubes. Fig. 6. is a detail view illustrating the arrangement of the large pipes of the boiler. Fig. 7. is a detail view of a modified construction of the tubes of my improved boiler.

The principal objects of my invention in water tube steam boilers, hereinafter described, are to so combine the water tubes that they form a series of flues through which the products of combustion and the heat from the fire-box must pass on their way to the smoke stack, thereby insuring an equal circulation thereof throughout all of the heating surface of the boiler, and also, in connecting the tubes forming these flues to suitable horizontal and vertical pipes or drums, so as to insure adequate circulation of the water therein.

The other features of my invention appear hereinafter in the specification and claims.

In the construction of my improved water-

tube boiler illustrated in the accompanying drawings, A A are the side walls, B the front, B' the rear, and C the top of the boiler setting; C' the aperture for the smoke stack; D the grate bars; J the fire-box and D' the ash pit wall, all of which features are of ordinary construction.

Directly at the rear B' of the boiler setting, I preferably place an upright pipe or drum E, and in the lower portion of this pipe or drum E, I secure a series of horizontal pipes F, F' and F² which project forward through the rear B' of the boiler setting far enough, so that the forward ends thereof extend to and rest upon the top of the ash pit wall D'; these pipes inside of the rear B' of the boiler setting being parallel with each other, as illustrated in Figs. 2, 3, and 6. In the upper portion of the drum E, I also secure a like series of horizontal pipes G, G' and G², which, likewise project forward through the rear B' of the boiler setting, parallel to each other nearly to the forward end B of the boiler setting, the number of the pipes G, G' and G² being the same as that of the pipes F, F' and F² above referred to.

I connect the pipes F and G, F' and G', and F² and G² together by means of tubes, preferably as follows: In the pipe F, I secure a row of water tubes *a', b, c, c', f', d, e, e', h', g, i, i', k'* and *j*, all of which are secured in the pipe F, and except the tube *a'*, and extend upward therefrom a distance, of say two feet to bends E' therein, from this point the tubes *b, c, c', d, e, e', g, i, i'* and *j* extend forward and upward at an incline, of say fifteen degrees, one above the other in close contact for a distance of say four feet to bends H therein, so as to form substantially a solid vertical wall of tubes from the bends E to the bends H therein; at the bends E' the tubes *f', h'* and *k'* are also bent laterally to the right so as to bring them at the sides of and parallel with the tubes *d, g* and *j* until the bends H are reached when they are bent back to the left again to their normal positions, and from the bends H the tubes *b, c, c', f', d, e, e', h', g, i, i', k'* and *j* extend upward vertically until they reach the pipe G in which they are secured. The tube *a'* is secured in the pipe F at the rear of the tube *b* and is then bent forward and sidewise to the right until it is brought to the right

hand side of the tube *b* and in close contact therewith, from which point it extends upward to the bend *E'*, and from thence at the right hand side of the tube *b* to the bend *H* and from this point where the tube *b* bends upward; the tube *a'* extends forward and upward at the same inclination at the right hand side of all of the tubes above described until it reaches a point opposite the forward end of the pipe *G* where it is bent laterally and upwardly to the pipe *G* and secured therein.

In the pipe *F'* I secure a row of water tubes *a' b, a, c, c' f, f' d, e, e' h, h' g, i, i' k, k'* and *j*, all of which are secured in the pipes *F'*, and except the tubes *a'* and *a*, extend upward therefrom a distance of say two feet to bends *E'* therein, from this point the tubes *b, c, c' d, e, e' g, i, i'* and *j*, extend forward and upward at an incline of say fifteen degrees one above the other in close contact for a distance of say four feet to bends *H* therein, so as to form substantially a solid vertical wall of tubes from the bends *E'* to the bends *H* therein; at the bends *E'* the tubes *f, h* and *k* are bent laterally to the left, and the tubes *f' h'* and *k'* to the right, as illustrated in Figs. 4 and 5, so as to bring them at the sides and parallel with and in contact with the sides of the tubes *d, g* and *j*, until the bends *H* are reached, so as to form substantially solid horizontally inclined walls of tubes from the bends *E'* to the bends *H* therein, as illustrated in Figs. 2 and 4; at the bends *H* the tubes *f, h* and *k* are bent back to the right, and the tubes *f' h'* and *k'* back to the left again, to their normal positions, as illustrated in Fig. 5, and from the bends *H*, the tubes *b, c, c' f, f' d, e, e' h, h' g, i, i' k, k'* and *j*, extend upward and vertically until they reach the pipes *G* in which they are secured. The tubes *a'* are preferably secured in the pipes *F'* at the rear of the tubes *b*, and the tubes *a* in front of the tubes *b*; the tubes *a'* are then bent forward and to the right, and the tubes *a* rearward and to the left of the tubes *b*, from which point they extend upward at each side of and in contact with the sides of the tubes *b* to the bends *E*, and from thence in contact with the sides of the tube *b* to the bends *H* and from this point where the tubes *b* bend upward; the tubes *a'* and *a* extend forward and upward at the same inclination, at the right and left hand sides of the tubes entering the pipes *G'* until they reach nearly to the forward ends of the pipes *G'* where they are bent laterally and upwardly to the pipes *G'* and secured therein. It will be seen by this arrangement of the tubes *a, b* and *a'*, I form therewith a solid wall of tubes extending from near their junction with the pipes *F* and *F'* upward and forward to the bends *H* in the pipes, as illustrated in Fig. 2.

The arrangement of the tubes connecting the pipes *F²* and *G²* at the right hand side of the boiler is the same in all respects as the arrangement of the tubes connecting the pipes *F* and *G* at the left hand side of the boiler here-

inbefore described, except that the tubes *a, f, h* and *k* are used, instead of the tubes *a' f' h'* and *k'*, which tubes are bent toward the left, in connecting the pipes *F²* and *G²* the same as the like lettered tubes are, in connecting the intermediate pipes *F'* and *G'*. It will be observed that by this arrangement of the tubes, I form therewith inclined rectangular flues *I*, extending from the bends *E'* of the tubes to the bends *H* thereof. All of the heat and products of combustion from the fire-box *J* passing freely between the vertical portions of the tubes below the bends *E'* thereof, and thence up into and through the flues *I*; and from the upper ends of the flues *I*, at the bends *H* of said tubes, up between the upright portions of the tubes above said bends *H* to the smoke stack opening *C'*, thus insuring an equitable distribution of the heat to all of the water-tubes hereinbefore described.

In the upright pipe or drum *E*, I secure a perforated disk *K*, at or near the normal water line of the boiler, and opposite the outlets *L* of the pipes *G, G' G²*, I secure an annular downwardly projecting deflector *M* the lower edge of which is provided with serrations *m*. The lower portion of the vertical pipe or drum *E* is divided by a transverse diaphragm *N* having inlet openings *n* therein, a semi-disk *O* is secured between the sides of the shell of the pipe or drum *E* and to the top of the diaphragm *N* which diaphragm *N* and semi-disk *O* form with the sides and bottom of the shell of the pipe or drum *E*, a chamber *P*, surrounding the inlets *p* of the pipes *F, F'* and *F²*. I also secure in the semi-disk *O* a short upright pipe *o* which operates to equalize the flow of the water in the chamber *P*. To the edge of the semi-disk *O* I secure an apron or shield *R* which extends downwardly at some distance over the diaphragm *N* below the lowermost of the openings *n* in said diaphragm. The feed pipe *S*, I preferably insert through the shell of the pipe or drum *E* near the bottom thereof, from which point it extends upward about two thirds of the way to the normal water line of the boiler. By this method of construction I am enabled to utilize the lower portion of the pipe or drum *E*, as a separating chamber, in which the impurities in the water separated by the action of the heat, settle to the bottom by gravity where they may be blown off by means of an ordinary blow off cock (not shown); I also provide the chamber *P* with a blow off cock *T* which can be used occasionally to blow off any impurities which may have passed into the chamber *P* through the openings *n*.

In operation the water from the chamber *P* passes into the pipes *F, F' F²* and then through the tubes hereinbefore described into the pipes *G, G' G²*, and back against the deflector *M* in the upper portion of the pipe or drum *E* where the steam rises to the top of the pipe or drum *E*, while the water passes down through the screen *K*, and as the temperature

thereof gradually lowers, the impurities therein separate therefrom, and settle to the bottom of the pipe or drum E outside of the diaphragm N, while the purified water passes through the openings *n* into the chamber P, to again traverse the path above described.

The traverse and action of the fire and heat among the tubes and through the flues I having been hereinbefore fully described, further reference thereto is deemed unnecessary.

In Fig. 7, I show a modified construction of the water tubes of my improved boiler; in this construction, the tubes *l* and *l'* are flattened horizontally, while the tubes *r* which form the vertical walls of the flues I of the boiler are flattened vertically; in this manner, I am enabled to use a less number of water-tubes in forming the flues; in all other respects, however this construction is substantially the same as that hereinbefore described.

I have thus shown and described a convenient mechanism for utilizing my invention, but I do not desire to limit myself to the exact construction shown and described, therefore,

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination in a water tube steam boiler, of water tubes extending from headers in the rear of the fire box to headers at the front of the boiler above the fire box, and a series of flues, one above another, extending from the rear toward the front of the boiler, the walls of which consist of the central portions of said water tubes, through which flues the heat and products of combustion pass on their way from the rear of the fire box of said boiler to the smoke stack, substantially as set forth.

2. The combination in a water-tube steam-boiler, of inclined water-tubes, and a flue or flues, inclined upward from the rear toward the front of the boiler, the walls of which consist of the central portions of said inclined water-tubes placed in close contact with each other, through which flue or flues the heat and products of combustion pass on their way from the rear of the fire-box of said boiler to the smoke-stack, substantially as set forth.

3. The combination in a water-tube steam-boiler, of water-tubes curved near their ends and having their central portions inclined, and a series of flues, one above another inclined upward from the rear toward the front of the boiler, the walls of which consist of the central portions of said inclined water-tubes, through which flues the heat and products of combustion pass on their way from the rear of the fire-box of the boiler to the smoke-stack, substantially as set forth.

4. The combination in a water-tube steam-boiler, of water-tubes curved near their ends and connected into horizontal header pipes and having their central portions inclined upward from the rear toward the front of the boiler, with inclined flues, the walls of which consist of the central inclined portions of said

water-tubes, through which flues the heat and products of combustion pass on their way from the rear of the fire-box of the boiler, upward and forward to the smoke-stack, substantially as set forth.

5. The combination in a water-tube steam-boiler, of a series of flues, one above another, inclined upward from the rear toward the front of the boiler, the walls of which flues consist of inclined water-tubes placed in close contact with each other, and each succeeding flue projecting rearward beyond the flue immediately below it far enough to form the inlet thereto, so as to insure each flue receiving its share of the heat and products of combustion, substantially as set forth.

6. The combination in a water-tube steam-boiler, of a group of water-tubes curved near the ends thereof and secured in header pipes communicating with downflow pipes or drums, the central portions of which water-tubes between the curves therein being closely in contact with each other and inclined upward from the rear toward the front of the boiler, so as to form an inclined flue or flues between the curves in said water-tubes; the walls of which flue or flues consist of the central inclined portions of said water-tubes, substantially as and for the purposes set forth.

7. The combination in a water-tube steam-boiler, of a fire box at the front of the boiler, header pipes extending rearwardly from the rear of the fire-box, water-tubes inserted in said header pipes and extending upward some distance substantially parallel to each other, so that the heat and products of combustion pass from the rear of the fire-box freely between and around them, bends in said water-tubes at some distance above said header pipes by means whereof said water-tubes are brought into contact with each other in tiers, one above another horizontally inclined from the said bends upward toward the front of the boiler, a second set of bends in said water-tubes above the fire-box and near the front of the boiler whereby said water-tubes are again separated from each other, so as to allow the heat and products of combustion to pass between them, and header pipes secured to the upper ends of said water-tubes, substantially as and for the purpose set forth.

8. The combination in a water-tube steam-boiler, of water-tubes formed into a group of flues inclined upward from the rear toward the front of the boiler, the vertical and horizontal walls of which flues consist of the central portions of the water-tubes placed in close contact with each other, so as to form a rectangular group of flues extending from the rear toward the front of the boiler substantially as set forth.

9. The combination in a water-tube steam-boiler, of horizontal pipes F, F' &c., at the lower part of the boiler, and horizontal pipes G, G' &c., at the upper part of said boiler, water-tubes curved near their ends and having the central portions thereof inclined, con-

- necting said pipes at the lower and upper parts of the boiler, with a vertical pipe or drum connecting with the ends of said pipes at the lower and upper parts of the boiler, and a semi-disk O and a diaphragm M in the lower part of said vertical pipe or drum, forming a chamber around the inlets of the pipes at the lower part of the boiler, substantially as and for the purpose set forth.
- 10 10. The combination in a water-tube steam-boiler, of horizontal pipes F, F' &c., at the lower part of the boiler, and horizontal pipes as G, G' &c., at the upper part of said boiler, water-tubes curved near their ends and having the central portions thereof inclined connecting said pipes at the lower and upper parts of the boiler, with a vertical pipe or

drum connecting with the ends of said pipes at the lower and upper parts of the boiler, a deflector M in the upper part of said pipe or drum above the inlets of the horizontal pipes at the upper part of the boiler, a semi-disk O and a diaphragm N in the lower part of said vertical pipe or drum, forming a chamber around the outlets of the pipes at the lower part of the boiler, substantially as and for the purpose set forth.

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

LEONARD D. DAVIS.

Witnesses:

H. J. CURTZE,
F. J. BASSETT.