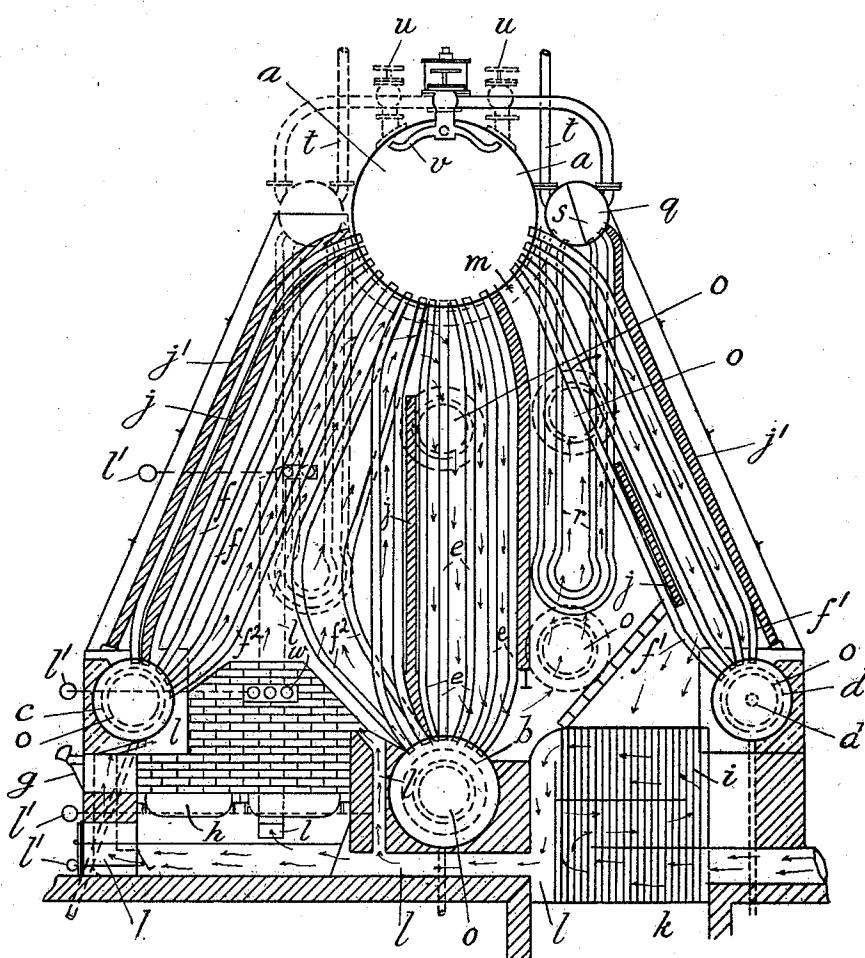


No. 842,284.

PATENTED JAN. 29, 1907.

W. R. WILLS.
STEAM GENERATOR.
APPLICATION FILED JULY 28, 1905.

3 SHEETS--SHEET 1.



WITNESSES

Alvin G. White

W. P. Burkg

FIG. 1.

INVENTOR
Walter Ridout Kells

BY
Richardson

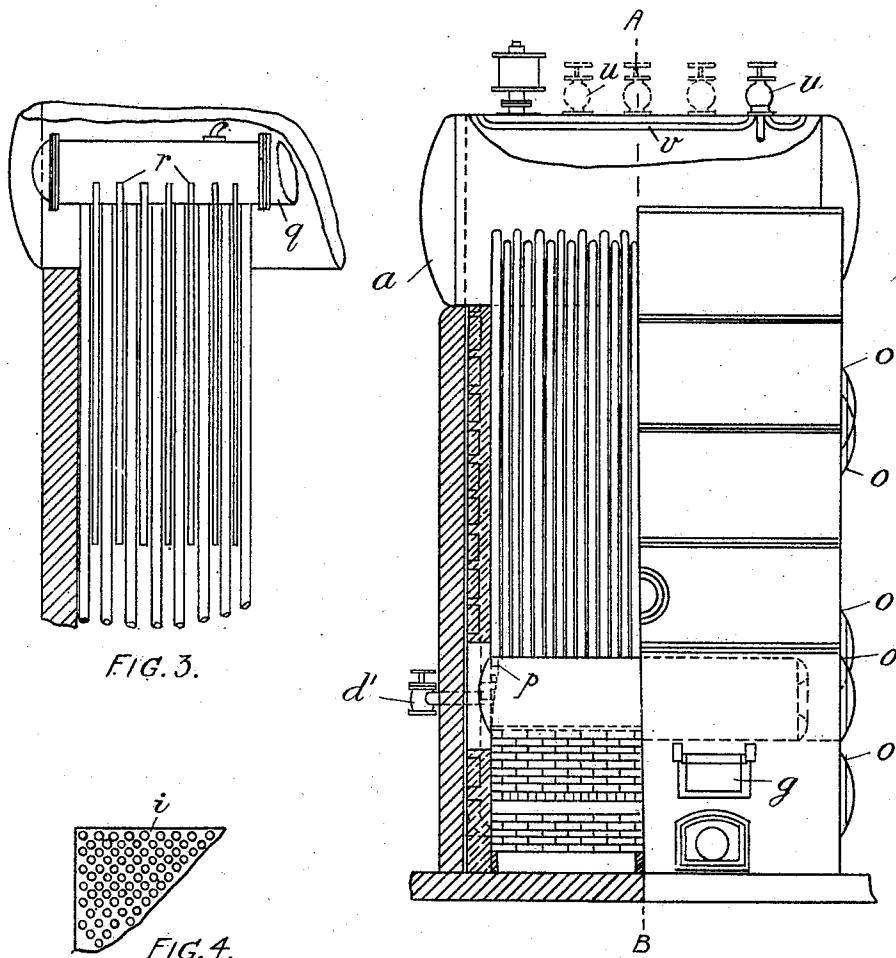
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3 SHEETS—SHEET 2.



WITNESSES
Alvin S. White
W. P. Burke

FIG. 2: INVENTOR
Walter Ridout Wills
BY
Richard A. ATT

No. 842,284.

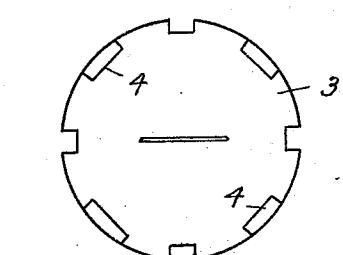
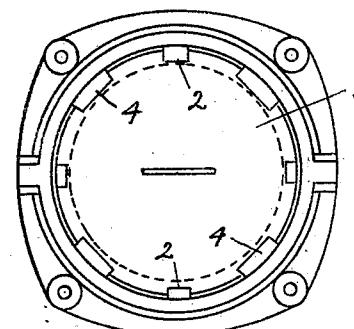
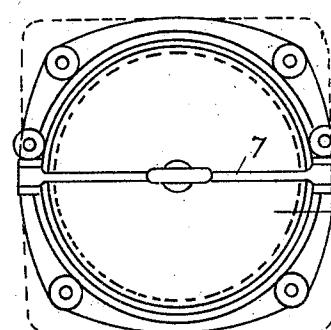
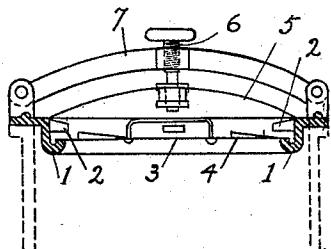
PATENTED JAN. 29, 1907.

W. R. WILLS.

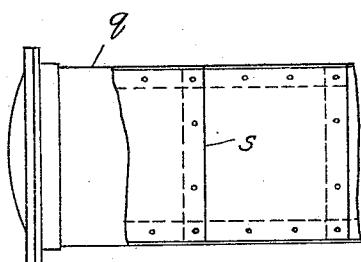
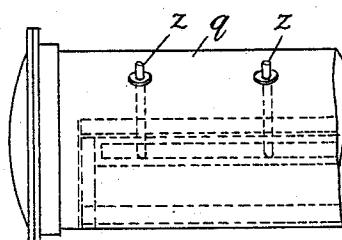
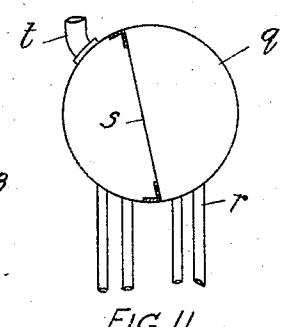
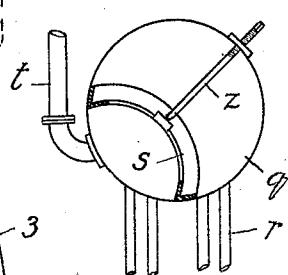
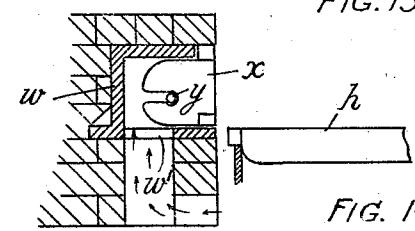
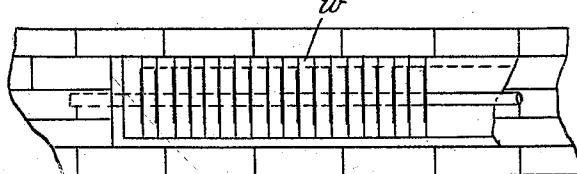
STEAM GENERATOR.

APPLICATION FILED JULY 28, 1905.

3 SHEETS—SHEET 3.



WITNESSES
Alvin G. White
W. P. Burks



INVENTOR
Walter Rudolf Wills

BY
Richardson
ATTYS

UNITED STATES PATENT OFFICE.

WALTER RIDOUT WILLS, OF SHEFFIELD, ENGLAND.

STEAM-GENERATOR.

No. 842,284.

Specification of Letters Patent.

Patented Jan. 29, 1907.

Application filed July 28, 1905. Serial No. 271,656.

To all whom it may concern:

Be it known that I, WALTER RIDOUT WILLS, a subject of the King of Great Britain and Ireland, residing at 203 Abbeyfield road, 5 Pitsmoor, Sheffield, in the county of York, England, have invented certain new and useful Improvements in Steam-Generators, (for which I have filed an application for a patent in Great Britain, No. 16,994, bearing 10 date August 3, 1904,) of which the following is a specification.

My invention is for improvements and modifications in water-tube boilers, which I will now describe; and it consists of a water-tube boiler so constructed by the careful arrangement of parts as to intercept as far as possible heat radiation and to bring the efficiency of the structure to the highest possible point, combined with an air-heater so 15 closed in the boiler structure as to be heated both externally and internally by the waste gases, and so to convey the heated air to the fire as to reduce the hot-air ducts to their shortest possible dimensions and at the 20 same time to keep both heater and air-ducts entirely within the walls of the heated structure, by this means obtaining the highest possible results under any given conditions.

My invention will be better understood on 25 reference to the accompanying two sheets of drawings, in which—

Figure 1 is a sectional elevation on the line A B, Fig. 2. Fig. 2 is an end elevation, partly in section. Fig. 3 is a back view of a portion 30 of a boiler with the brickwork removed, showing the position of the superheater. Fig. 4 is a portion of a plan view of the air-heating chamber. Fig. 5 is a sectional elevation of an access-door, and Fig. 6 is a plan 35 of the same. Fig. 7 is a plan of the door-frame with the outer dish and cross-bar removed. Fig. 8 is a plan of the inner door. Fig. 9 is a section of the superheater, showing 40 the internal box; and Fig. 10 is a part longitudinal elevation of the same. Fig. 11 is a 45 similar section to Fig. 9, showing an alternative arrangement in which the curved plate forming the internal box is replaced by a plate or diaphragm; and Fig. 12 is a part 50 longitudinal elevation of the same, partly in section. Fig. 13 is an elevation of the metal boxes fixed in the furnace-wall for air-heating, and Fig. 14 is a transverse section 55 of the same.

The same letters refer to similar parts throughout the several views.

My boiler consists of one upper or steam drum *a*, combined with three lower or water drums *b* *c* *d*, the central and lowest water-drum *b* being connected to the steam-drum *a* 60 by vertical pipes *e* and two outer water-drums *c* and *d* being connected to the steam-drum by diagonal pipes *f* and *f'*, respectively.

The fire door or doors *g* of the boiler is or are situated beneath one of the outer drums 65 *c*, while the fire-grate *h* is situated transversely between this outer water-drum *c* and the middle and lower water-drum *b*, while on the opposite side between the middle lower drum *b* and the other outer or back water-drum *d* is placed an air-heater *i*, so that it is surrounded by the hot waste gases.

The heat from the fire is conducted by suitable baffles *j*, coursing up and down the tubes until it reaches the outer lower water-drum at the back of the boiler. From thence 75 it passes through and round the air-heater and escapes to the chimney-outlet *k*.

From the air-heater *i* ducts *l* pass below the middle lower water-drum *b*, with connections leading to, first, the ash-pit; second, the bridge; third, an outlet above the door inside the furnace; fourth, outlets in side walls, if desired, these outlets being controlled by handles *l'* on the boiler-front. In certain 85 cases I also combine with these air-ducts metal boxes *w* in the furnace-walls to further increase the temperature of the air supplied and cause better admixture of the furnace-gases, as illustrated in Figs. 13 and 14. 90 These metal boxes consist of chamber-shaped castings *w*, open on one side and with suitable perforations *w'* in the bottom to admit air. These boxes are fixed in or against the furnace-walls, and through their open sides are 95 inserted a number of metal plates or gills *x* in contact at their outer edges with the furnace and having their lower edges on or about the furnace-level. These gills, which are provided with suitable holes and slots, are locked 100 and secured in their places by a bolt *y* or other device, and by means of the slots one or more gills may be removed and replaced without disturbing the others. Air-passages are arranged communicating from the ash pit or cavity below the grate to the aforesaid perforations, these passages being closed when desired by suitable dampers. Thus air ad-

mitted from the ash-pit by these passages through the perforations and between the gills becomes highly heated and assists to promote the better combustion of the gases.

5 The upper or steam drum *a* of this boiler is supported in semicircular cradles *m*. The lower drums of this boiler hang freely; but opposite to each manhole is a metal ring or frame *o* in the casing, with an iron door fitted 10 to it, which I sometimes make with an air-chamber to prevent any leakage into or from the boiler-easing, as hereinafter described, and illustrated in Figs. 5, 6, 7, and 8. In this boiler I bring out certain tubes *f*² from the 15 front outer water-drum (above the fire-door) and from the lower middle water-drum, so as to form tubular side walls to the furnace. Thus instead of only having heating-surface on one side of the fire, as is the case in boilers 20 of the Babcock and Stirling type, in this boiler there are water-tubes all round the fire in the combustion-chamber. The side walls *p*, where of brick, are brought out below these side tubes, so as to protect their 25 under sides. I also (where no superheater is used) sometimes bring the two outer rows of tubes in this boiler at the front and back into line, so as to form one nearly-continuous wall 30 of water-tubes at the front and back of the boiler for the better interception of the heat.

Where a superheater is used, I leave the outer tubes wide enough apart for the tubes of this to pass between the tubes of the boiler, as shown in Fig. 3.

35 The superheater preferably employed is one consisting of a drum *q*, having loops of tubes *r* depending therefrom. A light iron removable box *s* is fitted over the ends of one side of the tube-loops inside the superheater- 40 drum, from which a pipe *t* conveys the superheated steam away. In some cases I construct this box *s* like an inverted trough, as shown in Figs. 9 and 10, causing it to fit into two angle irons or castings in the interior of the superheater-drum, which angle-irons are joined at the ends by plates covering the 45 open ends of the trough when it is in position, this trough or box being pressed into and held in position by screws *z* passing through 50 the shell of the superheater-drum. In other cases I replace this trough *s* by short sections of plate either curved or flat bolted to the two angle-irons and to each other, as shown in Figs. 11 and 12.

55 The superheater as contrived can be put either at the furnace or air-heater side of the steam-drum, so as to give either a high or a low superheat, and the boiler can be so constructed that the superheater can be readily changed 60 from one position to the other. A special access or manhole door (illustrated in Figs. 5, 6, 7, and 8) is used on this boiler to intercept as far as possible heat radiation and leakage of air or gases. The framing of the door *r* is a circular iron ring *l*, having an inner ledge, with

certain lugs *2* about it, and an outer ledge. Against the inner ledge a circular sheet-iron door *3* is fitted by means of wedge-shaped pieces *4*, fastened to it, tightening against the lugs or other suitable fastening, and against the outer ledge another dished door *5* is secured by means of a screw *6*, attached to a swinging cross-bar *7*. Thus the door includes an air-chamber. Feed-water is admitted to this boiler by pumping it into the 75 back outer water-drum *d* through the feed-valve *d'*, whence it ascends into the main steam-drum *a* by the tubes in the back row.

In order to prevent priming, the steam is taken from the main steam-drum *a*, either by 80 a number of small stop-valves *u*, placed in various positions on the drum, so that there is no heavy draw of steam over any one part of the water-surface, or by a number of small steam-pipes *v*, led about inside the steam- 85 drum, converging to one central stop-valve.

I put at the back and front of the boiler a layer of brick or non-conducting material *j'*, resting on the tubes, and against this an outer casing, leaving an air-chamber between the two casings. As the side walls are also cavity-walls, there is thus a double casing on all four sides of the boiler.

What I do claim, and desire to secure by Letters Patent, is—

1. In steam-generators of the water-tube type, the combination with an upper steam-drum, *a*, three lower or water drums, *b*, *c*, *d*, the central and lowest water-drum, *b*, being connected to the steam-drum by tubes, *e*, and tubes, *f*², respectively, the front water-drum being connected to the steam-drum, *a*, by tubes, *f*, and *f*², respectively, and the back water-drum, *d*, by the tubes, *f'*, of a fire-grate, *h*, placed and arranged transversely between the front and middle water-drums, an outlet for the products of combustion arranged between the rear and middle water-drums and baffles, *j*, placed and arranged for directing the course of the gases, in the manner and for the purposes substantially as herein described.

2. In steam-generators of the water-tube type, the combination with an upper steam-drum, three lower parallel water-drums, tubes connecting the three water-drums with the steam-drum, and suitable baffle-plates between the drums, a fire-grate arranged between the front and middle water-drums, an outlet for the products of combustion arranged between the middle and rear water-drums, and an air-heater in the said outlet and a passage leading from the air-heater to beneath the grate.

3. In steam-generators of the water-tube type, the combination with an upper steam-drum, three lower parallel water-drums, tubes connecting the three water-drums with the steam-drum, and suitable baffle-plates between the drums, a fire-grate arranged be- 125

tween the front and middle water-drums, a
fuel-door beneath the front drum, an outlet
for the products of combustion arranged be-
tween the middle and rear water-drums, and
an air-heater in the said outlet and a passage
leading from the air-heater to beneath the
grate.

In witness whereof I have hereunto set my
hand in presence of two witnesses.

WALTER RIDOUT WILLS.

Witnesses:

W. H. BAIRSTO,
J. F. BIRD.