(No Model.) 3 Sheets—Sheet 1.

H. TETLOW & T. HARRISON.

BOILER

No. 527,515. Patented Oct. 16, 1894.

Fig. 1.

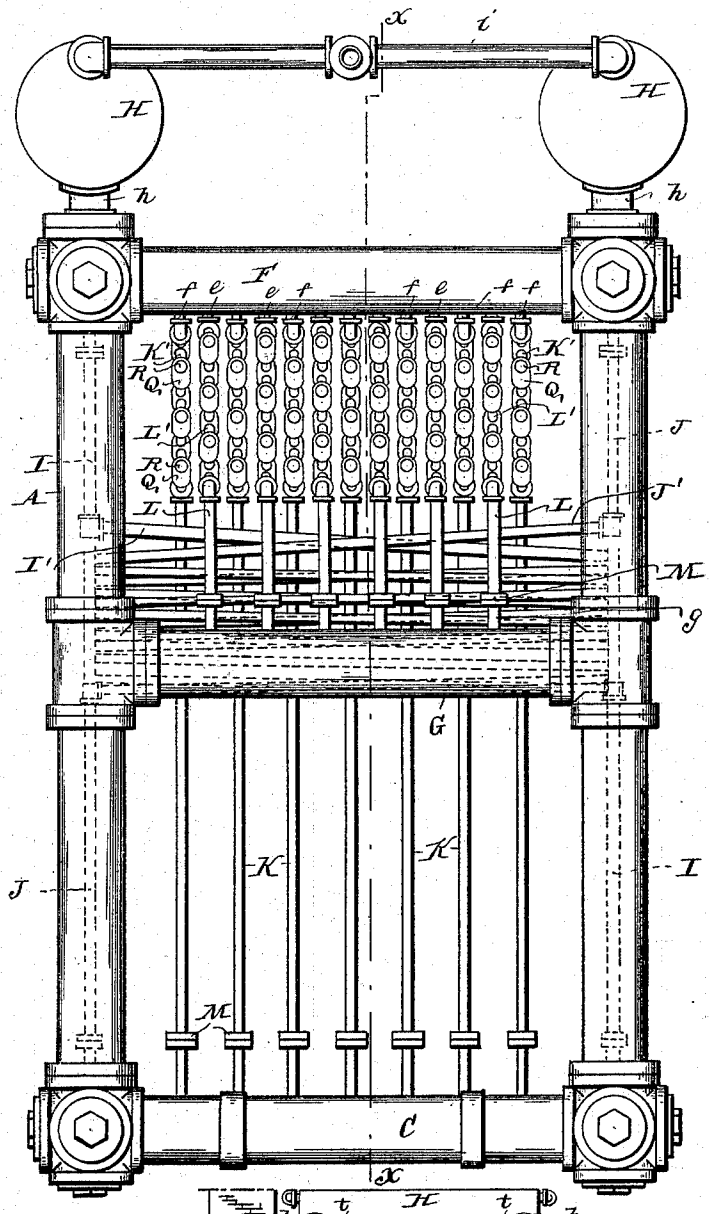
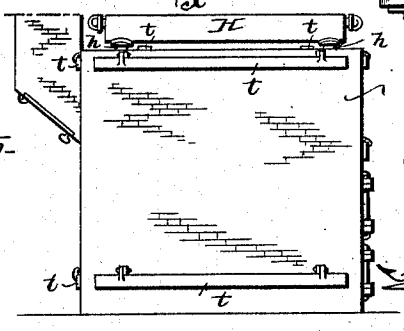


Fig. 5.



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(No Model.) 3 Sheets—Sheet 2.

H. TETLOW & T. HARRISON.

BOILER.

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Fig. 2.

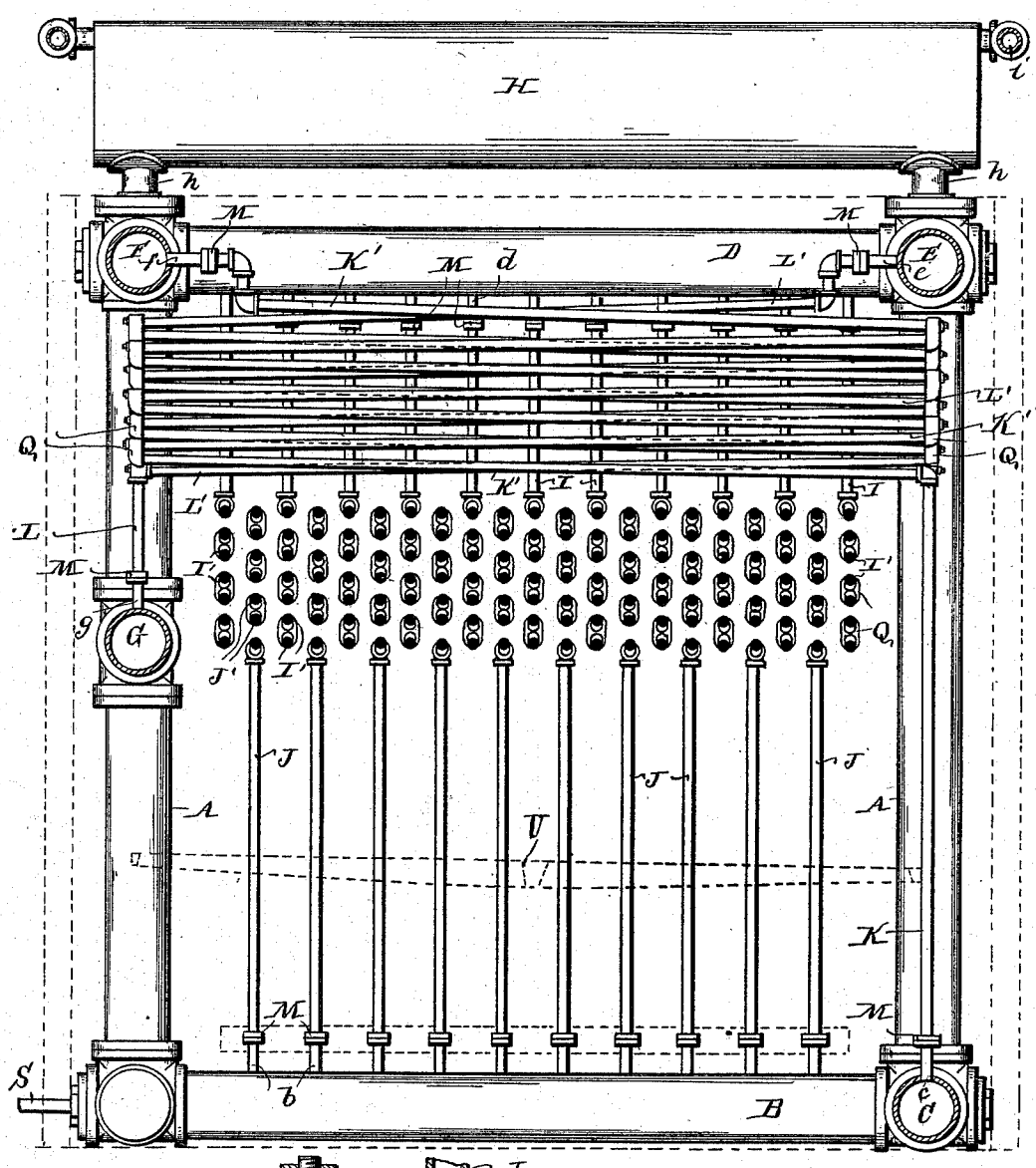


Fig 3

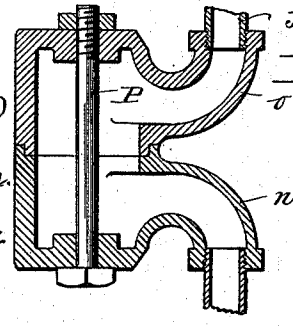
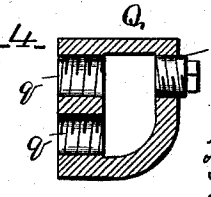


Fig 4.



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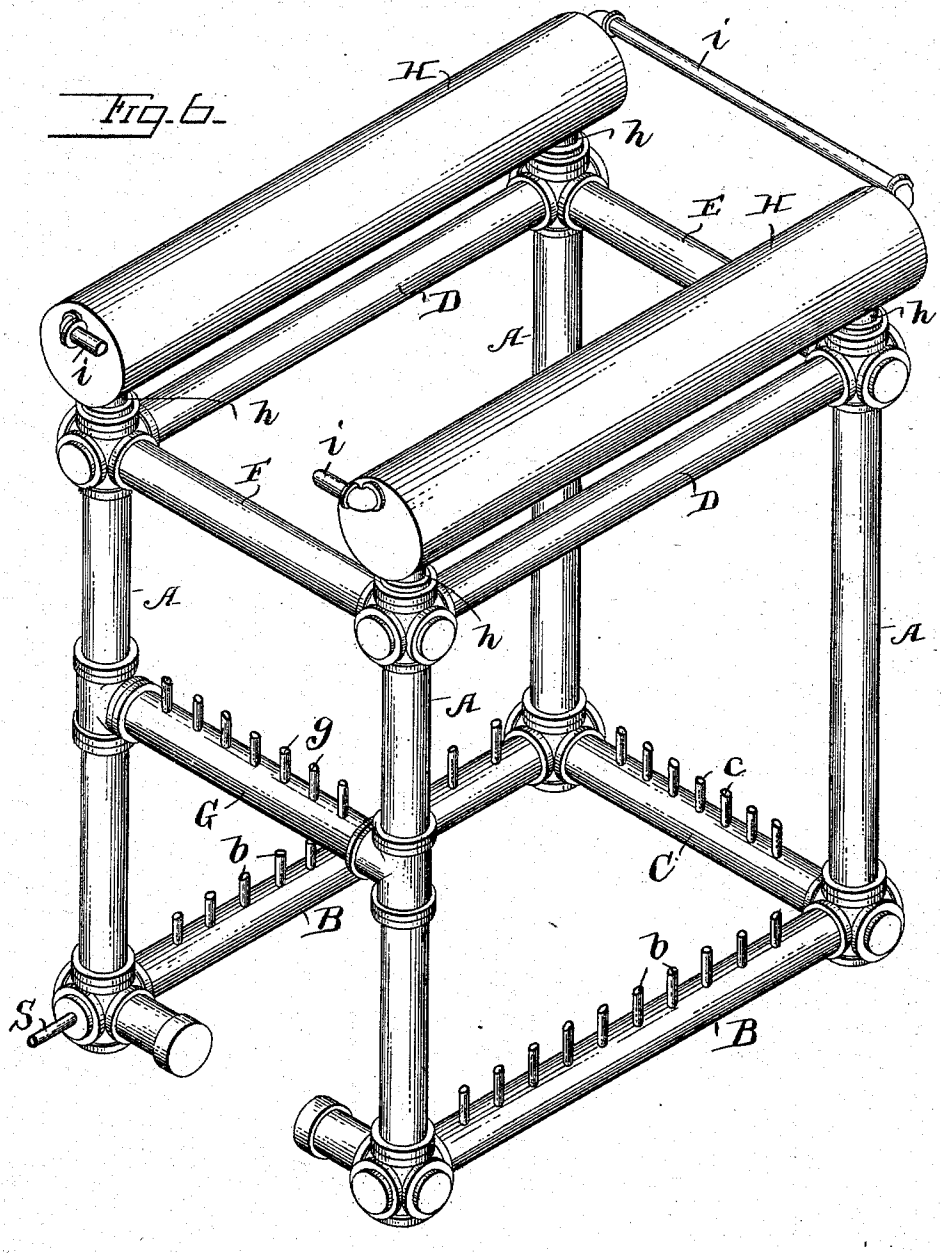
(No Model.) 3 Sheets—Sheet 3.

H. TETLOW & T. HARRISON.

BOILER.

No. 527,515. Patented Oct. 16, 1894.

Fig. 6.



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UNITED STATES PATENT OFFICE.

HENRY TETLOW AND THOMAS HARRISON, OF PHILADELPHIA, PENNSYLVANIA; SAID HARRISON ASSIGNOR TO SAID TETLOW.

BOILER.

SPECIFICATION forming part of Letters Patent No. 527,515, dated October 16, 1894.

Application filed July 28, 1893. Serial No. 481,712. (No model.)

To all whom it may concern:

Be it known that we, HENRY TETLOW and THOMAS HARRISON, both of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented an Improvement in Boilers, of which the following is a specification.

Our invention has reference to steam boilers, and consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings which form a part thereof.

The improvement contemplates certain features of construction which permit more perfect circulation of water and steam in a boiler entirely built up of tubes.

The invention also includes specific improvements in the construction looking to the assembling of the parts making up the water circulatory system in such a way that a water tube may be readily replaced when defective and without dismantling the structure as an entirety.

In carrying out our invention we employ large upright tubes located at each corner, and these are connected at the sides and back by a large horizontal tube at the bottom of the boiler; and at front, sides, and back by horizontal tubes at the top of the boiler. There is also a large transverse or cross tube connecting the two front upright corner tubes located intermediate of the top and bottom. A series of steam generating tubes of small diameter have their tops connected with the upper side horizontal tubes and their bottoms with the horizontal bottom side tubes. In addition to these two sets of steam generating tubes there are two other sets of similar tubes connected at the bottom with the two large transverse tubes and at the top with the upper large transverse tubes. These generating tubes have horizontal, or approximately horizontal portions or sections. These various generating tubes are coupled in position and connected with branches from the main large tubes by detachable couplings, preferably of the construction shown, so that any complete generating tube may be readily removed, repaired and replaced, or replaced by a new one. The fire grate is arranged between the walls of vertical tubes and below the intermediate front transverse tube and also below the horizontal parts of the generating tubes. The steam drums are formed of two rearwardly extending large tubes supported by and connecting with the four upright or corner tubes, two of which open into the bottom of one steam drum and two into the bottom of the other steam drum. The drums are also connected together at each end by transverse tubes or pipes, from one or both of which steam may be led to the place of consumption. In one of said connecting pipes the safety valve may be placed. The entire is inclosed by brickwork on sides and back and by breeching in front, and long doors or removable plates are arranged therein adjacent to or over the couplings in the generating tubes to permit access thereto when it may be necessary to make repairs or replace a defective tube.

In the operation of our improved boiler the heat from the furnace grate is caused to come into contact with the horizontal portions of the small generating tubes, thus generating steam very quickly and utilizing to the best advantage the products of combustion. The water is kept in a constant circulation and permits the ready escape of steam from the various pipes to the steam drums when it is clearly separated from any ebullition of the water, and thus may be delivered to the engine in a comparatively dry state. This is very advantageous in that it permits a greater evaporation duty per pound of coal than in those cases where the hot water of the boiler is carried off in suspension with the steam.

Our invention will be better understood by reference to the accompanying drawings, in which—

Figure 1 is a front elevation of our improved boiler. Fig. 2 is a longitudinal vertical sectional view on the line *x*—*x* of Fig. 1. Fig. 3 is a vertical sectional detail view on an enlarged scale of one form of coupling which may be employed. Fig. 4 is a similar view of one of the couplings for the small horizontal pipes. Fig. 5 is a side elevation of the structure with its inclosing walls; and Fig. 6 is a perspective view of the boiler structure composed of the large pipes.

A are the large vertical pipes. The bot-

toms of the pipes A, A on each side are connected by large side pipes B.

C is a large transverse pipe connecting the two rear pipes A, A. The tops of the pipes, A, A on each side are connected by the large side pipes D.

E is the rear transverse pipe connecting the tops of the two opposite rear pipes A, A.

F is the front transverse pipe connecting the tops of the two opposite front pipes A, A.

G is the intermediate large transverse pipe connecting the two opposite front pipes A, A between their tops and bottoms.

All of the pipes described are united at their points of connection by suitable water and steam tight couplings.

H, H are the steam drums which are connected with the tops of the pipes A, A through the connecting pipes or couplings *h*, *h*, the pipes A, A on one side being connected with one drum H and the pipes A, A on the other side with the other drum. The drums H, H are connected together at each end by transverse tubes or pipes, *i*, *i*, from one or both of which steam may be led to the place of consumption. The two transverse connecting pipes *i*, *i* may be connected by a pipe or tube. In one of the connecting pipes *i* a safety valve may be placed.

I are a set of small tubes connecting one of the lower side pipes B with one of the upper side pipes D and having horizontal portions I′ extending from side to side within the structure composed of the large pipes. J are a similar set of small tubes connecting the other lower side pipe B with the other upper side pipe D and having similar horizontal portions J′ extending from side to side within the structure composed of the large pipes.

K are a series of small tubes connecting the lower transverse rear pipe C with one of the transverse upper pipes and having horizontal portions K′ extending longitudinally within the structure composed of the large pipes and preferably above the horizontal portions I′ and J′ of the pipes or tubes I and J.

L are another set of small pipes or tubes connecting the intermediate transverse pipe G with the other upper transverse pipe and having horizontal portions L′ similar to the horizontal portions K′ of the pipes or tubes K.

We prefer to connect the small pipes or tubes I, J, K and L with the opposite top and bottom pipes, and they are so shown in the drawings. Thus the pipes or tubes I and J respectively connect one of the bottom side pipes B with the opposite top side pipes D; and the pipes K and L respectively connect the lower pipes C and G with the upper transverse pipes F and E. It will be understood however, that these small pipes or tubes I, J, K and L may connect the upper and lower pipes on the same side, instead of the opposite pipes.

The various small pipes I, J, K and L may be connected with the respective large pipes B, C, D, E, F and G by suitable couplings. The connection is preferably made through coupling M uniting the ends of the pipes I, J, K, and L with short pipe sections *b*, *c*, *d*, *e f* and carried by the respective pipes B, C, D, E, F and G. By the use of such couplings the pipes I, J, K and L or any portion of them, may be easily disconnected without dismantling the entire boiler. To permit easy access to these couplings M, the inclosing structure T may be provided with doors *t* suitably located to permit the couplings to be reached from the outside when the doors are opened.

In Fig. 3 we have shown a form of coupling which may be employed. In this construction the coupling M consists of the two parts N and O adapted to be secured together as by a bolt P. The parts N and O are provided respectively with threaded necks *n* and *o* adapted to receive the threaded ends of the pipes J, &c., and *b*, &c. Any other form of coupling may however be employed.

In Fig. 4 is shown our preferred coupling for the horizontal portions of the pipes I, J, K and L. This consists of a hollow cap Q provided with threaded sockets *q* to receive the ends of two horizontal portions I′, J′, K′, L′.

R is a removable plug in the cap Q in line with one of the sockets *q* so that when the plug is removed a cleaning rod may be inserted through the cap directly into one of the pipes connected therewith. Thus each cap gives access to the interior of one of the two pipes coupled by it and in that manner each horizontal pipe may be cleaned.

While the sections I′, J′, K′ and L′ are described as horizontal pipes, it will be observed that they incline slightly from the horizontal plane.

S is a water pipe which supplies water to the lower portion of the pipe structure formed by the large pipes. The grate is located within the structure below the horizontal pipes I′, J′, K′ and L′ as is shown at U in dotted lines in Fig. 2 so that these horizontal portions of small pipe are subjected directly to the heat.

While we prefer the minor details of construction shown we do not limit ourselves to them as they may be varied without departing from the invention.

The pipe structure which composes the boiler will be inclosed in a suitable setting of brick as has been heretofore stated or when used as a marine or locomotive boiler it may be enveloped in a suitable metal structure.

To increase the height of the boiler, when the same is desired it is apparent that a second pipe section or structure composed of the large upright corner pipes, upper horizontal connecting pipes and small tubes may be coupled with the upper large horizontal pipes of the first section or structure.

The operation of the boiler in the generation of steam will be readily understood from the foregoing description of the construction of the boiler. The water is admitted to the structure of large pipes by the pipe S and is subjected to the products of combustion from

the grate U. The connecting pipes or tubes induce a constant circulation of the water so that it is thoroughly subjected to the heat giving off its steam which passes off through the connecting tubes *h* into the steam drums H. As these drums are connected with the upright pipe A, A the steam will be separated from the water of ebullition the steam passing up through the connecting pipes *h* and the water filling through the tubes A. Thus a more dry steam is produced.

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

1. In a steam boiler, a tube structure composed of four large upright corner tubes connected at the top and bottom by large horizontal tubes, and sets of small generating tubes connecting the upper and lower horizontal tubes and having substantially horizontal portions or sections located at a distance above the lower large horizontal connecting tubes, and a grate located within the space bounded by the large upright tubes and situated above the lower horizontal connecting tubes and below the substantially horizontal portions of the small generating tubes.

2. In a steam boiler, the combination of four corner upright tubes connected on all sides by horizontal tubes, with two sets of small generating tubes respectively connected with the diagonally opposite horizontal tubes, detachable couplings between the generating tubes and the horizontal tubes, an inclosing covering for the tubes, a breeching provided with a door at the front to secure access to the front couplings, and covered openings at top and rear to secure access to the couplings at these places.

3. In a steam boiler, water circulating tubes combined with two horizontal or transverse water tubes at different elevations, a series of generating tubes of small diameter having their ends connecting with the horizontal or transverse tubes, detachable couplings adjacent to the horizontal or transverse tubes for disconnecting the generating tubes separately consisting of elbowed parts connected respectively with the return tubes and horizontal tubes and provided with communicating water passageways, and a clamping bolt for clamping the two parts together.

4. In a steam boiler, water circulating tubes combined with two horizontal or transverse water tubes at different elevations, a series of generating tubes of small diameter having their ends connecting with the horizontal or transverse tubes, detachable couplings adjacent to the horizontal or transverse tubes for disconnecting the generating tubes separately consisting of elbowed parts connected respectively with the return tubes and horizontal tubes and provided with communicating water passageways, and a clamping bolt for clamping the two parts together passing through the apertures parallel to the return tube and packed to prevent leakage.

5. A steam boiler composed of an upper and lower set of large horizontal tubes, the upper large horizontal tubes being located above the water level, a series of generating tubes connecting the upper and lower large horizontal tubes and having horizontal portions extending above the grate, large upright corner return tubes between the upper and lower sets of large horizontal tubes and non-connecting with the small generating tubes, whereby the steam is generated within the small generating tubes and passes thence into the upper large horizontal tubes without passing through the upright tubes and the water is returned through the large upright corner tubes, and a steam drum or drums having the inlet passages from the set of upper horizontal tubes leading directly from above the vertical return tubes, whereby the steam in passing to the inlet to the steam drum or drums will traverse the open upright return tubes, thereby becoming freed of the water of ebullition.

6. The steam boiler section consisting of the four large corner tubes A, the large side tubes B connecting the bottoms of the tubes A, the upper large side tubes connecting the top of the tubes A, the large transverse tube C connecting the rear tubes A at the bottom, the upper transverse large tubes E, F connecting the two rear and the two front tubes A respectively, the intermediate large connecting tube G between the front tubes A, and small connecting pipes between the upper and lower large connecting tubes.

7. The steam boiler section consisting of the four large corner tubes A, the large side tubes B connecting the bottoms of the tubes A, the upper large side tubes connecting the top of the tubes A, the large transverse tube C connecting the rear tubes A at the bottom, the upper transverse large tubes E, F connecting the two rear and the two front tubes A respectively, the intermediate large connecting tube G between the front tubes A, and small connecting pipes between the upper and lower large connecting tubes; in combination with the grate U located between the large tubes A above the connecting tubes B, B, C and below the intermediate front connecting tube G.

In testimony of which invention we have hereunto set our hands.

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THOMAS HARRISON.

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