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FIRE BOX FOR LOCOMOTIVES OR OTHER STEAM VEHICLES

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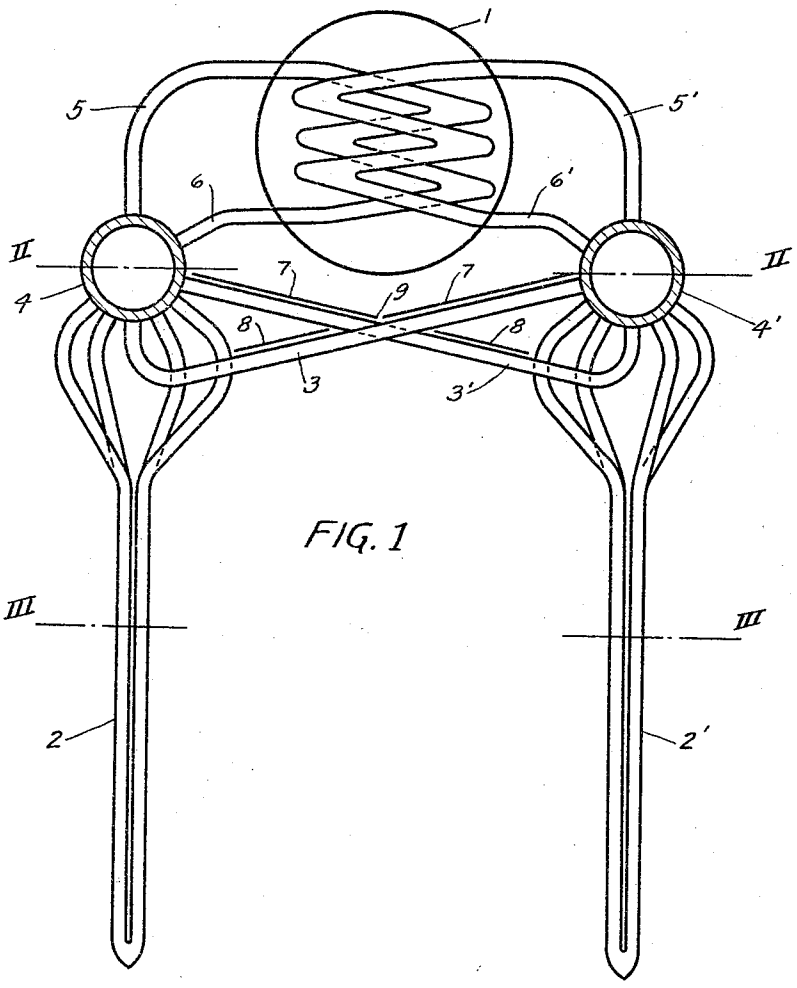
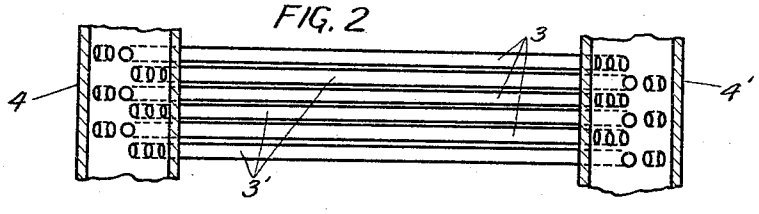


FIG. 1

FIG. 2



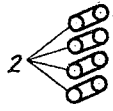
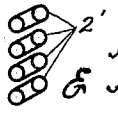


FIG. 3



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FIRE BOX FOR LOCOMOTIVES OR OTHER STEAM VEHICLES

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The prior art shows steam generators intended for use on locomotives or other vehicles and in which the steam to be utilized on the locomotives is obtained by means of an intermediate heating fluid, for example, water, which moves in a closed primary circuit. This closed primary circuit includes a vaporizing tube bundle in which the intermediate fluid is vaporized, and a condenser bundle in which it gives up to the secondary fluid its latent heat of vaporization after which it again returns to the vaporizing bundle.

Such fire boxes are generally made up of one or several upper collectors or steam separators tied to lower headers first by a set of tubes forming the vaporizing bundle and in addition by smaller number of tubes serving for the return of the water. The water delivered to these tubes is divided among the various vaporizing tubes after having undergone multiple changes of direction and flow area involving large friction loss.

The present invention has for its object a fire box intended for vehicles of this sort.

This fire box comprises essentially tubes either U-shaped or V-shaped which make up the walls and which are connected to the separator drums. These tubes are associated with a single header wall and are arranged in such a combination that one branch of each will be heated by the furnace more intensely than the other, so that it forms the evaporating part of the tube while the other serves as a return for the water.

In the preferred mode of realizing the invention, U tubes form the side walls of the fire box, and V tubes form the roof, these tubes being arranged in such a manner as to constitute a large number of circuits as short as possible and presenting the minimum of pressure drop, so that in all the tubes the circulation and the evaporation will be as active as possible, and that the water supply for the vaporizing parts will be assured without fail. For the U tubes this water supply will be assured principally by the water coming from the vaporizing tubes and returning directly to the other branch or the return water branch of the same tube. For the V tubes the water supply will be principally water coming from a vaporizing branch and entering into a water return branch of a V tube or V tubes immediately adjacent to the first. The following description which refers to the annexed drawing and which is given by way of example, will make it clear how the invention may be carried out.

The example chosen and illustrated refers more particularly to a locomotive boiler, but the invention can be applied in a similar fashion to all boilers of the type referred to above.

Fig. 1 is a transverse section of a locomotive fire box embodying the invention; and Figs. 2 and 3 are fragmentary horizontal sections on lines II—II and III—III respectively of Fig. 1.

The secondary fluid to be evaporated is delivered by piping, not shown, into a drum or cylindrical body 1 and the steam produced is carried away by connections which are likewise omitted.

The primary closed circuit comprises a vaporizing bundle made up of U tubes 2 and 2′ and of tubes 3 and 3′ bent into a V shape whose extremities open into the separating steam collectors or headers 4 and 4′. This circuit comprises further a condenser bundle located in the cylindrical drum 1 and immersed in the secondary fluid to be evaporated. The condenser bundle is connected to the collectors 4 and 4′ by connecting tubes 5 and 5′ and 6 and 6′.

The tubes 2 and 2′ which form the lateral wall of the fire box are in the case illustrated in the figure arranged obliquely with regard to the longitudinal axis of the locomotive so that those branches which are located toward the outside lie opposite the openings left between the branches facing the inside, and vice versa. The two ends of each U open into the same collector 4 or 4′ and in closely adjacent vertical planes transverse to the locomotive and on either side of the vertical plane of symmetry of the collector.

It will be obvious that in each of the tubes the vaporizing branch is the one located toward the interior, the other branch constituting the water return by which the former is fed without interruption.

It will also be seen that as a result of the form and arrangement of the tube ends the water entrained by the steam at the outlet of a vaporizing branch will have the tendency to enter into the return branch of the same tube, being, moreover projected by the energy of this motion toward the entrance of this branch.

The U tubes may also be arranged vertically and perpendicular to the axis of the locomotive. In fact their exterior or return branches may be more or less masked with relation to the furnace by the vaporizing branches. They may participate in a limited measure in the vaporization so as to enhance the latter as well as the circulation through the primary bundle.

Each of the bent tubes 3 and 3′ starts from one of the headers 4 or 4′ by a branch substantially vertical forming a water return and extends to the other collector by an oblique branch which is the vaporizing part, the assembly of these latter branches forming the roof for the fire box.

The openings of the vertical branches or the water returns are arranged in the lowest part of the header and, with respect to the outlets from the oblique branches which form the vaporizing parts, they are in such a position that the water leaving the latter will, due to its movement and due to the force of gravity, have a natural tendency to enter directly into the nearest return branch or branches.

As a result, the water circulating in the V tubes will constantly describe a closed circuit having the form of a figure 8.

The steam formed in the tubes 2 and 2′ and 3 and 3′ arrives by very direct paths and by paths resulting in a minimum friction loss in the collectors 4 and 4′, where it will be separated from the water accompanying it, the latter returning, also by very direct paths and paths involving a minimum friction loss, toward the vaporizing parts. Steam thus separated flows by the risers 5 and 5′ into the condenser bundle partly shown in the drawing, and after there having given up its latent heat of vaporization the condensate returns to the collectors 4 and 4′ by the return tubes 6 and 6′ and then describes the same circuit again.

The connection between the two collectors made up of the tubes 3 and 3′ assures a perfect equilibrium in the whole primary circuit both in pressure and in quantity of water and of steam.

The primary circuit contains a quantity of water sufficient so that the vaporizing branches will always be supplied with water at least to the level 9 where the branches form the roof of the fire box cross. This point of crossing is preferably located at least at the height of the lower part of the collectors 4 and 4′.

The roof can also be made up by baffles arranged for example on the oblique tubes 7—7 or 8—8, the baffles being made up of tiles.

It will be noted that the ends of the U-tubes and of the V-tubes are suitably bent and that the connections of the U-tubes and V-tubes to the collectors are properly grouped so that the connections will be shielded against the radiation from the fire box by the bends which make up the tube ends. It goes without saying that modifications of the details can be made in the form described without departing from the spirit of the invention.

Thus, the U tubes may be in vertical planes perpendicular to the axis of the locomotive instead of being in planes which are oblique to this axis. Similarly the ends of two neighboring V-tubes may be arranged in a common plane transverse to the locomotive.

It should be noted that to make up the U tubes it will be advantageous to use return bends with an interior section which first increases and then decreases, but which is always larger than the section of the other portions of the tube so that the pressure drop may be kept as low as possible and that the use of large diameter bends should be avoided, since these would necessarily involve a flattening of the tube with a resulting diminution of the cross section.

To facilitate the steam separation and to make sure that there is a sufficient reserve capacity to take care of the expansion of the water and of the steam volume included in the water in service, the headers 4 and 4′ may be doubled or increased in number by adding other similar headers in the path of the tubes 5 and 5′.

What we claim is:

1. In apparatus of the class described, the combination of a main steam generating drum, a steam collecting header, a U-shaped tubular steam generating element with one of its legs adjacent to a furnace and the other shielded from the furnace by the first, both legs opening into said header, a tubular condenser element in the drum both ends of which open into the header.

2. In apparatus of the class described, the combination of a main steam generating drum, a steam collecting header, a series of U-shaped tubular steam generating elements with one of the legs of each adjacent to a furnace and the other shielded from the furnace by the first, both legs of each opening into the header, and a plurality of tubular condenser elements in the drum, the two ends of each opening into the header.

3. Apparatus in accordance with claim 2, the steam generating elements all being substantially similar and having their legs which are exposed to the furnace alined in one row and in close proximity to each other, and their other legs alined in a second row.

4. In apparatus of the class described, the

combination of a main horizontally arranged steam generating drum, two steam collecting headers arranged parallel to and on the two sides respectively of the drum and lower than the drum, two series of similar alined U-shaped tubular steam generating elements opening respectively with their ends into the two headers, the two legs of each element lying in a plane transverse to the headers, and two series of tubular condenser elements in the drum, both ends of each element of one series opening into one of the headers and both ends of each element of the second series opening into the other of the headers.

5. Apparatus according to claim 4, the openings of the two ends of each steam generating element into their header being so arranged that discharge of a steam and water mixture from one end occurs in a direction to favor easy re-entry of water into the other end.

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