

L. E. FEIGHTNER.  
 SUPERHEATER FOR LOCOMOTIVE BOILERS.  
 APPLICATION FILED MAR. 27, 1909.

939,237.

Patented Nov. 9, 1909.

5 SHEETS—SHEET 1.

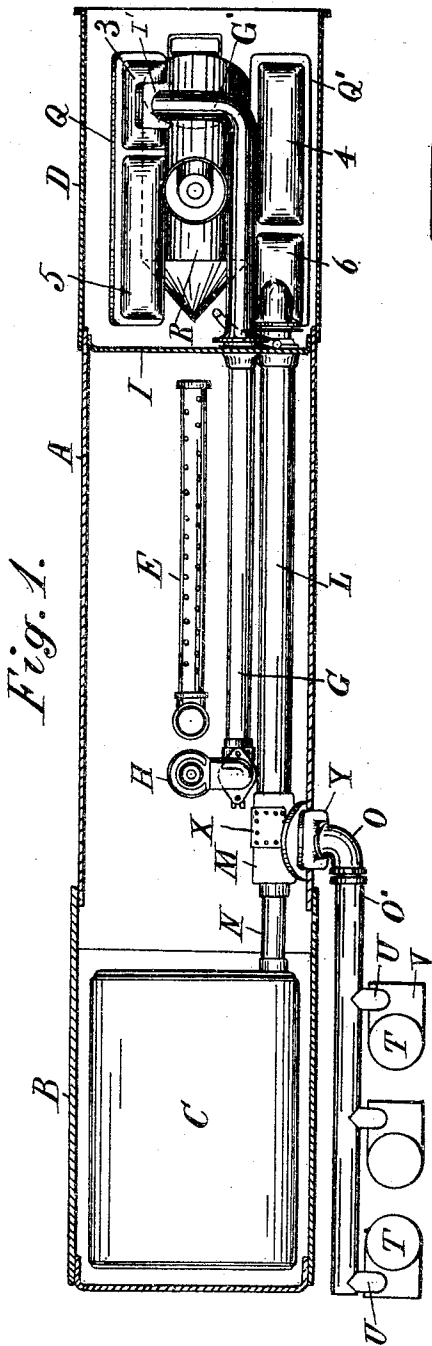


Fig. 1.

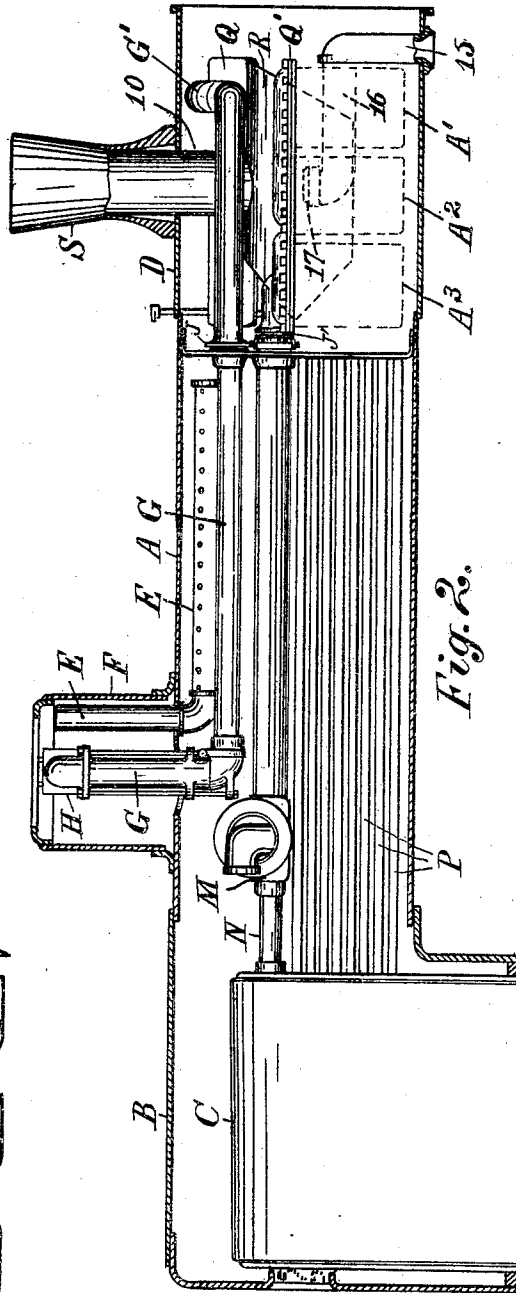


Fig. 2.

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 Lewis C. Feightner, per  
 Thomas S. Crane, Atty.

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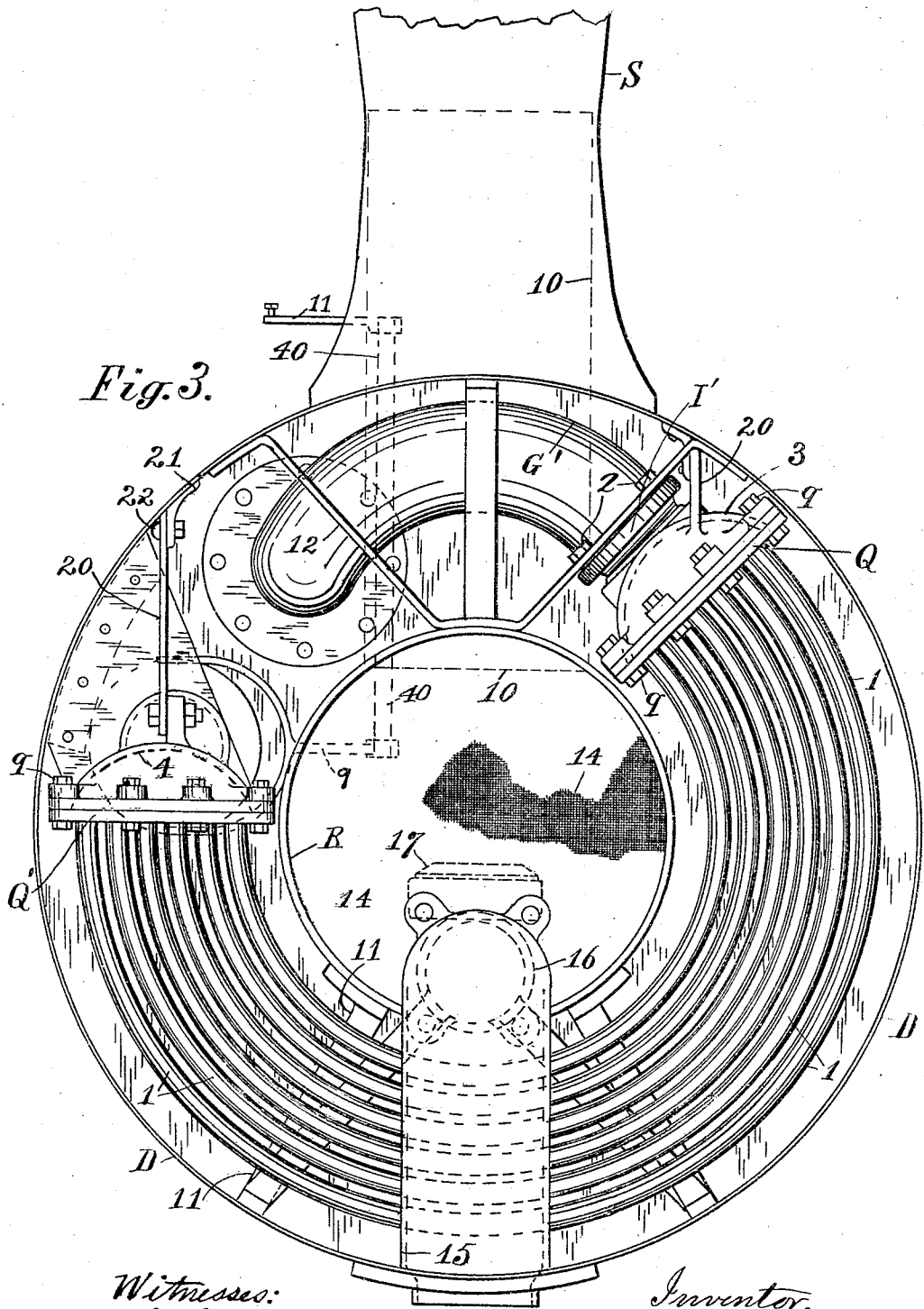


Fig. 3.

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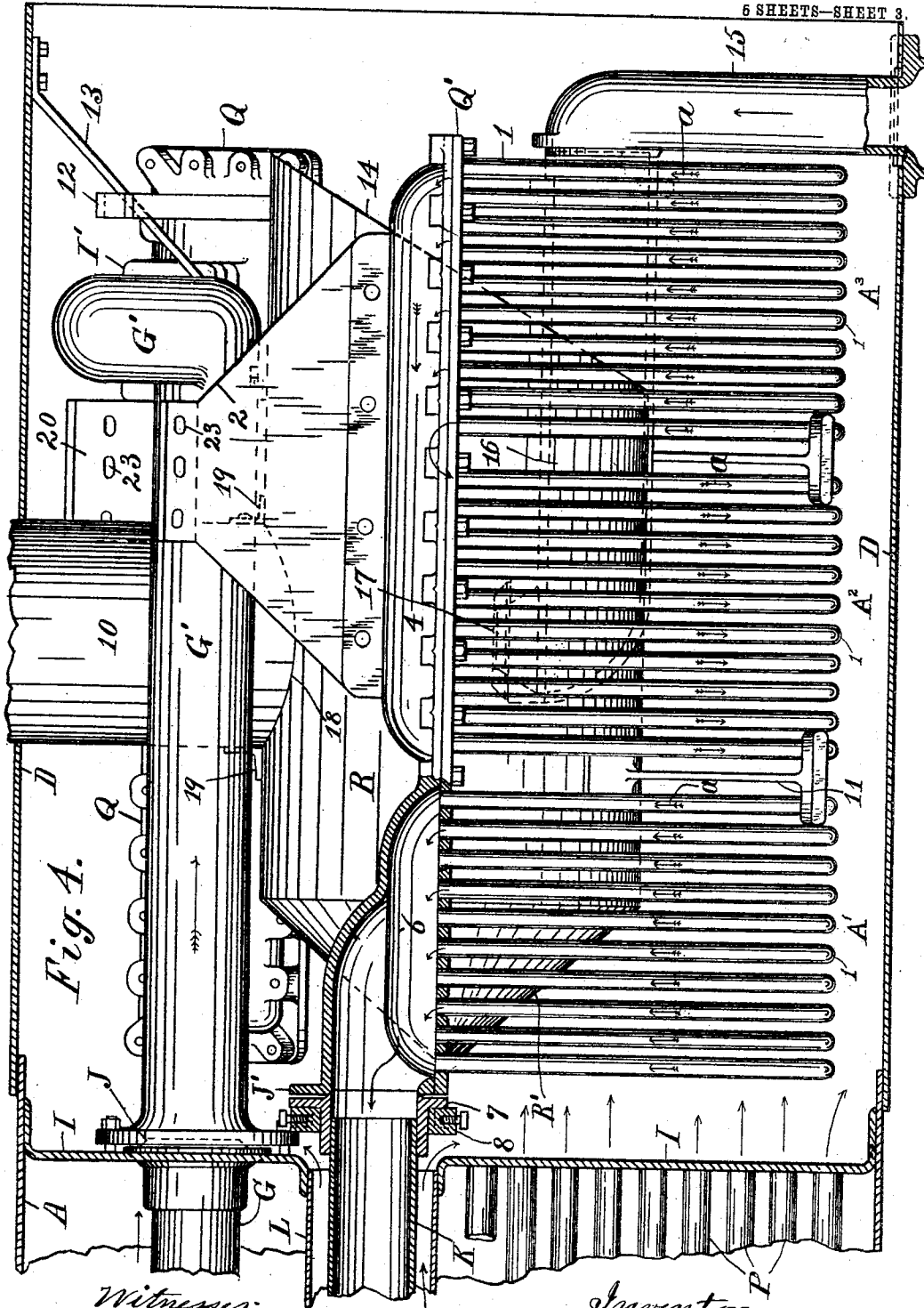


Fig. A.

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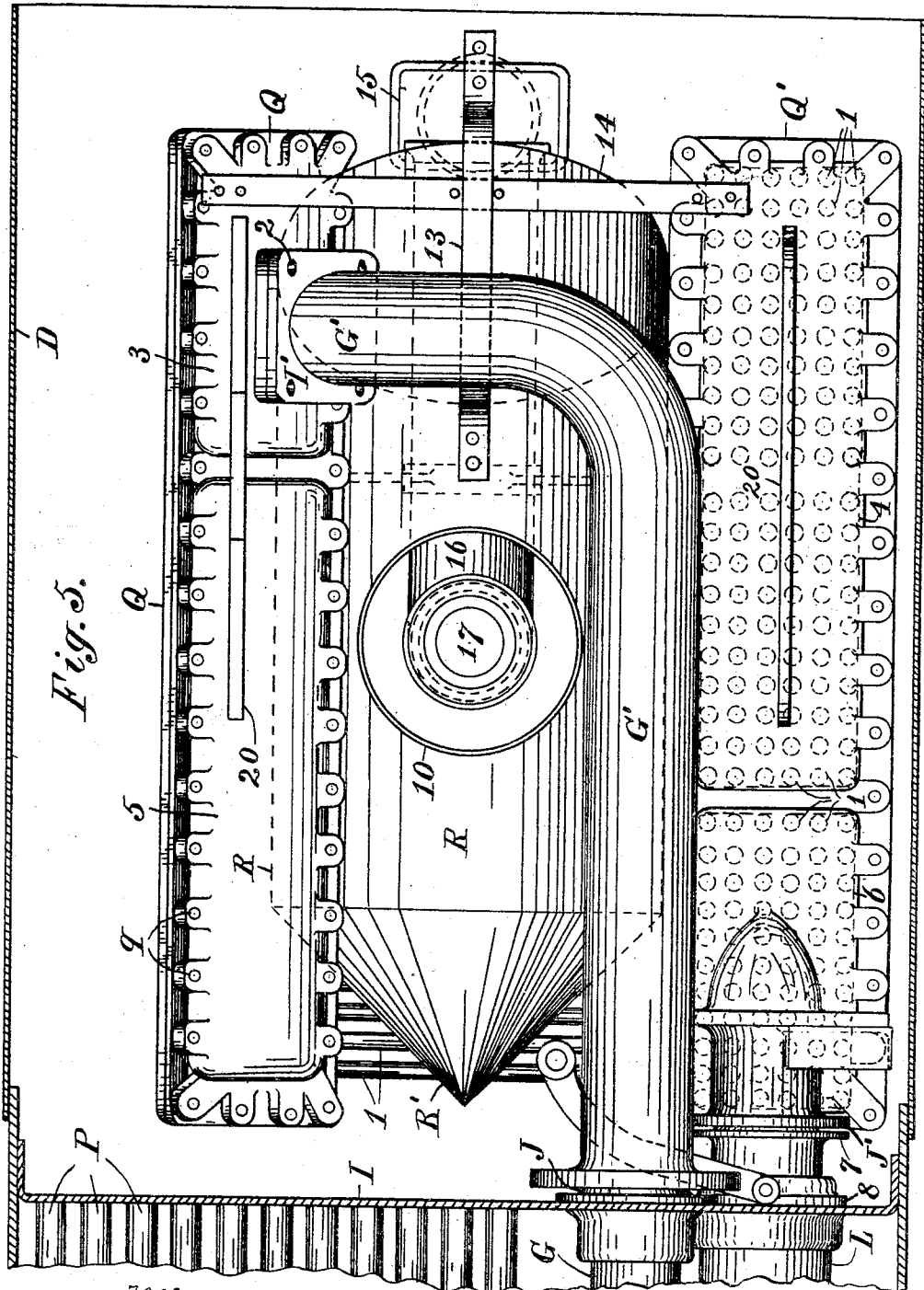


Fig. 5.

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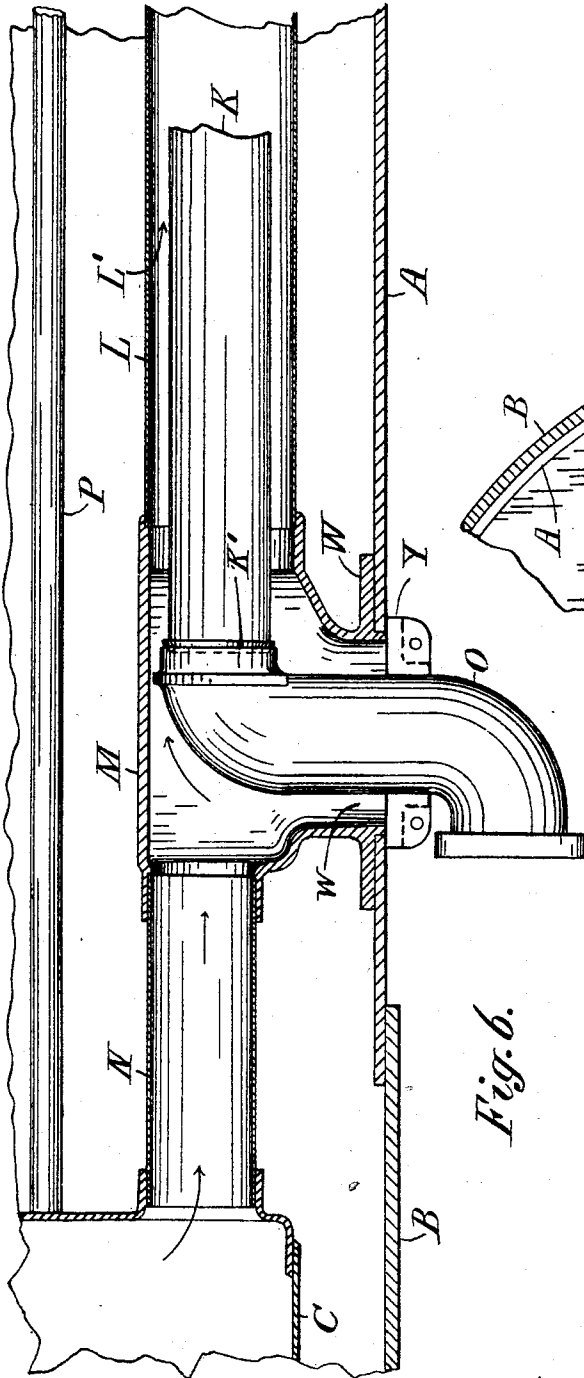


Fig. 6.

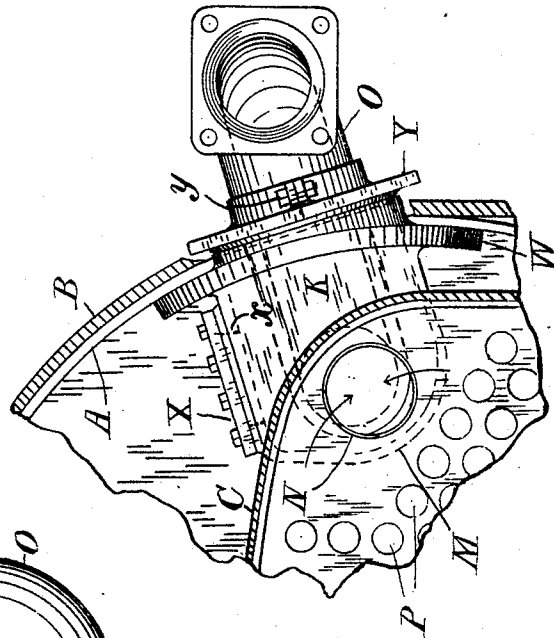


Fig. 7.

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# UNITED STATES PATENT OFFICE.

LEWIS E. FEIGHTNER, OF LIMA, OHIO, ASSIGNOR TO LIMA LOCOMOTIVE & MACHINE COMPANY, OF LIMA, OHIO, A CORPORATION OF OHIO.

SUPERHEATER FOR LOCOMOTIVE-BOILERS.

939,237.

Specification of Letters Patent.

Patented Nov. 9, 1909.

Application filed March 27, 1909. Serial No. 486,074.

*To all whom it may concern:*

Be it known that I, LEWIS E. FEIGHTNER, a citizen of the United States, residing at 715 South Broadway, Lima, county of Allen, and State of Ohio, have invented certain new and useful Improvements in Superheaters for Locomotive-Boilers, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The present invention relates to a superheater for use upon locomotive boilers for delivering very hot superheated steam to the engine cylinders. It is well known that the utility of a superheater in drying the steam is largely neutralized if the steam is conveyed for any considerable distance before it is delivered to the cylinder steam-chest, as cooling or condensation commonly occurs in the conveying pipe. In a locomotive the superheater is often located in a smokebox in the path of the heated gases as they escape from the smoke-flues, and where the cylinders as in the Shay or Mallet type of locomotive, are located near the firebox of the boiler, it is obvious that great difficulty is experienced in maintaining the dryness or temperature of the superheated steam in transmission from the smokebox to the cylinders, unless special means is provided to prevent radiation of heat.

The means which I employ to prevent radiation of heat in the present construction, consists of a tube extended directly from the firebox to the smokebox, forming a passage through which the hot gases flow to the stack and through which the cylinder-pipe is extended. It is led outward from this tube through the side thereof and through the side of the boiler, near the connection to the cylinder steam-chests. The heat of the steam is not only maintained in its passage to the cylinders, but is increased as it approaches the cylinders, because it meets the fresh gases from the firebox.

In the present invention, the superheater is formed of headers extended longitudinally in the smokebox with successive groups of tubes connected serially by the headers and extended concentric with the shell of the smokebox, across the bottom of the smokebox. Owing to the disposition of the smoke-flues, the heated gases enter the lower part

of the smokebox, and these tubes are therefore located within such lower part to absorb the heat. The central part of the smokebox is filled with a cylindrical deflector having a conical end next the tube-sheet and having its upper side connected with the smoke-stack, so that the gases are compelled to circulate between the tubes of the superheater on their way to enter the forward end of the deflector before they can escape to the stack. The inlet to the headers is connected with the throttle-valve, and the chambers in the headers are so formed that the steam traverses the entire course of the superheater-pipes three times back and forth before it escapes to the cylinder-pipe.

The invention further includes various details of construction, all of which will be understood by reference to the annexed drawing, in which—

Figure 1 is a plan of a locomotive boiler with the upper half of the shell removed to show the interior; Fig. 2 is an elevation with the nearer side of the shell removed; Fig. 3 shows the interior of the firebox viewed from the front end; Fig. 4 is a side elevation of the firebox with the nearer half of the shell removed and the discharge connections from the superheater shown in section, where hatched, at the center of the discharge-pipe; Fig. 5 is a plan of the smokebox with the top of the shell removed; Fig. 6 is a horizontal section of the steam-pipe and the gas-passage at the firebox end, where the cylinder steam-pipe emerges from the side of the boiler; and Fig. 7 is an end view of the said connections with the crown-sheet and the shell of the firebox in section.

In Figs. 1 and 2, A is the barrel of the boiler, B the shell of the firebox, C its crown-sheet, D the shell of the smokebox, E the dry-pipe for delivering dry steam to the dome F, G the steam supply-pipe to the top of which the throttle H is applied, and the end of which is extended through the forward tube-sheet I with the usual adjustable joint J.

The superheater supply-pipe G' extends within the smokebox from the joint J to the inlet flange I' of the superheater. The outlet-flange J' of the superheater is connected with the cylinder-pipe K, and the said pipe K is extended from the smokebox to the

proximity of the firebox through a smoke or gas-pipe L and a junction-box M, which is connected directly with the firebox by a tube N opening through its tube-sheet. From the junction-box the cylinder-pipe is carried outward through the barrel A of the boiler to an elbow O and steam-chest pipe O'.

In the Shay locomotive the engines are constructed with upright cylinders T, as shown in Fig. 1, the pipe O' having branches U leading directly into the chests V of the cylinders, as shown in Fig. 1.

The tube L is materially larger than the cylinder-pipe K, leaving an annular gas-passage L' between the two (see Fig. 6), and the draft to the smoke-stack draws the heated gases from the hottest part of the firebox through the gas-pipe L thus enveloping the cylinder-pipe in its passage to the cylinders, and exposing the same to a temperature which increases as the steam approaches the cylinders.

The headers Q and Q' for the superheater are formed of tube-plates, and cover-plates having chambers therein and secured to the tube-plates by bolts g.

The ends of the superheater-tubes 1 are expanded in the tube-plates, which are disposed at opposite sides of the smokebox, and the tubes are curved downwardly between the tube-plates, concentric with the shell D.

The cover-plates are formed with chambers 3, 4, 5 and 6; the chamber 3 connecting with one group A' of the tubes which leads the steam across the smokebox into one end of the chamber 4, the opposite end of which connects with the second group A<sup>2</sup> of tubes which in turn leads the steam across to one end of the chamber 5, from the opposite end of which it is delivered through the third group A<sup>3</sup> to the final chamber 6, whence it passes through the outlet-flange J' to the cylinder-pipe K, (see Figs. 1, 4, and 5).

The cylinder-pipe has a flange 7 for coupling to the flange J' adjacent to the forward tube-sheet I, and on the hub of this flange 7 a gas-damper, made in the form of a ring 8, is fitted to slide to and from the annular opening L' at the forward end of the gas-tube L where it opens into the smokebox. Such damper is actuated by a lever 9 with a spindle 40 extended upward through the shell of the smokebox, and provided on top with a lever 11 from which a connection would be extended to the engineer's cab.

It is obvious that with the highly heated smoke and gases passing through the passage L', the steam-pipe would be readily overheated when no steam is passing through it to absorb the heat, and such damper is therefore closed when the steam is not being used in the engine cylinders.

Fig. 7 shows the upper right hand corner of the firebox from which a few of the smoke-flues P are in practice omitted to ad-

mit the smoke-tube N, which thus receives the gases from the upper part of the firebox, and leads them into the smoke-passage L'.

To facilitate connection with the cylinder-pipe K which is upon the same level with the pipe N, (see Fig. 2) the outlet-flange J' of the superheater is set upon that level, and the header Q' containing the chambers 4 and 6 is thus located near the center level of the smokebox.

The header Q connected with the supply-pipe G' is extended in the firebox about midway between its horizontal center line and the stack S, and thus the bolts 2, which secure the supply-pipe G' to this header, are in a position accessible to a workman within the center of the curved tubes, and interference with the passage of the exhaust to the stack is avoided.

The headers, complete with the tubes, can be finished entirely apart from the smokebox and slid within the same, being then secured in place and supported by hangers 20 attached to the upper part of the shell D. The open space in the center of the superheater-tubes permits a workman then to gain access to the flange J' for coupling the superheater outlet with the cylinder steam-pipe K, and to the flange I' for coupling it with the supply-pipe G'.

A cylindrical deflector R, having a conical end R' next the tube-plate I, is supported in the center of the tubes 1 by braces 11, 12 and 13, and a petticoat-pipe 10 is extended downward from the stack within the upper part of the deflector. The gases can only escape from the firebox through the interior of the deflector, and its forward end, as shown in Fig. 4, is inclined and provided with a screen 14.

The conical end of the deflector is set near to the forward tube-sheet i so as to obstruct the gases which enter the smokebox at its center and deflect them laterally. The cylindrical deflector forms a chamber entirely closed except at the forward end, and where the petticoat-pipe forms a closed connection therewith, and the cross-section of the deflector is circular so as to obstruct the gases in the entire center of the smokebox and drive them laterally, as desired.

The combined operation of the conical end and the cylindrical deflector is to first deflect the gases outwardly against the superheater tubes and to then confine the gases closely to the annular space in which the tubes are located; the draft in such annular space being chiefly downward, because the outlet for the escape of the gases consists only of the downwardly inclined screen 14 on the front end of the deflector.

The exhaust-pipe 15 is introduced into the smokebox at the bottom of its forward end and extended upward to the bottom line of the deflector into which a horizontal

section 16 is extended, passing through the screen 14 and having an upright nozzle 17 upon its inner end beneath the petticoat-pipe 10.

5 As the smoke-flues P from the firebox enter the lower part of the smokebox, the heated gases from such tubes are compelled to pass between the superheater-tubes 1 to reach the screen 14 before they can escape through the petticoat-pipe 10. As the  
10 steam passes three times across the smokebox through the tubes 1 (as shown by the reverse direction of the arrows *a* in Fig. 4) it is fully exposed to the heat of the gases and is thus superheated in the desired manner. Its movement through the cylinder-pipe K within the hot gas-passage L' maintains its heat and dryness until it is close to the steam-chest connection O', when it passes  
20 through the side of the boiler and is delivered immediately to the steam-chests V.

The details of construction which are shown in the drawing greatly facilitates the manufacture of the superheater and its  
25 connection in the smokebox with various other parts of the apparatus.

The hangers 20 which support the superheater are fastened by bolts 22 to angles 21 upon the shell of the smokebox, the holes 23 for the bolts being slotted, as shown in Fig. 4, to permit expansion of the parts. These connections are readily made when the superheater is slid into the smokebox and blocked up in its working position, and the inlet and outlet of the superheater are then  
35 connected to the steam supply-pipe G' and the cylinder-pipe K.

The petticoat-pipe 10 is movable in the smoke-stack so that it can be slid upward  
40 when inserting the deflector R in its working position, and then lowered into the aperture 18 in the top of the deflector, being then supported upon the deflector by brackets 19, as shown in Fig. 4.

45 The braces 11 for the lower part of the deflector are secured in place when the superheater is inserted, thus supporting the deflector when set in place, and the braces 12 and 13 are then secured to the deflector and to the shell of the smoke-stack, and the exhaust-pipes 15 and 16 are then secured in  
50 their working position.

The parts can be readily removed by reverse operations, and access can be obtained  
55 to any of the joints about the superheater, in case they require attention, by removing the exhaust-pipe and the deflector from the smokebox.

By reference to Fig. 1, it will be observed  
60 that the header Q' must deliver the superheated steam close to the tube-sheet I, and it is therefore desirable to introduce the steam to the superheater near the forward end of the smokebox. This compels the disposition of the pipe G' and the header Q

at opposite sides of the center line to secure as great a length as possible for the superheater-tubes, and also clear the petticoat-pipe 10 and leave a free passage for the escaping smoke to the stack. The header Q  
70 is therefore set as close as possible to one side of the petticoat-pipe 10, as is clearly shown in Fig. 3, and the pipe G is extended through the steam-space of the boiler A upon the opposite side of the center, so as  
75 to connect with the header readily in such position. This arrangement of the dry-pipe G and the supply-pipe G' prevents the pipe G' from lying over the top of either of the headers, and thus leaves their covers ac-  
80 cessible at all times for attending to the bolts *g*. The tubes 1 thus extend more than half a circle.

Another detail of construction is found in the junction-box M, which is exposed to the steam-pressure in the boiler and therefore has a flange W secured steam-tight to the barrel A of the boiler, with an opening *w* in the flange sufficiently large to allow insertion of that portion of the elbow O  
90 which is connected by an adjustable joint K' with the pipe K. This joint is in practice formed with a nut for tightening it, and the junction-box is formed with an aperture 23 in the top having a cover X bolted there-  
95 on, by which access to the nut can be obtained when necessary through the man-hole upon the barrel A, as the cover X lies above the level of all the smoke-flues P.

The interior of the junction-box contains  
100 merely the hot gases, and the space *w* around the elbow O can thus be closed by a plate Y which is formed in halves, as shown in Figs. 6 and 7, and clamped upon the elbow by bolts *y* to hold it in place; the plate being  
105 fitted to a seat upon the flange W.

It will be understood from the above description that the essential feature of the superheater is the disposition of successive groups of concentric tubes within the shell  
110 of the firebox with headers serially connecting the same, and connected themselves respectively to the throttle and the end of the cylinder-pipe; while another important feature is the extension of the cylinder-pipe  
115 through a passage containing the highly heated gases, so that the heat of the steam is increased as it gradually approaches the cylinders.

The invention is shown herein as adapted  
120 for use upon a Shay or Mallet locomotive, and claims are made to such an application of the invention, but the invention may be used in any boiler to which it is adapted.

Having thus set forth the nature of the  
125 invention what is claimed herein is:

1. In a fire-tube locomotive boiler having a superheater in its smokebox, and a cylinder near its rear end, the combination of a smoke-passage extending from the firebox  
130



directly to the smokebox and an outlet-pipe for conducting steam from the superheater to the cylinder, which pipe passes through the said smoke-passage, so that the heat of the gases to which the steam in said pipe is exposed increases as it approaches the cylinders.

2. In a tubular locomotive boiler, the combination, with the firebox, smokebox, and smoke-flues connecting the same, of a tubular superheater supported in the firebox, a smoke-passage extended directly from the firebox to the smokebox, a cylinder steam-pipe connected with the superheater outlet and extended through such smoke-passage, and thence laterally through the shell of the boiler, and a damper J for closing the smoke-passage when the steam is not required for the cylinders.

3. In a tubular locomotive boiler, the combination, with the firebox, smokebox, and smoke-flues connecting the same, of a tubular superheater supported in the firebox, a smoke-passage extended directly from the firebox to the smokebox, a cylinder steam-pipe connected with the superheater outlet and extended through such smoke-passage and thence laterally through the shell of the boiler, an annular damper fitted movably upon the cylinder pipe within the smokebox, and means for pressing the same toward the forward tube flue-sheet for closing the smoke-passage when the steam is not required for the cylinders.

4. In a tubular locomotive boiler, the combination, with the firebox, smokebox, and smoke-flues P connecting the same, of a tubular superheater supported in the firebox the superheater having an inlet with connection to a steam supply-pipe, the gas or smoke-pipe L extended from the smokebox through the water-space of the boiler to the junction-box M, with the pipe N connecting such junction-box to the firebox, the flange W connecting the junction-box tightly with the barrel A of the boiler and having an opening through such barrel, the cylinder-pipe K connected with the superheater outlet and extended through the smoke-pipe L with gas-passage L' between the two pipes,

and the elbow O extended from the cylinder-pipe within the junction-box to the outer side of the barrel.

5. In a tubular locomotive boiler, the combination, with the firebox, smokebox, and smoke-flues P connecting the same, of a tubular superheater supported in the firebox the superheater having an inlet with connection to a steam supply-pipe, the gas or smoke-pipe L extended from the smokebox through the water-space of the boiler to the junction-box M, with the pipe N connecting such junction-box to the firebox, the flange W connecting the junction-box tightly with the barrel A of the boiler and having an opening through such barrel, the cylinder-pipe K connected with the superheater outlet and extended through the gas-pipe L with gas-passage L' between the two pipes, the elbow O connected with the cylinder-pipe K inside the junction-box by the joint K' and extended outside of the barrel for connection to the cylinder steam-chests, and the junction-box having an aperture 23 in the top with cover X bolted thereon for access to the joint K'.

6. The combination, with a tubular locomotive boiler having a firebox and a smokebox connected by smoke-flues P, of engine cylinders T with steam-chests V adjacent to the side of the firebox, a superheater located in the smokebox and having an inlet connected with a steam supply-pipe and an outlet adjacent to the forward tube-plate I, pipes L and N and a junction-box M forming a smoke-passage between the firebox and smokebox adjacent to the outlet of the superheater, the cylinder steam-pipe K extended from the superheater through such gas-passage to the junction-box and thence by elbow O outwardly through the barrel of the boiler.

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

LEWIS E. FEIGHTNER.

Witnesses:

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THOS. NESMITH, Jr.