S. M. COCKBURN & J. R. & J. TEMPERLEY.

WATER TUBE STEAM BOILER.

APPLICATION FILED JAN. 28, 1908.

996,401. Patented June 27, 1911.

4 SHEETS—SHEET 1.

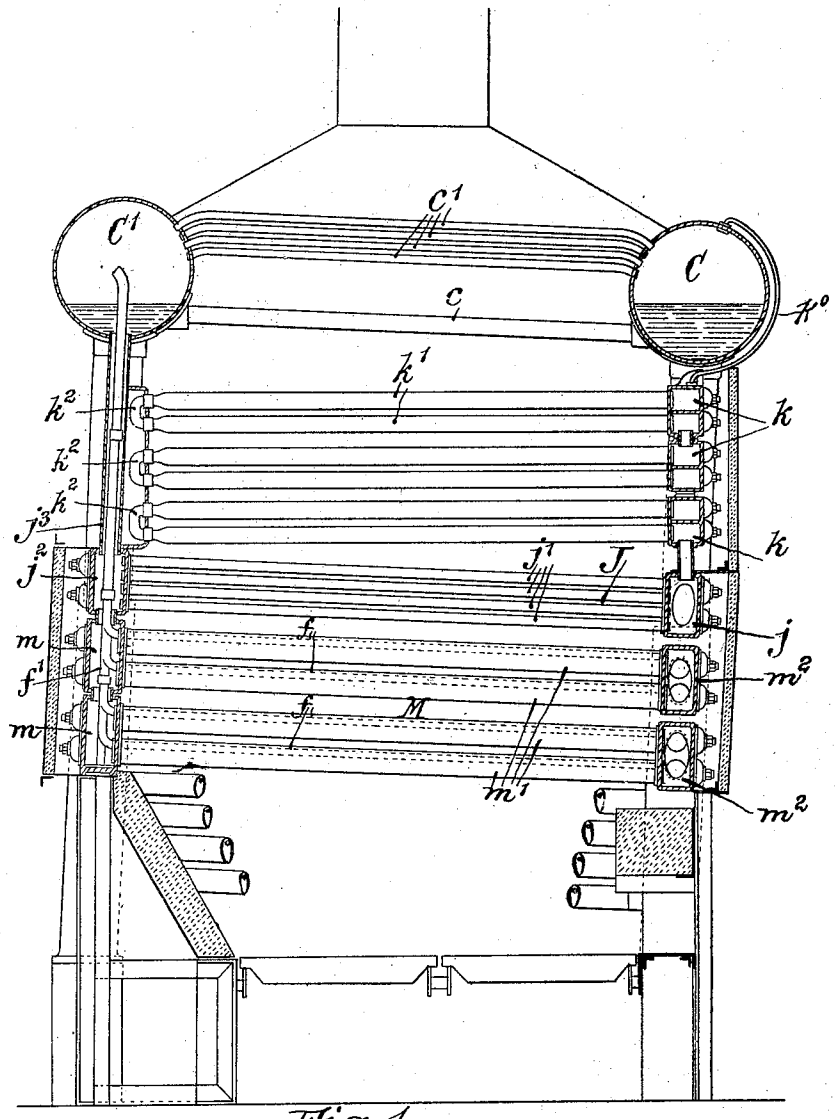

Fig. 1.

WITNESSES

W. P. Burke

Chas. E. Smith.

INVENTORS

Sidney Manthrop Cockburn

John Ridley Temperley

Joseph Temperley

BY Wallace Gluck

ATTY.

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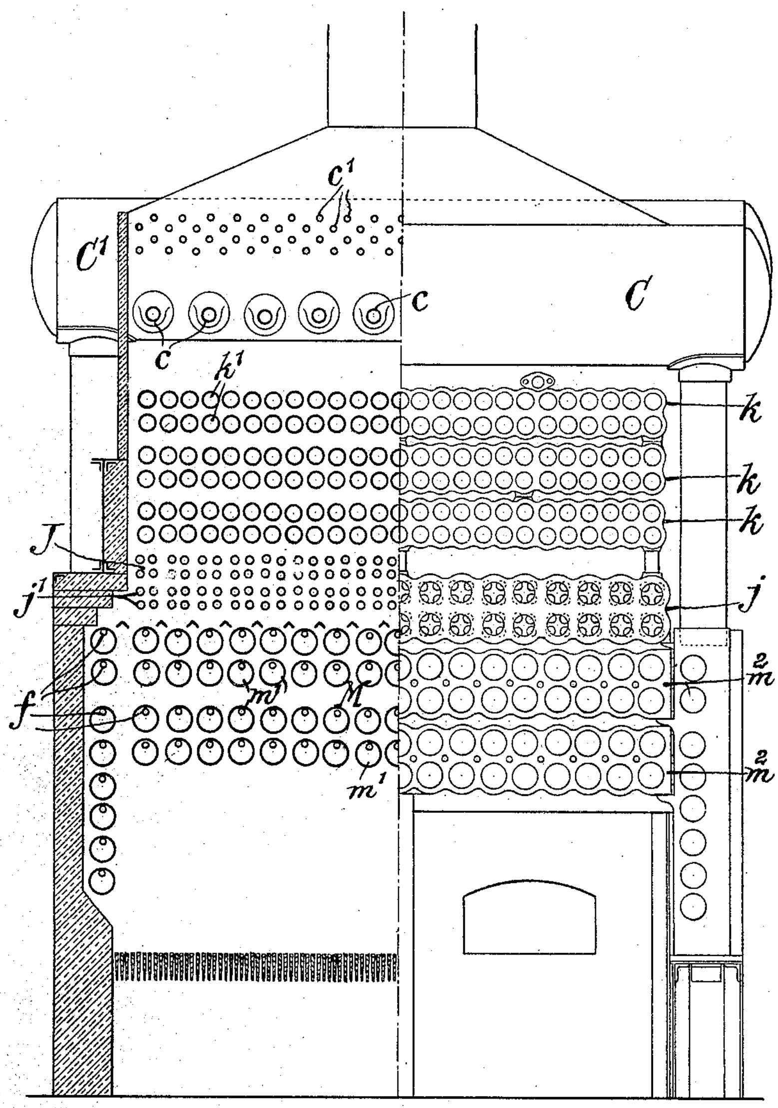

Fig. 2.

WITNESSES

W. P. Burke

Wm. G. Smith

INVENTORS

Sidney Manthrop Cockburn

John Ridley Temperley

Joseph Temperley

BY W. Wallace White

ATTY.

S. M. COCKBURN & J. R. & J. TEMPERLEY.

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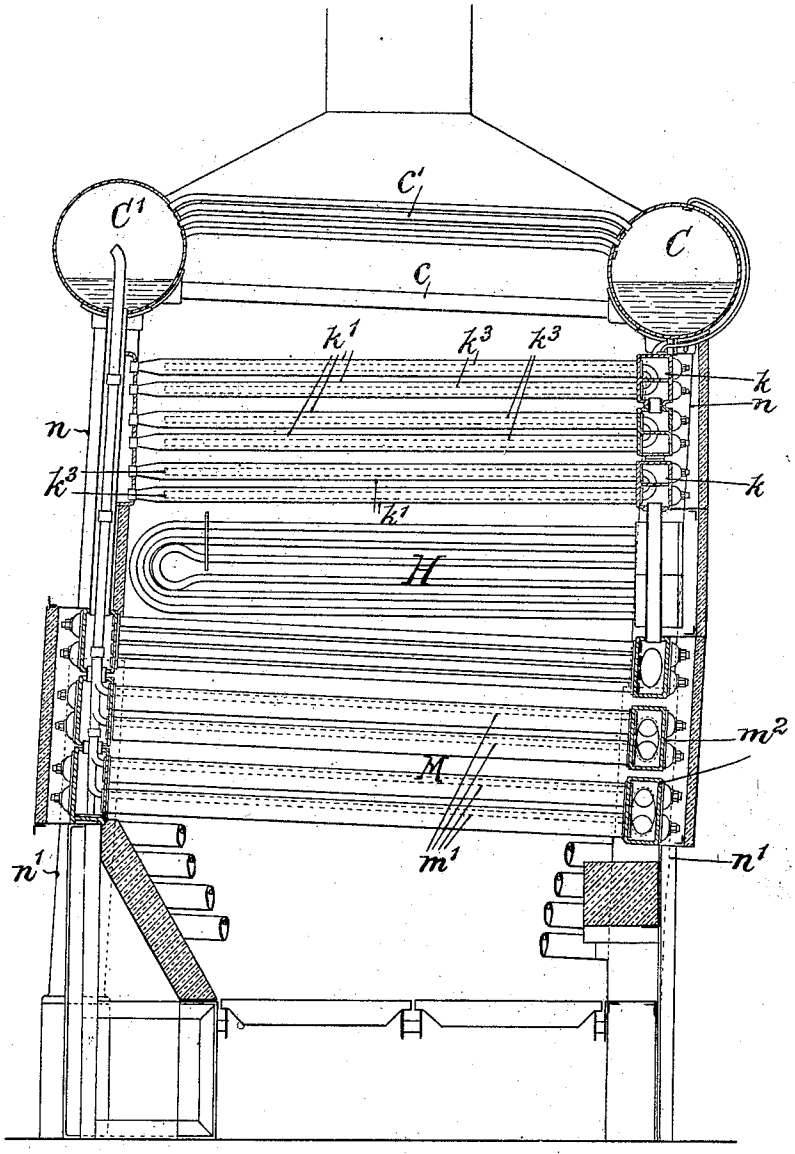

Fig. 3.

WITNESSES

W. P. Burke

Chas. E. Smith

INVENTORS

Sidney Manthrop Cockburn

John Ridley Temperley

Joseph Temperley

BY Wallace Fluid ATTY.

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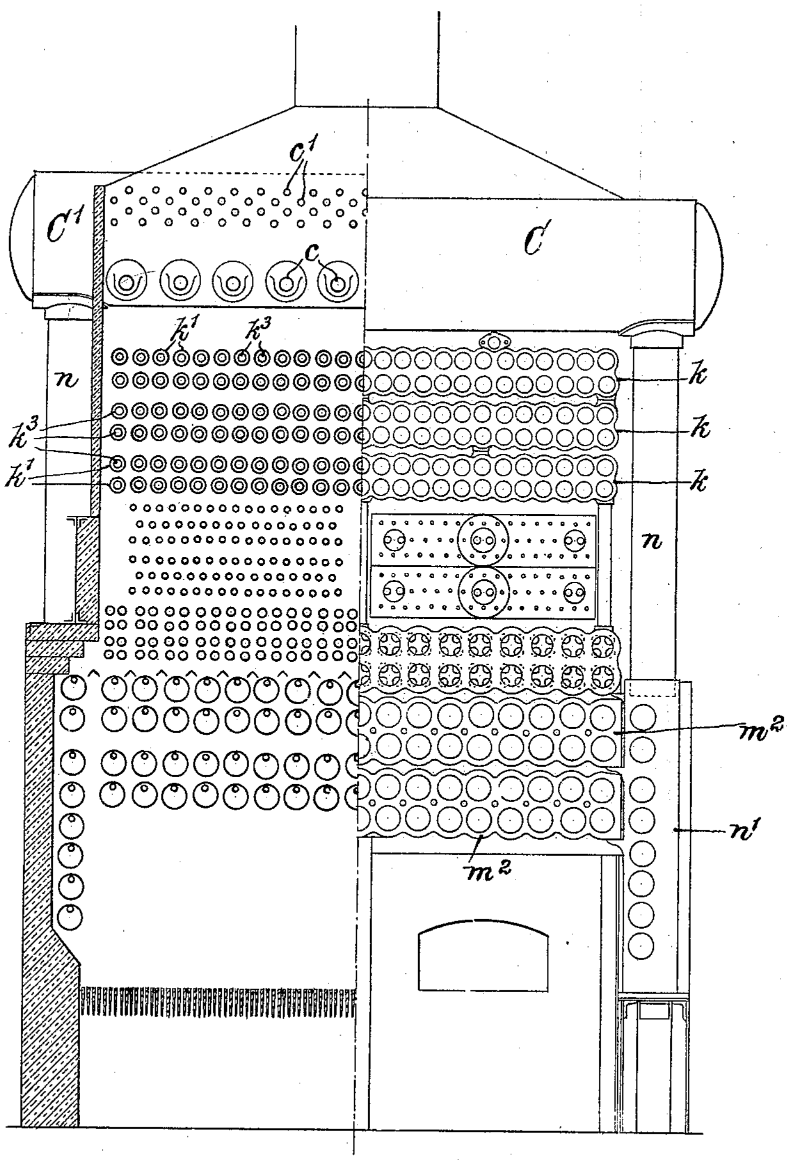

Fig. 4.

WITNESSES
W. P. Burke
Wm. G. Smith

INVENTORS
Sidney Manthrop Cockburn
John Ridley Temperley
Joseph Temperley
by W. McLean ATTY.

UNITED STATES PATENT OFFICE.

SIDNEY M. COCKBURN, JOHN R. TEMPERLEY, AND JOSEPH TEMPERLEY, OF WESTMINSTER, ENGLAND.

WATER-TUBE STEAM-BOILER.

996,401. Specification of Letters Patent. Patented June 27, 1911.

Application filed January 28, 1908. Serial No. 413,129.

To all whom it may concern:

Be it known that we, SIDNEY MANTHORP COCKBURN, JOHN RIDLEY TEMPERLEY, and JOSEPH TEMPERLEY, subjects of the King of Great Britain, and residents of Westminster, England, have invented certain new and useful Improvements in Water-Tube Steam-Boilers, of which the following is a specification.

This invention relates to improvements in the construction of water tube steam generators of the type described in the specification of Patent No. 751,718 granted to one of us.

The principal features of the present invention relate to improved means for effecting the progressive heating of the feed-water as described in the former specification #751718. Accordingly in carrying out this invention and as in the previous specification the total heat-transmission is divided into a number of successive stages and to each stage a special section of the boiler is devoted.

The accompanying drawings show various modifications of construction and arrangement of the elements of water-tube boilers embodying the present invention.

In these: Figure 1 is a sectional side elevation of one form of boiler, and Fig. 2 is a front elevation corresponding therewith, the left hand portion being shown in section. Fig. 3 is a sectional side elevation of modified form of boiler, and Fig. 4 is a front elevation thereof, the left hand portion being likewise shown in section.

Figs. 1 and 2 show a method of heating the feed-water in which, by means of an interposed adjuster J, the process of progressive heating of the feed-water during its descent from the top of the boiler can be successfully carried out; and thereby the most perfect conditions afforded for the transfer of heat from the products of combustion to the feed-water. According to this form of construction, the feed-water is supplied under pressure by feed-pumps to the upper compartment of the upper horizontal trunk k and traverses a tube k^1 leading therefrom in a downward sloping manner to the back of the boiler and by means of a U shaped connector k^2 returned to the trunk k, but to a lower compartment thereof, through a second tube k^1 placed below and parallel to the first. From the lower compartment of the uppermost horizontal trunk the partially heated water flows through nipple pipes to the upper compartment of the next horizontal trunk k from which it flows and to which it returns by means similar to those which have been described with reference to the first trunk and so on in succession.

To permit of the escape of air on filling the boiler and any steam which may be generated in the feed-heating section under abnormal circumstances, as for instance a temporary interruption of the feed-water, one or more pipes k^0 are provided leading from the upper compartment of the uppermost trunk k to the upper side to the steam drum C. On arriving at the lower compartment of the bottom trunk k the water, which should have a temperature distinctly short of the boiling point, will flow through nipple pipes to the front horizontal trunk j of the adjuster section J from which it will flow in parallel through tubes j^1, which slope upward to the back of the boiler, to a back horizontal trunk j^2 which, at intervals along its length, is provided with risers j^3, the upper ends of which are connected to a back steam-drum C^1. In passing along the adjuster section J the water will, normally, be raised to the boiling point and any steam which may be generated therein will readily find its way through the risers j^3 to the steam-drum C^1. The trunk j^2 besides being connected by the risers j^3 to the steam-drum C^1 is also by means of nipple pipes, placed in line with the risers, connected to the uppermost back horizontal trunk m of the steam-generating section M of the boiler. From this trunk steam-generating tubes m^1 extend in a downward sloping direction to a horizontal trunk m^2 in the front of the boiler and below these trunks and tubes other similarly constructed trunks m and m^2 and steam-generating tubes m^1 are provided, the back trunks being connected together by nipple-pipes. The front trunks m^2 may also be similarly united by nipple pipes although not so shown in the drawing, the front trunks of this section being connected to another section of the boiler as will be presently described. The back trunks m and the front-trunks m^2 are each common to a pair of layers of tubes m.

In the steam-generating tubes m^1 steam-extracting pipes f, leading into ascension pipes f^1 are fitted to carry away the generated steam in the manner previously de-

scribed. The steam thus delivered to the back steam-drum C^1 will pass to the front drum C through a nest of comparatively small-bore pipes c^1 which, being surrounded with products of combustion which are normally at a higher temperature than the steam, will operate to effect the drying of the steam and possibly its superheating also. Any water which may be conveyed with the steam through the steam-extracting and ascension pipes will flow from the back drum C^1 to the front drum C through tubes c and, by traversing the products of combustion once more, will have another opportunity of extracting heat therefrom. By making the front trunks k j and m^2 with a wave profile, spaces will be provided for the free insertion of brushes and other tools for cleaning the outside surfaces of the tubes.

The purpose of the adjuster J is to make provision for variations in the conditions under which the boiler may be operating as sometimes it may be forced and at other times steaming easily, it being important to avoid the generation of steam in the tubes k^1 and very desirable that on reaching the steam-generating section the water should be at the boiling temperature.

The boiler shown in Figs. 3 and 4 differs from that of Figs. 1 and 2 in respect to the fact that there is a superheater section H. Besides this, there is a modification in the construction of the feed-heating section, but in this also the feed-water proceeds downward and becomes progressively heated while the products of combustion become progressively cooled, as in the construction of Figs. 1 and 2. Also the trunks k are divided into upper and lower compartments as in the previous boiler but, instead of connecting together the back ends of consecutive tubes k^1 k^1 as in Fig. 4, those ends are closed and the water which flows along the tube from the upper compartment of k is required to return to the front of the boiler through an open-ended internal pipe k^3 the front end of which occupies an orifice formed in the partition which separates the two compartments of the trunk k and mouths on to a similar pipe k^3 inserted within the next lower tube k^1. By this second pipe k^3 the partially heated water will be conducted to the back end of the boiler and required to again proceed to the front through the annular space between the tube k^1 and the inserted pipe k^3. Otherwise the construction is as previously described with reference to Fig. 4. By such a construction the employment of the connectors k^2 will be avoided. The pipes k^3 can be readily extracted through the doors in the trunks k for purposes of inspection, cleaning and repairs.

According to the construction shown in Figs. 3 and 4 and also in Figs. 1 and 2 there is, at each corner of the boiler a downcast pipe n which, at its lower end, is connected to a header n^1 and at its upper end to one of the steam-drums C or C^1. The headers at the front corners of the boiler are connected to the ends of the horizontal trunks m^2 by means of nipple pipes and thus any water carried up with the steam through the steam-extraction and ascension pipes will be returned to the steam-generating tubes m^1.

We claim.

1. In a water tube boiler, a feed water inlet, a feed heating section comprising a plurality of substantially parallel interconnected tubes arranged in different levels, said feed water inlet communicating with the tubes in the upper level, an adjuster section communicating with the tubes in the lower level of said feed heating section, said adjuster section comprising a plurality of tubes through which the water flows, a steam generating section communicating with said adjuster section and provided with steam extracting pipes, a steam drum, and a conduit extending between said adjuster section and said steam drum.

2. In a water tube boiler, a feed water inlet, a feed heating section comprising a plurality of substantially parallel interconnected tubes arranged in different levels, said feed water inlet communicating with the upper end of said feed heater, a section through which the fluid subsequently passes consisting of a horizontal trunk connected to the lower end of said feed-heater, a second horizontal trunk, a series of comparatively narrow tubes sloping upward from and connecting said first mentioned trunk with said second trunk, a steam drum, a riser connecting said second trunk with said steam drum and a steam generating section fitted with steam extracting pipes connected to said second trunk.

3. In a water tube boiler, a feed water inlet, a feed heating section comprising a plurality of substantially parallel interconnected tubes arranged in different levels, said feed water inlet communicating with the upper end of said feed heater, a section through which the fluid subsequently passes consisting of a front horizontal trunk connected to the lower end of said feed-heater, a back horizontal trunk, a series of comparatively narrow tubes sloping upward from and connecting said front trunk with said back trunk, a steam drum, a riser connecting said back trunk with said steam drum and a steam generating section fitted with steam extracting pipes connected to said back trunk.

4. In a water-tube boiler, a steam-generating section comprising horizontal trunks at one side of the boiler, horizontal trunks at the other side of the boiler, layers of ap-

proximately horizontal water-tubes connecting said first-mentioned trunks and said second-mentioned trunks, a steam drum, down-cast pipes leading from said steam drum to said second mentioned trunks, risers leading to said steam drum from said second-mentioned trunks, steam-extracting pipes located in said water-tubes and steam-ascension pipes located in said risers and leading from said steam-extracting pipes to the steam space.

5. In a water-tube boiler, a steam-generating section comprising front horizontal trunks, back horizontal trunks, layers of approximately horizontal water-tubes connecting said front trunks and said back trunks, a steam drum, down-cast pipes leading from said steam drum to said second mentioned trunks, risers leading to said steam drum from said back trunks, steam-extracting pipes located in said water-tubes and steam ascension pipes located in said risers and leading from said steam-extracting pipes to the steam space.

6. In a water-tube boiler, a steam generating section comprising horizontal trunks at one side of the boiler, horizontal trunks at the other side of the boiler, a plurality of layers of approximately horizontal water-tubes connecting each of said first mentioned trunks with each of said second-mentioned trunks, a steam drum, down-cast pipes leading from said steam-drum to said second-mentioned trunks, risers leading to said steam-drum from said second-mentioned trunks, steam extracting pipes, located in said water-tubes and steam ascension pipes located in said risers and leading from said steam-extracting pipes to the steam space.

7. In a water-tube boiler, a steam generating section comprising front horizontal trunks, back horizontal trunks, a plurality of layers of approximately horizontal water-tubes connecting each of said front trunks with each of said back trunks, a steam drum, down-cast pipes leading from said steam-drum to said back trunks, risers leading to said steam-drum from said back trunks, steam-extracting pipes located in said water-tubes and steam-ascension pipes located in said risers and leading from said steam-extracting pipes to the steam space.

In witness whereof we have hereunto set our hands in presence of two witnesses.

S. M. COCKBURN.
JOHN R. TEMPERLEY.
JOSEPH TEMPERLEY.

Witnesses:
R. S SMITH,
H. D. JAMESON.