(No Model.) 3 Sheets—Sheet 1.

M. SCOVEL.

STEAM BOILER.

No. 479,023. Patented July 19, 1892.

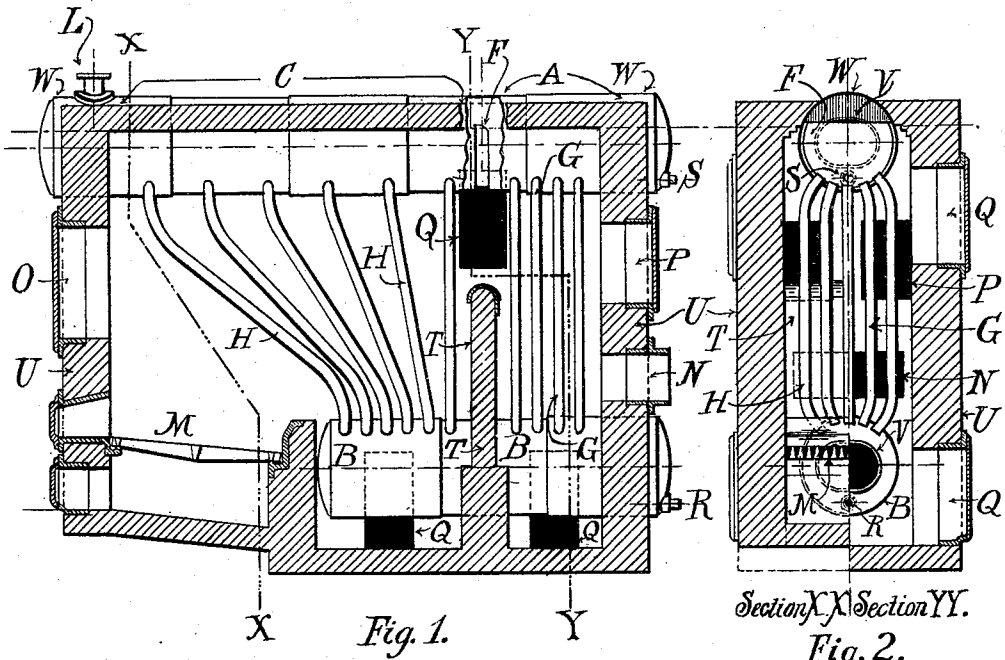

Fig. 1.

Section X X Section Y Y.

Fig. 2.

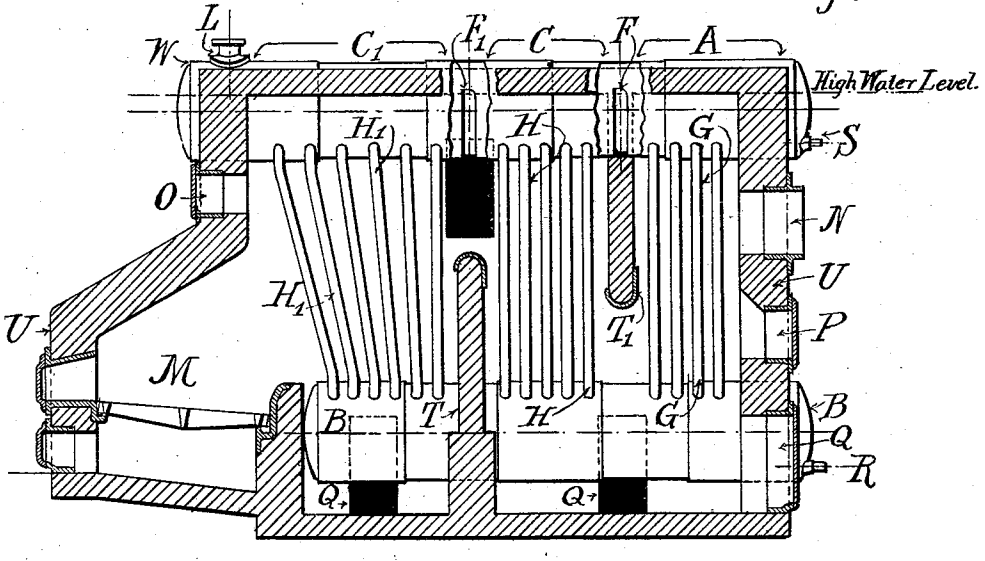

Fig. 3.

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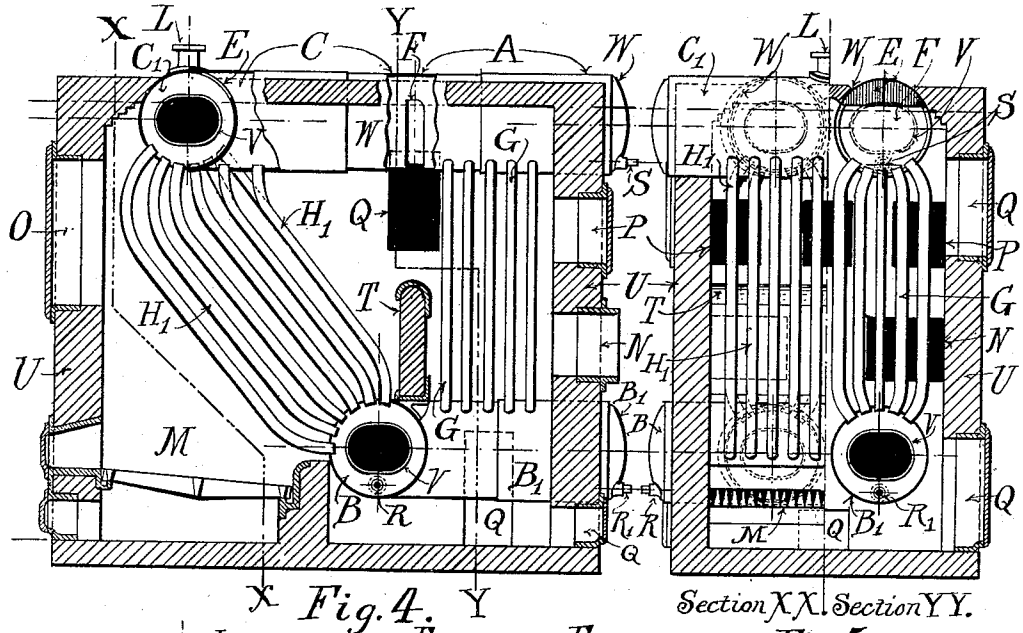

Fig. 4.

Section X X. Section Y Y.

Fig. 5.

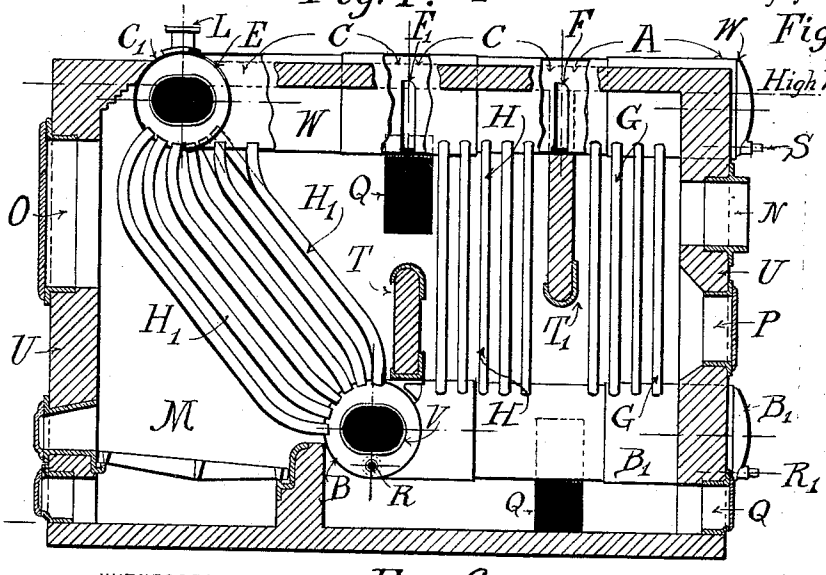

Fig. 6.

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(No Model.) 3 Sheets—Sheet 3.

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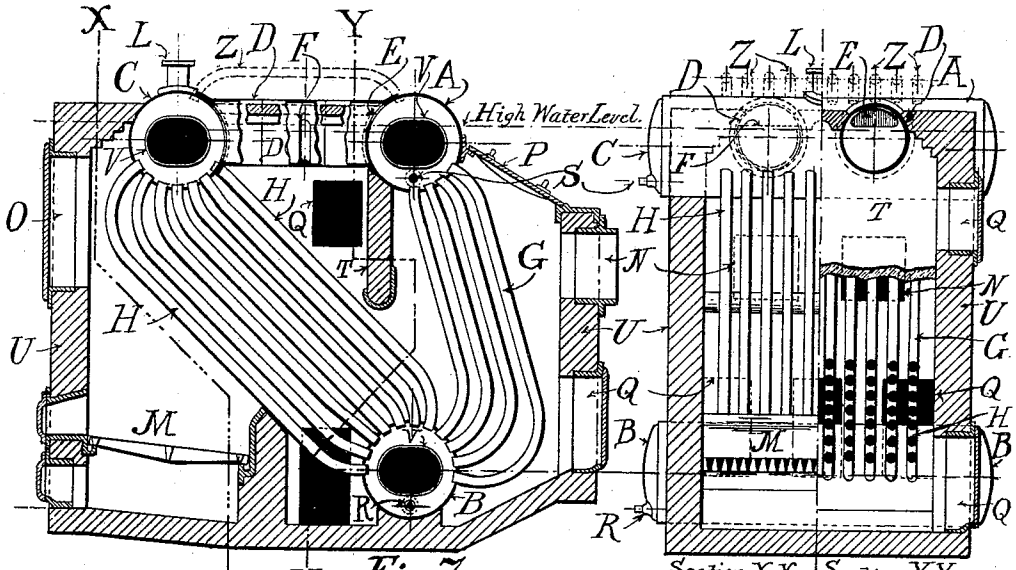

Fig. 7.

Fig. 8.

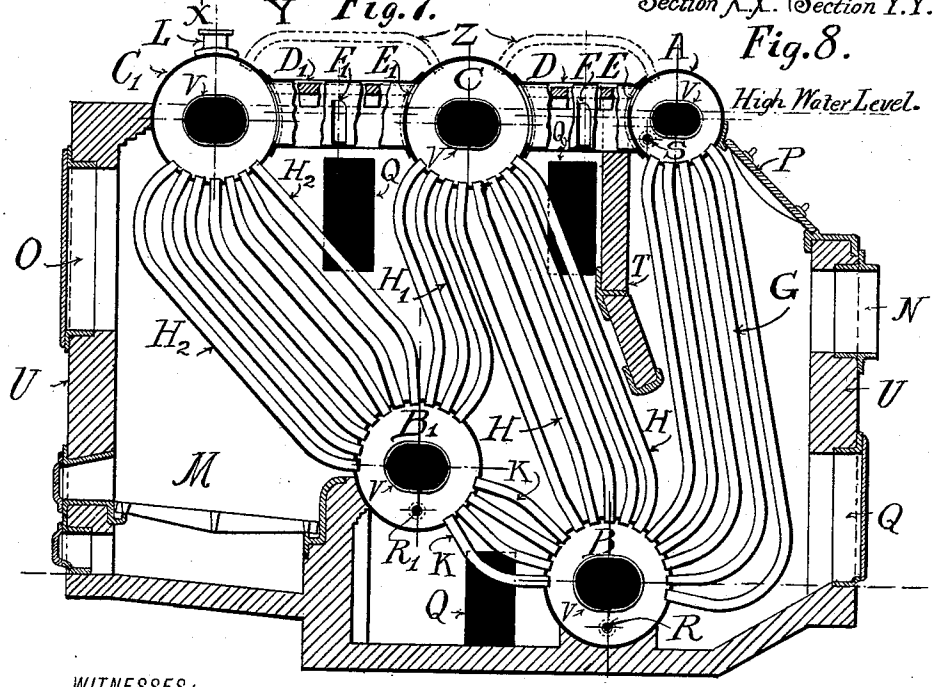

Fig. 9.

WITNESSES:

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Milton Scovel

UNITED STATES PATENT OFFICE.

MINOR SCOVEL, OF NEW YORK, N. Y.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 479,023, dated July 19, 1892.

Application filed January 26, 1892. Serial No. 419,320. (No model.)

To all whom it may concern:

Be it known that I, MINOR SCOVEL, a citizen of the United States, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a specification.

My invention relates to a new type or system of water-tube steam-boilers. Aside from those governing the character and strength of the materials of construction and those governing the combustion of the fuels in the furnace, the essential principles which I have applied practically in my boilers by the novel combinations hereinafter set out may thus be stated: First, the circulation of the water should be continuous and slow from the feed heating and storage space, over all the feed heating and steam-making surfaces, toward and to the steam disengaging and storage space, so directed that every square foot of steam-making surface should receive its full supply of water and no more, and so controlled that no backflow or return current of water shall be set up from the steam disengaging and storage space to or toward the feed storage and heating space; second, the circulation of the water should be continuous and slow and in one direction, all of it passing first over the feed-heating surfaces, thereafter through a mud-drum removed from the action of the fire, and thence to the steam-making surfaces, thus making certain the deposition and convenient the ejection of any sedimentary or scale-making materials contained in the feed-water, and consequently preventing deposits upon the steam-making surfaces, and, third, convenient means of access to the interiors of the drums, tubes, and setting to be provided, so that inspection may be thorough and easy and the substitution of new tubes for defective or damaged tubes may be made possible without the disturbance of any other tube or of the brickwork of the setting or of the deflection plates or walls.

The means and combinations of parts I have invented and applied are described and illustrated in the following specification and drawings, so as to enable any one skilled in the art to comprehend the same and to construct my boiler.

Similar letters refer to similar parts throughout the various views and sections.

In the drawings, Figure 1 is a vertical longitudinal section of my improved steam-boiler. Fig. 2 is a vertical cross-section partly on the section-line $x\ x$ and partly on the section-line $y\ y$ of Fig. 1. Fig. 3 is a vertical longitudinal section of the construction shown in Figs. 1 and 2, showing the steam-drum divided into three parts by cross-partitions. Fig. 4 is a vertical longitudinal section of my improvement having two elevated drums connected by a transverse drum. Fig. 5 is a vertical cross-section of the same, partly on the line $x\ x$ and partly on the line $y\ y$ of Fig. 4. Fig. 6 is a vertical longitudinal section of a modification of the construction shown in Figs. 4 and 5. Fig. 7 is a vertical longitudinal section of a modified construction of my improvement in which there are two elevated drums arranged transversely and connected by longitudinal drums. Fig. 8 is a vertical cross-section of the construction shown in Fig. 7, partly on the line $x\ x$ and partly on the line $y\ y$. Fig. 9 is a vertical longitudinal section of a modification of the construction shown in Fig. 7.

The parts into which such a type or system of water-tube steam-boilers must be divided are shown in their simplest form practically available in Figs. 1 and 2, in which—

W is an elevated receptacle or drum with its internal space divided into two portions A and C by the partition F, A being the feed heating and storage space, and C the steam disengaging and storage space.

B is a mud-drum on a lower level.

G is a bank of feed-heating water-tubes connecting space A with mud-drum B, and H a bank of water-tubes for steam-making connecting mud-drum B with space C.

L is a steam-outlet; M, any usual firing-grate or furnace structure, and N the outlet to the chimney.

O P, &c., are frames and doors so built in in the brickwork of the setting that through some one of them or by the use of a pair of them any tube may be removed and replaced without the disturbance of any other tube or the brickwork of the setting or of the walls or plates T.

Q Q, &c., are cleaning-doors for access to the interior of the setting.

R is a mud-blow-off pipe, and S a feed-water-inlet pipe.

T is a plate or wall to deflect or change the direction of the currents of the gaseous products of combustion.

U is a brickwork iron-stayed and iron-fronted setting of convenient style, shape, and strength.

V V, &c., are manholes for convenient access to the interiors of the various drums and the tubes.

The manner in which I combine these parts and the method of their operation so as to secure the practical application of the principles stated above may be described as follows:

I. *Movements of steam and water currents.*—From the feed storage and heating space A, into which it is fed by the feed-water-inlet pipe S, the water descends through the feed-heating tubes G into the mud-drum B, and, rising through the steam-making tubes H, it fills the steam disengaging and storage space C up to the designed water-level. As the gaseous products of combustion, guided by the plate or wall T, pass from the furnace M to their outlet N the heat is absorbed by the bank of steam-making tubes H and the bank of feed-heating tubes G and the contained water. Steam is consequently generated in the tubes, the currents or streams of steam-bubbles rising into and through the water in the steam disengaging and storage spaces above, being liberated at the water's surface and flowing thence to the steam-outlet L. As the various banks of tubes are unequally heated, unequal expansion of the contained water follows, and the mingled columns of water and steam are lightest in those tubes most exposed to the heat. Consequently a more or less active circulation would tend to arise through the drum W from the hotter space C into the cooler space A and thence through the tubes G, the mud-drum B, and the tubes H back into the space C. Such a circulation, for many reasons, I desire to prevent, and hence place across its path a dam or partition F, with its upper edge so placed with reference to the proposed high-water level of the boiler that no water can flow over it under ordinary conditions of working. Thus the water is compelled to flow from the feed storage and heating space A through the mud-drum B to the steam disengaging and storage space C, and any steam generated in the feed-heating tubes G and rising into the feed storage and heating space A can flow over the upper edge of the dam or partition F, which thus directs and controls the steam and water currents as I desire.

II. *Deposition and ejection of feed-water impurities.*—By reason of the above-described direction and control of the steam and water currents it is evident that all the water entering at the feed-inlet S to replace the steam withdrawn at the outlet L must necessarily pass through the feed-heating tubes G into the mud-drum B. As the total sectional area of the entire bank of tubes G is very much greater than that of the feed-inlet S, the motion of the descending currents of water therein is very slow, and under ordinary running conditions ample opportunity is given for the raising of the temperature of the descending feed-water up to or above the boiling-point, due to the pressure existing in the boiler. Consequently any of the ordinary sedimentary or scale-making materials carried in the water are heated up to or above their points of separation, disassociation, or precipitation, and they are therefore during the slow drift of the water across or through the mud-drum quietly and effectually deposited therein, from whence they can conveniently be ejected by means of the blow-off pipe R. As the total sectional area of the entire bank of steam-making tubes H is much in excess of that of the feed-heating tubes G, the currents out of the mud-drum and into the steam-making tubes are necessarily also very slow, as only enough water to replace the steam withdrawn can rise therein. No tendency, therefore, exists to disturb the comparatively heavy sedimentary or scale-making materials deposited in the mud-drum or to lift them up into the steam-making tubes, which are hence always clean and free from deposits of scale.

III. *Substitution of new tubes for old.*—To provide for this, I space the tubes or the rows thereof, or both, far enough apart from each other and the side and end walls of the setting to allow a tube of like or greater dimensions to be passed freely between and build in the brick walls of the setting two or more openings—such as O P P′, &c.—provided with doors and frames and so placed that through some one, or by the use of a pair of them, any tube may be removed and replaced without disturbing any other tube or the brick-work of the setting or of the deflection plates or walls T.

As I do not desire to confine myself to the one simple arrangement of parts, as shown in Figs. 1 and 2, but have devised and invented the combination of parts necessary to carry out the practical application of the essential principles as laid down above in order to utilize the same in a type or system of water-tube steam-boilers better adapted than many others to meet varied requirements and services, I show, therefore, in the hereinafter-described figures various other arrangements of parts, in which for some of the parts their mechanical equivalents are substituted, for others their relative positions are changed, while some are divided and some duplicated, but all of which arrangements contain the same combination of parts and in which arrangements similarly-lettered parts perform precisely similar functions to those performed by the parts with like letters, the functions of

which were described above with reference to Figs. 1 and 2. Fig. 3 therefore shows an arrangement in which the drum W is divided into three parts by the partitions F and F′, the parts being lettered A, C, and C′. The mud-drum is also lengthened out to make room for another bank of steam-making tubes H′.

Figs. 4 and 5 show two elevated drums similar to W, connected together by a steam-drum C′ at right angles to their main axes. This steam-drum C′ takes the place of the steam storage and disengaging space C′ in Fig. 3. In this case it is evident that the orifice E in the shell of the steam-drum C′, with its lower edge above the designed high-water level of the boiler, is the exact mechanical equivalent of the dam or partition F and fully performs all its functions in directing and controlling the water and steam currents, and can therefore be used interchangeably therewith when convenient. Two lower mud-drums parallel to W are shown connected by a third mud-drum B at right angles to their main axes.

In Fig. 6 the same arrangement is shown as in Figs. 4 and 5, except that an additional bank of steam-making tubes H and the necessary additional orifices or partitions are used.

In Figs. 7 and 8 the drum W of Fig. 1 is replaced by two drums elevated at or about the same level with their main axes approximately parallel. The drum A replaces the feed storage and heating space A, and the drum C the steam disengaging and storage space C of the drum W of Fig. 1. The drum D is added to connect drums A and C and covers the orifice E or contains the partition F. A single mud-drum only is shown; but two or more may be used.

In Fig. 9 the same arrangement is shown as in Figs. 7 and 8, except that an additional elevated steam-drum C′ is connected to the drum C by an additional connecting-drum D′, another lower mud-drum B′ is added, together with the additional banks of steam-making tubes H′ and H″ and the bank of tubes K, connecting the mud-drums B and B′. The necessary orifices E or partitions F are covered by or placed within the connecting-drums D and D′. It is evident, also, that in such arrangements of parts as are shown in Figs. 7, 8, and 9 the separation of the feed heating and storage space A and the steam disengaging and storage spaces C and C′ and their distribution into several and separate drums make it possible by connecting those drums only above their designed high-water level to so direct and control the water and steam currents as to prevent the setting up of any backflow or return-current of water from the steam disengaging and storage space or spaces to or toward the feed storage and heating space, in which case the row of tubes Z, (shown in dotted lines in Figs. 7, 8, and 9,) having both ends of each tube above the designed high-water level in the drums, or a single tube in a like position, becomes by virtue of its position and use the exact mechanical equivalent of the orifices E and the partitions F and fully performs all their functions, as shown in the same and previous figures, and as described above, and such a tube or a row of them, or rows thereof similarly placed, may be used interchangeably with said orifices or partitions when convenient. The word "dam" is used in the claim as a generic term to indicate either the partition F, orifice E, or tube or tubes Z.

In the various arrangements shown in the foregoing figures the parts lettered M, N, L, and V remain practically unchanged, being for present purposes unimportant. Parts O, P, and Q and their duplicates are placed in the several positions in the brick-work of the setting, as convenience in their described uses may dictate. Parts R, S, and T are in some cases duplicated. Part U takes any convenient shape and style as may be determined by the general contour of the arrangement of parts it may happen to surround or support. The deflective wall or plate T in some instances rises from the bottom of the structure and in others depends from the top, and in some cases both arrangements are used.

I am aware that prior to my invention water-tube steam-boilers have been in use of a type seemingly similar to that shown in Figs. 7, 8, and 9, having two or more elevated steam and water drums, together with one or more lower mud-drums, and connected thereto by water-tubes; but, aside from the indirect connection afforded by such water-tubes, the direct connection between the two or more elevated steam and water drums has hitherto always been made by rows of bent tubes, of which some connect the steam-spaces above high-water level and some connect the water-spaces below low-water level of the upper drums, respectively. As the currents of water are free in such a boiler to pass in either direction from drum to drum through the rows of submerged connecting-tubes, any unequal heating and expansion of the water contained in the various banks of water-tubes inevitably sets up through and between the elevated drums a more or less active backflow or return-current of water from the hotter steam disengaging and storage space to or toward the cooler feed storage and heating space, thus stirring up the contents of the mud-drum and carrying them into the water-tubes and preventing their quiet and efficient deposition and easy ejection. Such a manner of connection between the upper drums does not and cannot therefore direct and control the steam and water currents properly, as does the use of the partition F, the orifice E, or the steam-tube Z, which I have devised and described hereinbefore.

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

1. In a water-tube steam-boiler, the combination of an elevated feed-water and steam

chamber, a mud-drum, feed-water-heating tubes leading from the feed-chamber down to the mud-drum, an elevated steam disengaging and storage chamber, steam-generating tubes leading from the mud-drum to the steam-disengaging chamber, and a dam separating the elevated feed-water chamber from the steam-disengaging chamber, substantially as and for the purposes described.

2. In a water-tube steam-boiler having an elevated feed-water chamber, an elevated steam-disengaging chamber, and a mud-drum, the combination of the feed-water chamber mud-drum, and steam-disengaging chamber, with a feed-water-inlet pipe, feed-water-heating tubes leading from the elevated feed-water chamber down to the mud-drum, the said tubes having a total sectional area greater than the sectional area of the inlet-pipe, and steam-generating tubes leading from the mud-drum up to the elevated steam-disengaging chamber, the total sectional area of such steam-generating tubes being greater than that of the feed-water-heating tubes, substantially as and for the purposes described.

3. In a water-tube steam-boiler, an elevated feed-water and steam chamber, a mud-drum, and an elevated steam disengaging and storage chamber, in combination with a second steam disengaging and storage chamber separated from the first steam disengaging and storage chamber by a dam, and feed-water-heating tubes connecting the feed-water chamber with the mud-drum, and steam-generating tubes connecting the mud-drum with the elevated steam disengaging and storage chambers, substantially as and for the purposes described.

4. In a water-tube steam-boiler, two or more elevated drums or receptacles connected by a cross-drum or receptacle and divided by dams into feed-water and steam disengaging chambers, in combination with feed-water-heating tubes leading from the feed-water chambers down to a mud-drum space, and steam-generating tubes leading from the mud-drum space up to the steam-disengaging chambers, substantially as and for the purposes described.

In testimony whereof I have set my hand hereunto in the presence of two subscribing witnesses.

MINOR SCOVEL.

Witnesses:

WALTER J. MULLINS,

JOHN MCSWEENEY.