Feb. 13, 1934. H. M. PFLAGER ET AL 1,947,225

LOCOMOTIVE BOILER

Filed Jan. 11, 1932 8 Sheets-Sheet 1

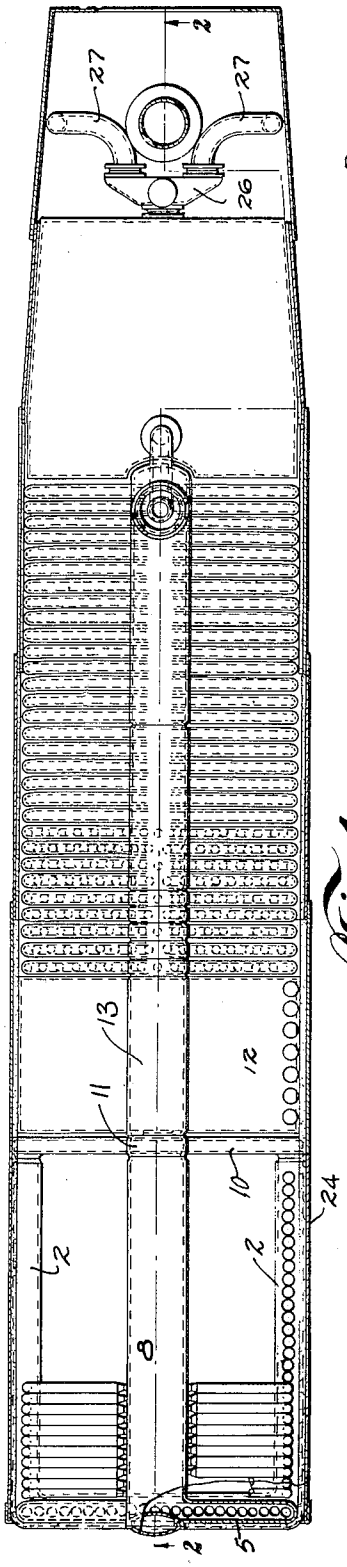


Fig. 1.

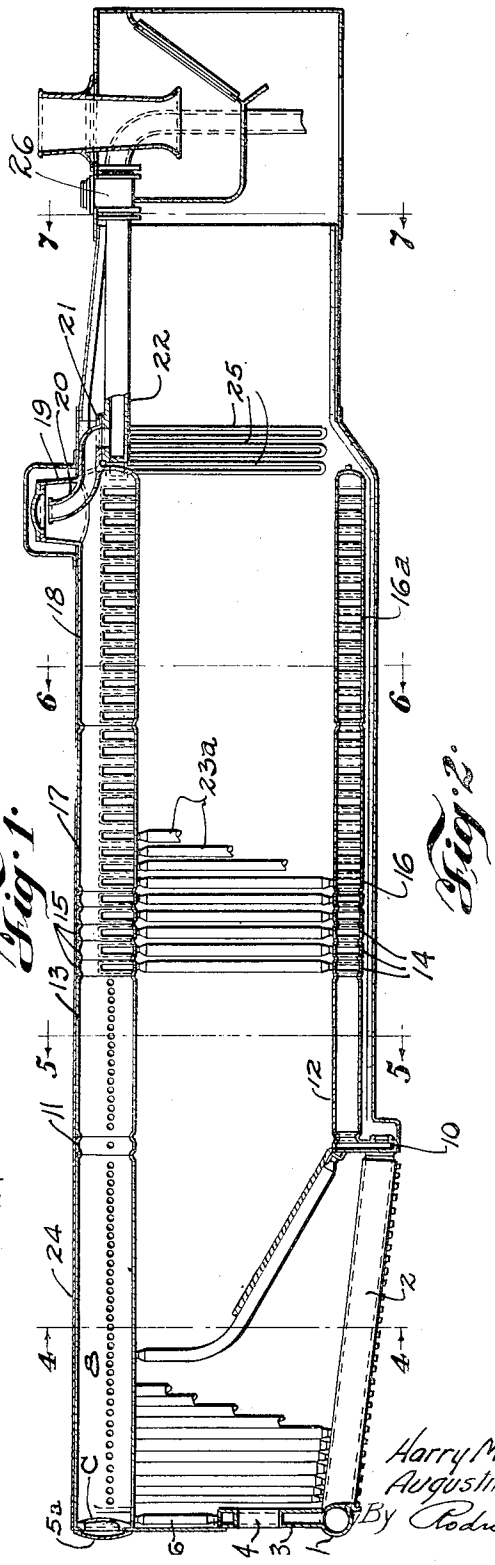


Fig. 2.

Inventors
Harry M. Pflager
Augustine R. Ayers
By Rodney Radcliff
Attorney

Feb. 13, 1934. H. M. PFLAGER ET AL 1,947,225

LOCOMOTIVE BOILER

Filed Jan. 11, 1932 8 Sheets-Sheet 2

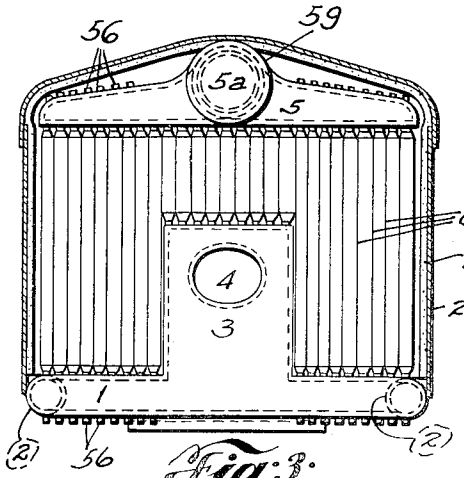


Fig. 3.

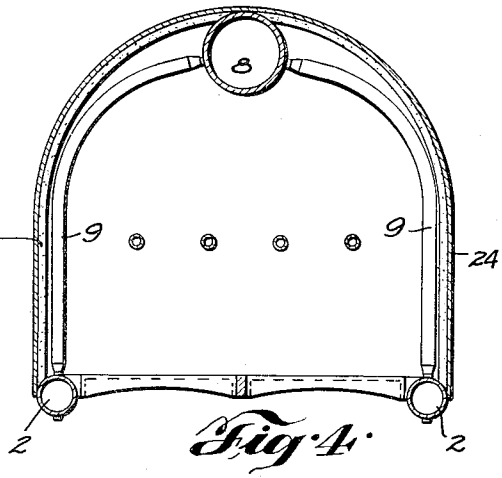


Fig. 4.

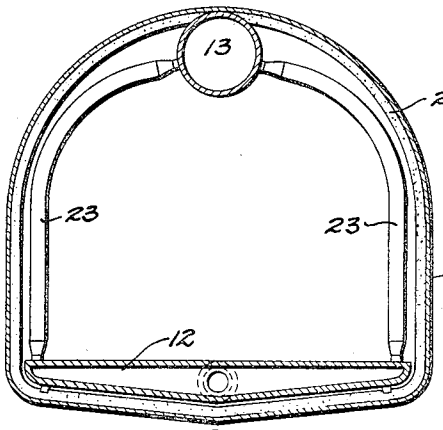


Fig. 5.

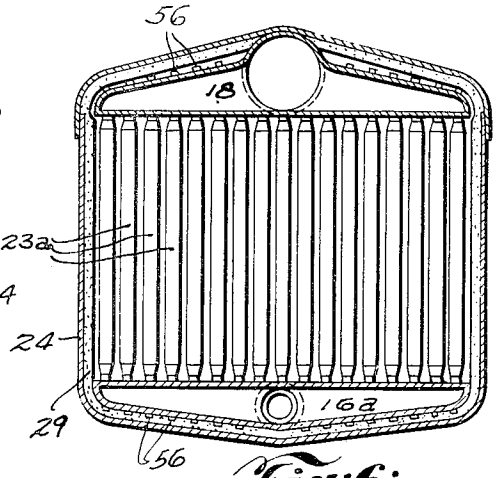


Fig. 6.

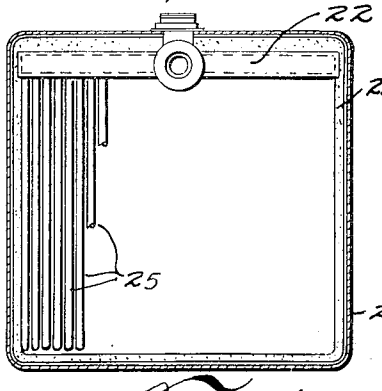


Fig. 7.

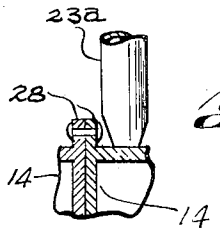


Fig 8a

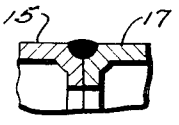


Fig. 8.

Inventors
Harry M. Pflager
Augustine R. Ayers
By Rodney Bedell
Attorney

Feb. 13, 1934. H. M. PFLAGER ET AL 1,947,225

LOCOMOTIVE BOILER

Filed Jan. 11, 1932 8 Sheets-Sheet 3

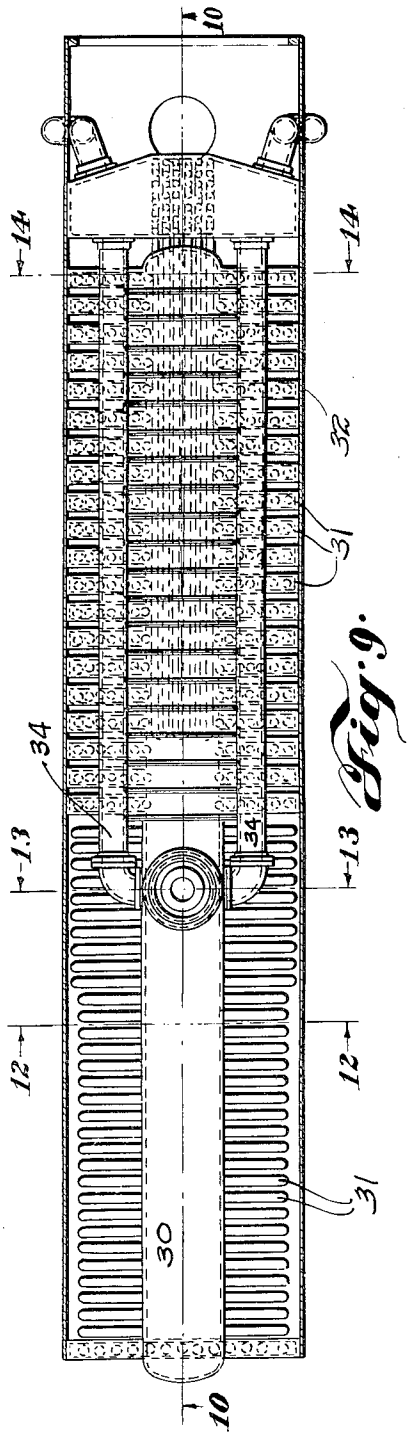


Fig. 9.

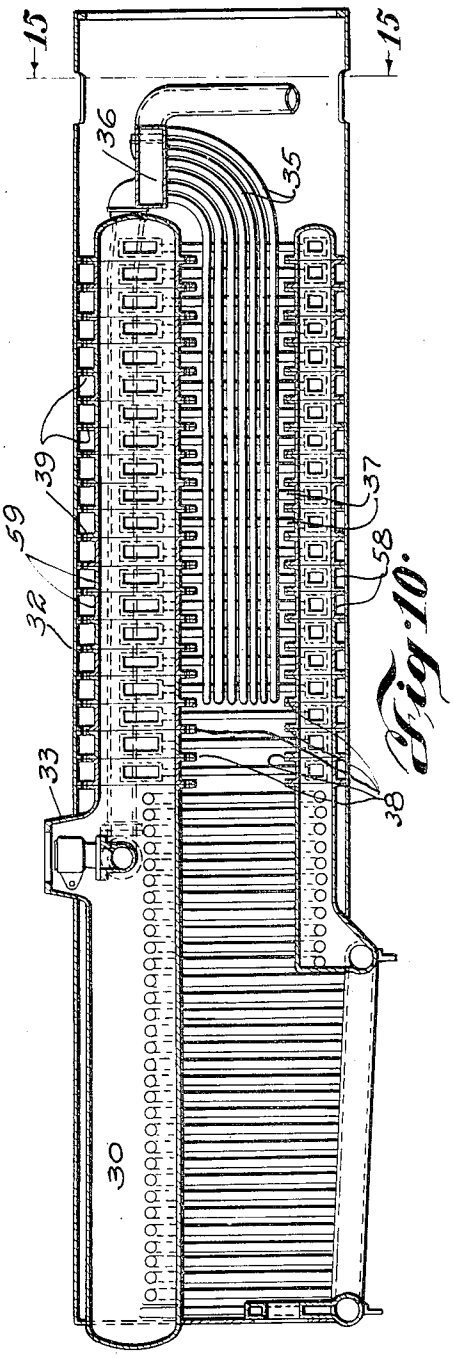


Fig. 10.

Inventors:
Harry M. Pflager
Augustine R. Ayers
By Rodney Badell
Attorney

Feb. 13, 1934. H. M. PFLAGER ET AL 1,947,225

LOCOMOTIVE BOILER

Filed Jan. 11, 1932 8 Sheets-Sheet 4

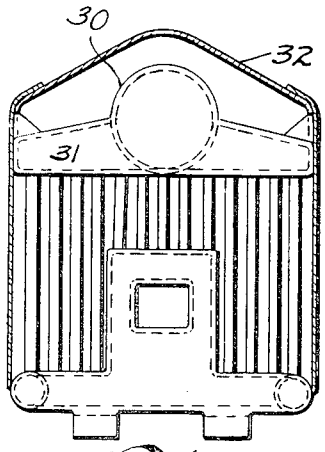


Fig. 11.

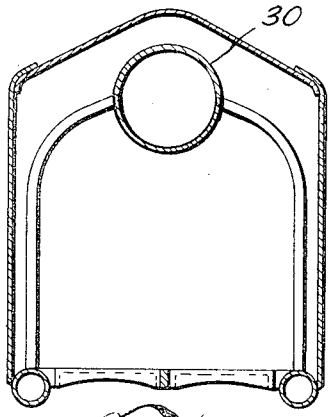


Fig. 12.

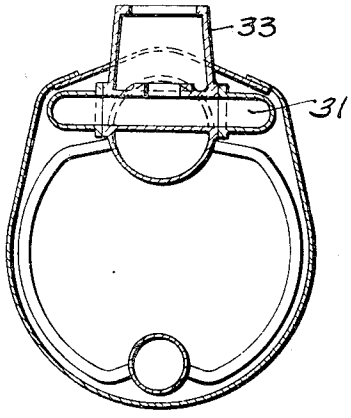


Fig. 13.

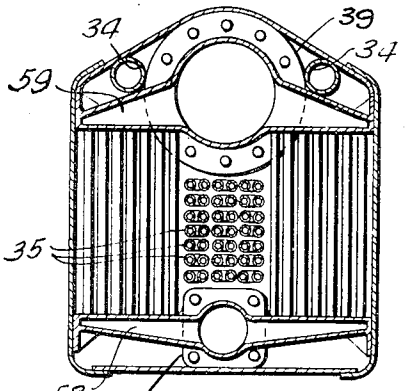


Fig. 14.

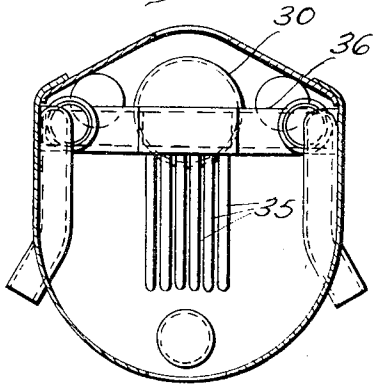


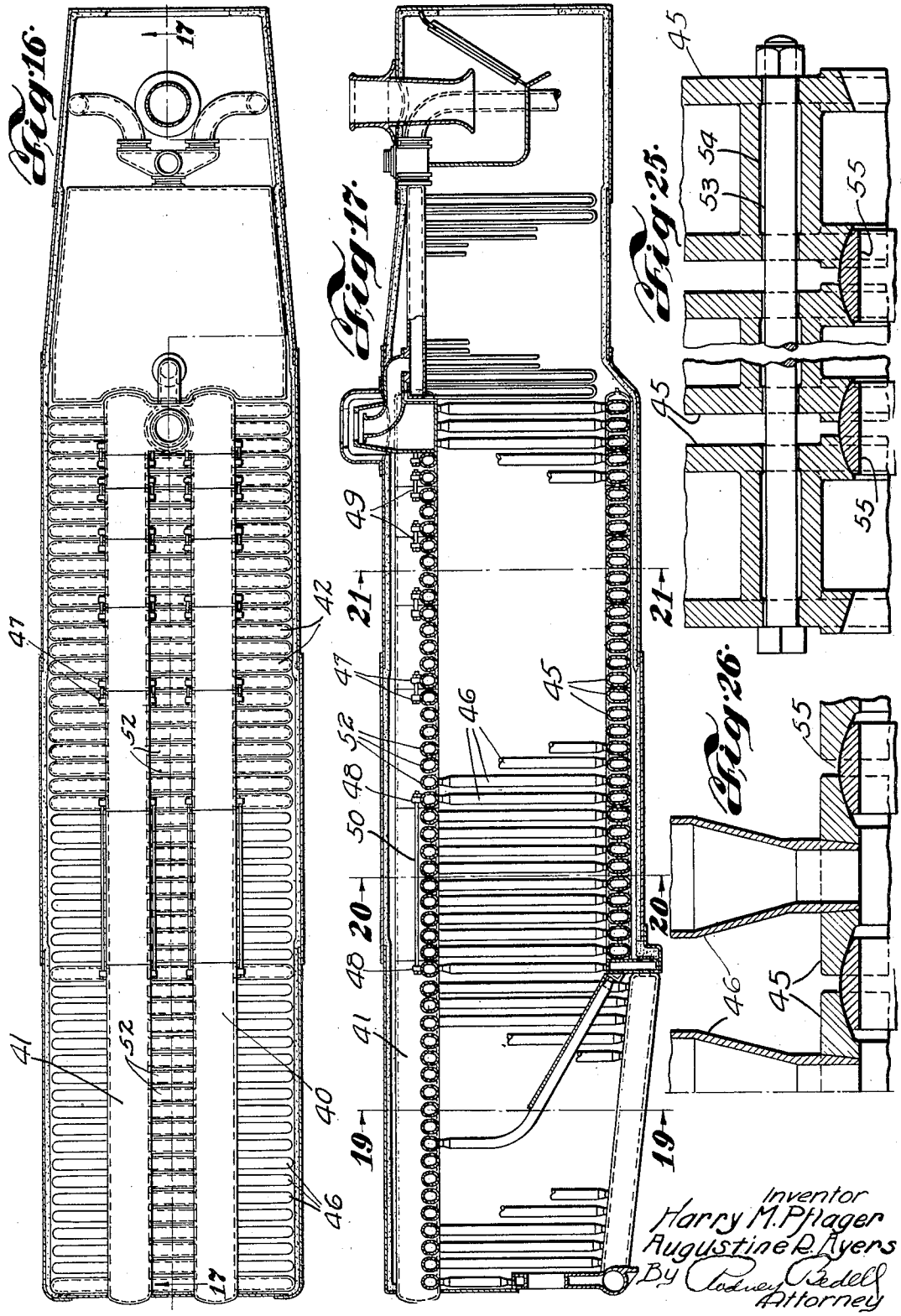
Fig. 15.

Inventors
Harry M. Pflager
Augustine R Ayers
By Rodney Bedell
Attorney

Feb. 13, 1934. H. M. PFLAGER ET AL 1,947,225

LOCOMOTIVE BOILER

Filed Jan. 11, 1932 8 Sheets-Sheet 5



Inventor
Harry M. Pflager
Augustine R. Ayers
By Rodney Redell
Attorney

Feb. 13, 1934. H. M. PFLAGER ET AL 1,947,225

LOCOMOTIVE BOILER

Filed Jan. 11, 1932 8 Sheets-Sheet 6

Fig. 18.

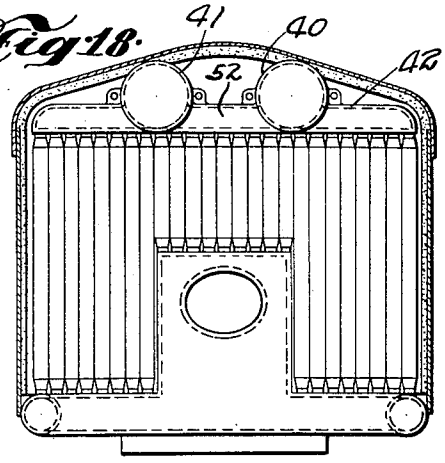


Fig. 19.

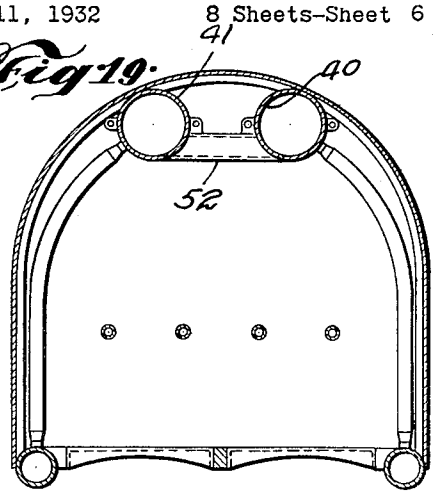


Fig. 20.

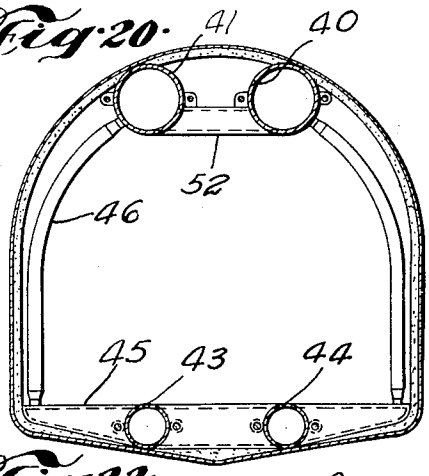


Fig. 21.

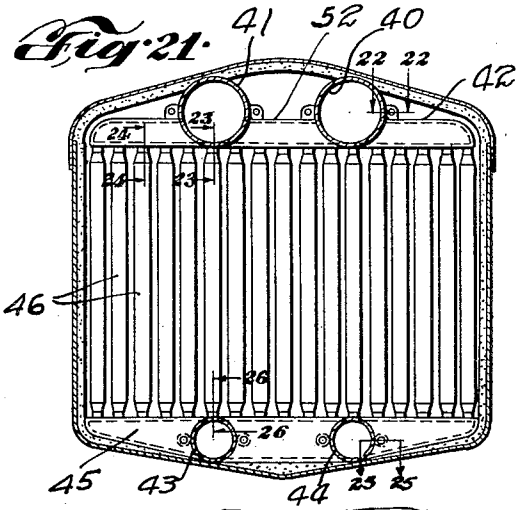


Fig. 22.

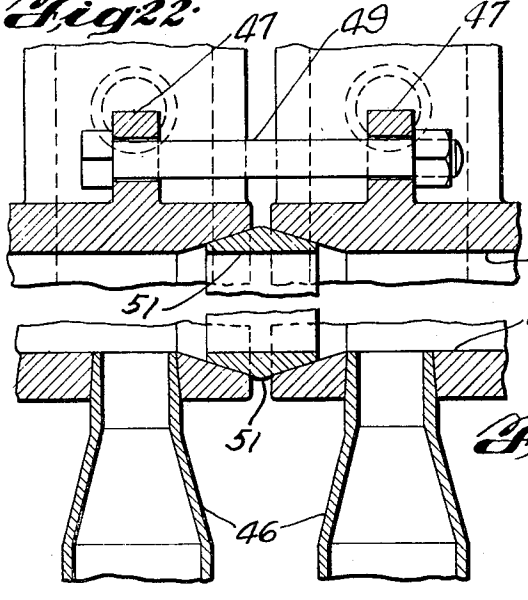


Fig. 23.

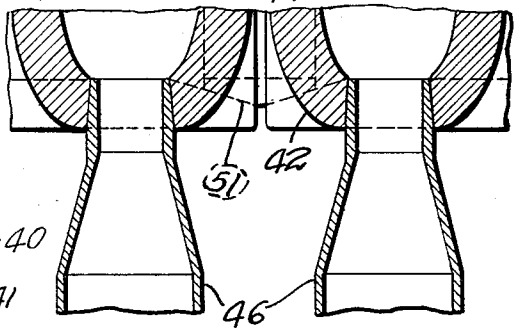


Fig. 24.

Inventors
Harry M. Pflager
Augustine R. Ayers
By Rodney Bedell
Attorney

Feb. 13, 1934. H. M. PFLAGER ET AL 1,947,225

LOCOMOTIVE BOILER

Filed Jan. 11, 1932 8 Sheets-Sheet 7

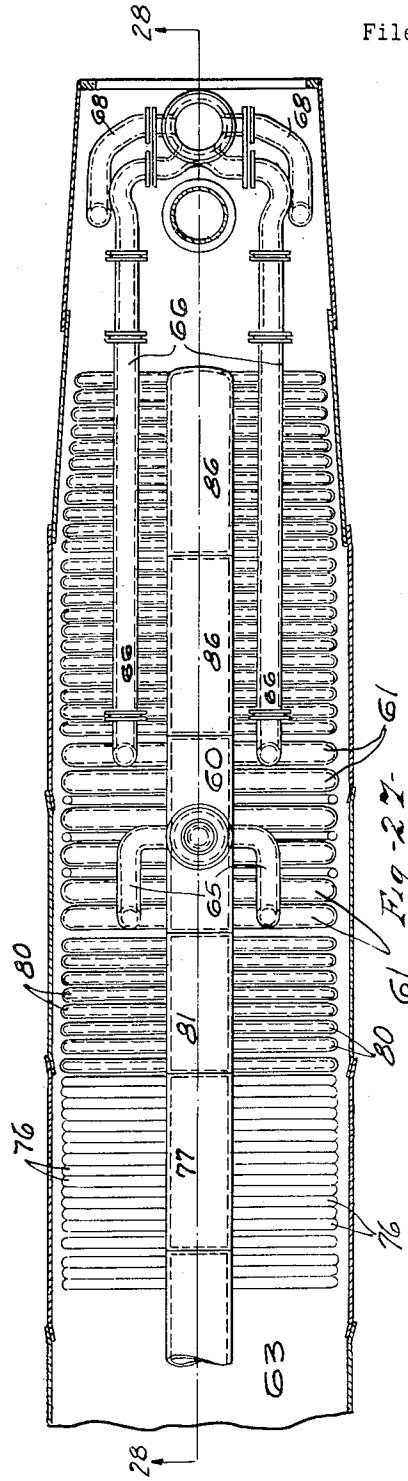


Fig-27-

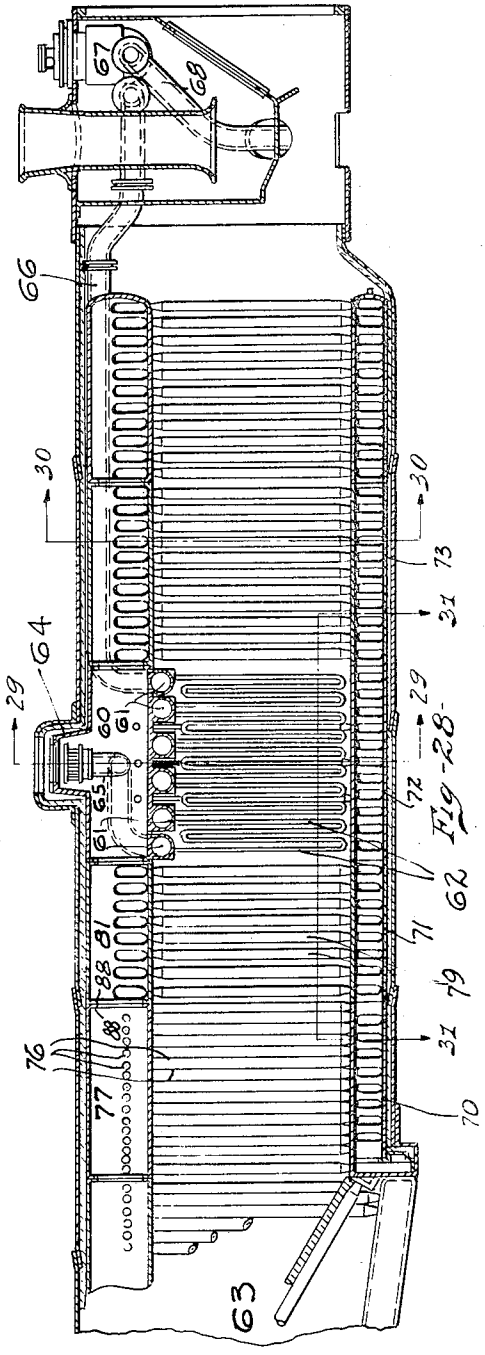


Fig-28-

Inventors
Harry M Pflager
Augustine R Ayers
By Rodney Bedell
Attorney

Feb. 13, 1934. H. M. PFLAGER ET AL 1,947,225

LOCOMOTIVE BOILER

Filed Jan. 11, 1932 8 Sheets-Sheet 8

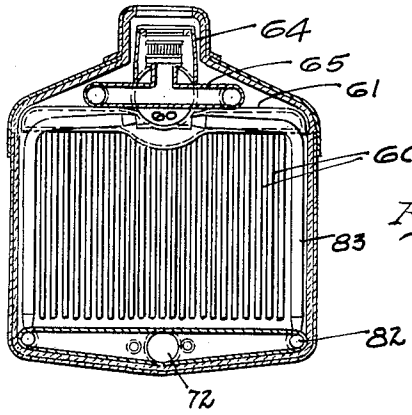


Fig-29-

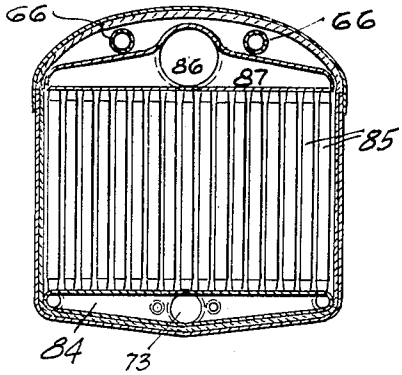


Fig-30-

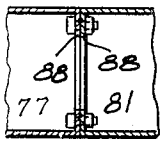


Fig-32-

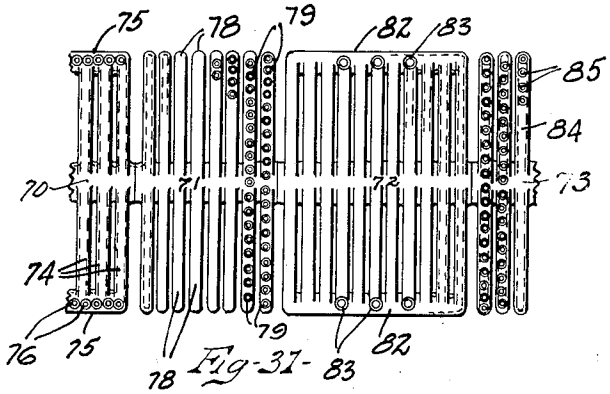


Fig-31-

Inventors
Harry M Pflager
Augustine R Ayers
By Rodney Bedell
Attorney

Patented Feb. 13, 1934 1,947,225

UNITED STATES PATENT OFFICE

1,947,225

LOCOMOTIVE BOILER

Harry M. Pflager, St. Louis, Mo., and Augustine R. Ayers, Cleveland, Ohio; said Pflager assignor of his entire right to General Steel Castings Corporation, Granite City, Ill., a corporation of Delaware

Application January 11, 1932. Serial No. 585,978

16 Claims. (Cl. 122—235)

Our invention relates to railway rolling stock and particularly to locomotive boiler structure and consists in a novel construction and arrangement of boiler steam and water drums and headers, fire box and mud ring structure and associated elements.

In locomotive boiler structures such as have been made heretofore, suitable wrought iron or steel tubes have been joined at their ends to suitable plates constituting tube sheets, fire box sheets, etc, and the fire box has usually been constructed of inner and outer sheets adapted to receive water between them and requiring a multitude of stay bolts for strengthening purposes and also requiring continual inspection and maintenance work.

The main object of our invention is to construct a high pressure, high capacity boiler by providing water and steam headers in heavy units, preferably of cast steel, and in connecting the units with a multitude of water tubes and utilizing all the space between the headers and the tubes for the passage of heated air and gases from the fire box to the smoke stack, thus providing a greatly increased area of water containing chambers to which heat may be applied.

It is another object of our invention to construct a boiler providing for different degrees of expansion in its upper and lower portions due to different temperatures at these parts.

Another object is to provide a locomotive boiler comprised of a number of cast members assembled together, any one of which may be replaced without removing the locomotive from service for a substantial period.

Another object of our invention is to eliminate a large number of riveted joints where leakage may occur and we attain this object by forming various parts, which previously have been made separately, in a single unitary structure.

There are a number of detail objects, incidental to the general objects set forth above, which will appear from the following description of the structure embodying our invention and from the accompanying drawings in which:

Figure 1 is a top view of a locomotive boiler, the outer casing being sectioned.

Figure 2 is a longitudinal vertical section on the center line of the boiler.

Figure 3 is a rear end view of the boiler with the boiler covering sectioned.

Figures 4, 5, 6, and 7 are vertical transverse sections taken on the corresponding section lines of Figure 2.

Figure 8 is a detail section of one of the joints between adjacent headers.

Figure 8*a* illustrates a modification of the same.

Figures 9 to 15 correspond to Figures 1 to 7 but illustrate a modified structure, Figures 12 to 15 being transverse sections taken on the corresponding section lines of Figure 9.

Figures 16 to 21 similarly illustrate another modification, Figures 19, 20, and 21 being sections on corresponding section lines of Figure 17.

Figures 22 to 26, inclusive are detail sections taken on the corresponding section lines of Figure 21.

Figure 27 is a top view of the boiler, with the covering sectioned, illustrating another modification of the invention.

Figure 28 is a vertical longitudinal section of the same taken on the line 28—28 of Figure 27.

Figures 29 and 30 are vertical transverse sections taken on the section lines 29—29 and 30—30 of Figure 28.

Figure 31 is a horizontal section showing the tube arrangement and is taken on the line 31—31 of Figure 28.

Figure 32 is an enlarged detail section of a connection between adjacent header members.

In the constructions shown in Figures 1 to 8 inclusive, we utilize a plurality of integral hollow castings to form substantial portions of the boiler structure. One of these castings has a general U shape, the cross bar 1 of which constitutes a rear lower water header or rear mud ring section of the firebox, and the leg sections 2 of which form lower side headers or mud ring sections of the firebox. These portions are of cylindrical section. The rear portion includes an upstanding centrally located hollow extension 3 having a transverse opening 4 for receiving the fire door. An upper header 5 extends from side to side of the firebox over the rear member 1—3 and a plurality of upright water tubes 6 connect these two castings.

Transverse header arms 5 are integral with a cylindrical drum 8 extending along the top of the firebox and centrally thereof and merge with the drum in reinforcing curves of substantial radius. A plurality of water tubes 9 extend upwardly from the lower header sections 2 and then curve inwardly to connect with the upper drum 8. The header and drum member 5—8 has a cap 5*a* which may be an integral part of hte member but, to facilitate casting and cleaning operations, may be formed separately and secured in place by a familiar type of clamp shown at C.

At the front of the firebox is a lower transverse header section 10 and an upper drum section 11, the lower header 10 extending the full width of the boiler, and each section comprising a single hollow casting. The lower section 10 is secured to the forward ends of header legs 2 and the upper section 11 is secured to the forward end of drum 8.

Adjoining section 10 is a section 12 of a lower water header extending from side to side of the combustion chamber and adjoining section 11 is a section 13 of an upper steam drum. Sections 12 and 13 are connected by a plurality of water tubes 23 extending upwardly from the lower header 12 and then curving inwardly to connect with the upper drum 13.

Adjoining the front ends of sections 12 and 13 are a series of header sections 14 and 15, each including a hollow arm extending across the boiler and a portion for connection with the adjacent section. The entire boiler may consist of a series of similar sections, as sections 14 and 15, or a number of sections may be combined in larger units as 16, 16*a*, 17 and 18, each having a series of projecting arms spaced apart longitudinally of the boiler.

The upper and lower headers are connected by a plurality of water tubes 23*a* exposed to the hot gases passing from the firebox to the smokebox. The tubes connecting one pair of arms are in staggered relation with the tubes of the adjacent pair of arms so as to break up the streams of hot gases and thereby most effectively extract the heat therefrom. It is to be understood that the lengths of these header sections may be varied to suit different designs of boilers and to accommodate manufacturing conditions which may favor longer or shorter castings under certain circumstances. Each transverse arm is provided with a row of plugged openings 56 to permit access to the interior of the header to facilitate securing the ends of the tubes 6 and 23*a* in the tube seats.

The header 18, which terminates the upper header series, includes an upwardly extending enlargement 19 forming a steam dome. Preferably, an outlet dry steam pipe 20 is formed integrally with the dome and header structure and terminates in a flange portion 21 adapted to be connected to a superheater header 22.

The superheater tubes 25 are vertically disposed and are distributed throughout the boiler chamber in front of the water tube chamber. The tubes 25 extend the full depth of the boiler and the steam is caused to circulate through the tubes 25 by means of suitable partitions in the header 22. The discharge end of the header has an outlet 26 which branches into the steam conduits 27 leading to the main steam cylinders (not shown).

Adjacent header castings are shown as welded together, as illustrated in detail in Figure 8, but suitable bolting flanges and cooperating bolts or rivets may be used as shown in Figure 8*a*. The joints may include spherical or tapered bushings as shown in Figures 23, 25 and 26 referred to later.

The boiler is provided with an outer cover 24 of any suitable construction which preferably is fitted with insulation 29.

In the construction shown in Figures 9 to 15, the central upper drum 30 has lateral arms 31 spaced below the boiler covering 32 and its steam dome extension 33 is located intermediate the ends of the boiler. Dry steam pipes 34 are located in the space above arms 31 and present a substantial length of surface exposed to the heated gases above the tubes and transverse headers.

The superheater tubes 35 extend downwardly and rearwardly from the header 36 and project between the vertical water tubes 37. The sections 58 and 59 of the boiler headers are shown provided with flanges 38 and 39, respectively, whereby adjacent sections may be fastened together as indicated in Figure 8*a*.

The form shown in Figures 16 to 24 inclusive, has a pair of spaced longitudinal upper drums 40 and 41, each comprising a plurality of cast sections of suitable lengths with integral connections 52. Some of these sections have integral transverse arms 42 extending outwardly to the side of the boiler. A pair of headers 43 and 44 in the lower part of the boiler comprise similar sections with integral transverse arms 45. Tubes 46 connect arms 45 with arms 42 or with drums 40 and 41.

The upper header sections are secured together by means of lugs or flanges 47 and 48, and bolts 49 and 50. The lugs may be located on adjacent ends of abutting sections, in which case short bolts, as at 49, would be used, or the lugs may be located on spaced sections permitting the use of longer bolts, as at 50. Lugs 48 and 49 are placed above arms 42 in order to be removed from the direct path of gases in the boiler. Spherical or tapered bushings 51 are inserted in the joints between the adjacent sections.

The lower headers are secured together by means of bolts 53 inserted in suitable recesses 54 extending transversely through arms 45. These bolts 53 can be long enough to extend through several arms if desired. As in the case of the upper headers just described, the joints between the cast sections are sealed by spherical or tapered bushings 55.

This modification is in other respects similar to the forms first described. Portions of both the upper and lower headers will be exposed to hot flue gases while the connecting bolts and lugs will be substantially protected therefrom. However, consequent expansion of the header sections will tend to tighten the joints and more effectively prevent leaks.

In the modification illustrated in Figures 27 to 32, the superheater is located intermediate the ends of the boiler and the boiler longitudinal drum section 60 has a series of transverse superheater headers 61 depending therefrom and projecting laterally thereof. Superheater tubes 62 extend downwardly from headers 61 and are exposed to the flue gases at a point much nearer to the firebox 63 than the superheater tubes in the previously described forms of the invention. Drum 60 also includes the integral steam dome portion 64 from which steam passes from the drum to the rear superheater header 61 through an integral pipe 65. Dry steam pipes 66 lead from the forward superheater header 61 to the throttle valve 67 and from there through pipes 68 to the cylinder valves (not shown).

As indicated in Figure 31 the lower portion of the boiler consists of a plurality of sections including drums 70, 71, 72, and 73. Drum section 70 is immediately in front of the firebox 63 and includes a series of transverse headers 74, the outer ends of which are interconnected by side drums 75. Water tubes 76 extend from side drums 75 upwardly and inwardly to connect directly with central longitudinal header 77. Drum 71 has transverse headers 78 provided

throughout their lengths with a plurality of water tubes 79 which connect with transverse headers 80 extending lateraly from the central upper drum 81. Abreast of the superheater, the lower drum 72 has side drums 82 similar to the corresponding parts 75 of the rear section and tubes 83 lead upwardly and over the superheater tubes 62 and then inwardly to connect with drum 60. Section 73 in front of the superheater is provided with headers 84 which mount another bank of tubes 85 corresponding to tubes 79 similarly connected to transverse headers 87 extending laterally from the upper central header 86.

This modification also illustrates another method of securing adjacent sections together, as indicated, by inturned flanges 88 on headers 60, 77, 81, and 86. These flanges bolt together as indicated in Figure 32 and the bolts are subjected only to steam temperatures and are protected from the higher temperatures and other deterioration which would arise from direct contact with the flue gases.

Obviously, many other changes in the contour and arrangements of the headers and in their assembly may be made without departing from the spirit of the invention. Many of the header castings may be made uniform, if desired, to facilitate replacement. Also, various castings may be secured together entirely by welding, or parts requiring occasional renewal may be bolted or riveted together.

The exclusive use of all modifications of the described structure which come within the scope of our claims is contemplated.

We claim:

1. A locomotive boiler header structure comprising a series of header sections, each adjacent pair of sections having centrally located opposing bolting flanges spaced from the adjacent faces of the sections, a bushing between said sections, said bushing having its outer surface tapered in opposite directions and fitting within the adjacent open ends of said sections, and bolt elements cooperating with said flanges to draw together said sections and cause the same to tightly engage said bushing, each of said headers including elongated hollow arms extending outwardly in opposite directions from said bolting flanges.

2. In a locomotive boiler, a plurality of spaced header structures each including a hollow arm portion extending transversely of the boiler, a cylindrical drum portion extending longitudinally of the boiler, and bolting flanges, spherically shaped bushings fitting within the adjacent open ends of said drum portions, and bolt elements cooperating with said flanges to draw together said structures and cause said drum portions to tightly engage said bushings, there being substantial spaces between adjacent arm portions.

3. In a locomotive boiler, a cast metal lower structure forming a rectangular base extending from side to side of the boiler and having hollow side headers and hollow transverse headers connecting said side headers, a cast metal upper structure forming a central longitudinal member, water tubes extending from the side headers of said lower structure upwardly and inwardly to said upper structure, and superheater headers integral with said upper structure with tubes depending therefrom substantially the depth of the boiler, there being water headers and tubes below, at each side of, and above said superheater tubes.

4. A locomotive boiler device comprising a water and steam drum with an upper extension intermediate its ends forming a steam dome and a lower extension forming a superheater header, there being a dry steam pipe leading from said dome through said water and steam drum to said header.

5. An integral cast metal header structure for a locomotive boiler comprising a hollow part forming a portion of a continuous drum section and a plurality of hollow arms projecting on each side from said hollow part and spaced from each other and having water tube seats.

6. An integral cast metal header structure for a locomotive boiler comprising an elongated transverse water receiving part having tube seats, a central enlargement forming a longitudinal water drum section, a bulge in the upper wall of said enlargement forming a steam collecting dome, and a dry steam pipe section integral with the wall of said enlargement and extending from inside said bulge to a point outside said structure.

7. In a locomotive boiler, an elongated hollow header extending across a lower edge of the fire box, elements on said header for supporting the same on the locomotive underframe, the central portion of said header being enlarged upwardly and recessed to form a fire door opening, a header extending across the upper edge of said fire box above said first-mentioned header, and tubes connecting said headers, certain of said tubes connecting with said enlargement and others at the sides of said enlargement extending substantially from top to bottom of the fire box.

8. In a locomotive boiler, lower headers including transverse members extending across the boiler and longitudinal members between the extremities of said transverse members, an upper superheater header structure, superheater tubes depending from said last-mentioned header, a steam header above said superheater header, and water tubes connecting said lower headers and said steam header, there being water and steam tubes and headers below, above, and on all sides of said superheater tubes.

9. In a locomotive boiler, a lower water header including spaced transverse members, a superheater header above the same with depending superheater tubes, a water or steam header above said superheater header and extending forwardly and rearwardly thereof, and water tubes connecting said lower header and said upper water or steam header, there being water or steam tubes and headers above, below, and forwardly and rearwardly of said superheater tubes.

10. A header structure for a locomotive boiler including a transverse part forming a superheater header, a longitudinal drum section, there being a steam dome on the upper surface of said section immediately above said part, and a dry steam pipe extending from said superheater header part into said dome.

11. In a locomotive boiler, a superheater header with superheater tubes projecting therefrom, a steam drum above said superheater header, water tubes forwardly and rearwardly of said superheater tubes and connected with said steam drum, a steam dome on said drum immediately above said superheater header, and a dry steam pipe supported by said drum and including a part extending into said dome and parts extending transversely through the walls of said drum and connected with said superheater header.

12. A locomotive boiler integral cast metal structure comprising a longitudinal steam drum

section, an arm disposed transversely thereof and forming a superheater header, there being a bulge in the wall of said section forming a steam dome immediately above said arm, and a dry steam pipe with an end inside said dome and a part extending through the wall of said section and connecting with said arm.

13. A locomotive boiler header comprising a pair of separately formed parts each including a hollow section having a bolt receiving passage extending through its fluid chamber and sealed therefrom, and bolt head or nut engaging elements on the exterior of said sections, and bolts cooperating with said elements to secure together said parts.

14. In combination in a locomotive fire box, a one piece hollow header of substantially inverted T shape having a cross bar extending from side to side of the fire box and a wide upright intermediate the end of said cross bar, there being alined openings in the front and rear walls of said upright with a continuous integral web extending through the upright at the edges of said openings to form a fire door, a header extending transversely of the fire box and spaced a substantial distance above said first-mentioned header, and a plurality of water tubes extending between said upper header and the upper walls of the cross bar and upright of said first-mentioned header.

15. In a locomotive boiler, a lower structure extending from side to side of the boiler and including spaced side headers and transverse headers connecting the same, an upright structure forming a longitudinal member intermediate the vertical planes of said side headers, water tubes extending from said side headers upwardly and inwardly to said upper structure, and a superheater including a header connected with said upper structure and including tubes depending therefrom for substantially the depth of the boiler, there being water headers and water tubes below, at each side of, and above said superheater tubes.

16. In a locomotive boiler, a header structure comprising a continuous hollow drum part and a plurality of relatively shallow elongated spaced apart arms extending transversely of said drum part, there being a plurality of transversely spaced upright water tubes extending downwardly from said arms, the spaces between said arms and said water tubes being open from top to bottom of the structure to provide for the free passage of the products of combustion over substantially the entire area of said arms and tubes.

H. M. PFLAGER.
AUGUSTINE R. AYERS.