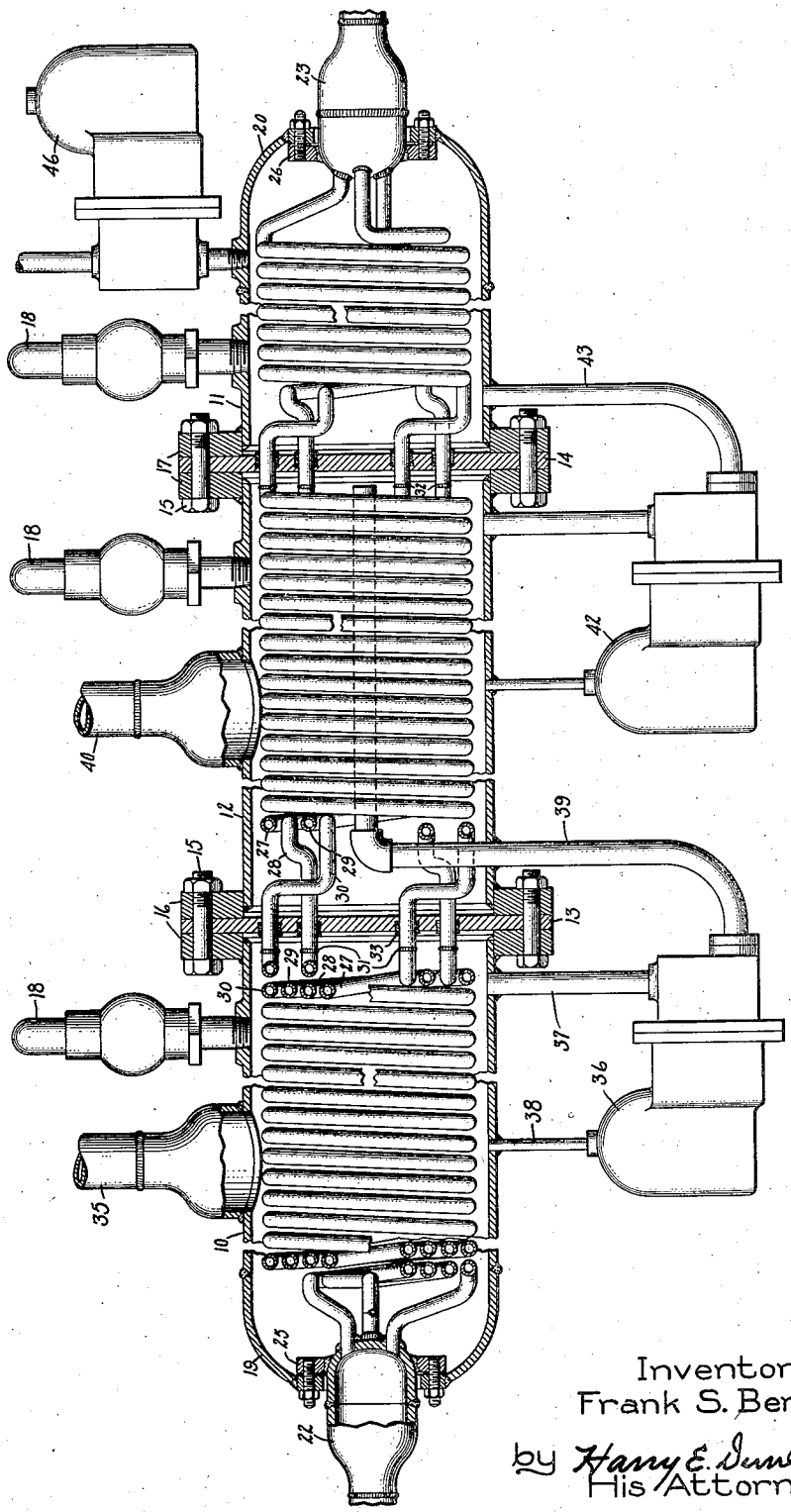
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FEED WATER PREHEATER

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FEED WATER PREHEATER

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2 Claims. (Cl. 257—32)

The present invention relates to an improved heat exchanger particularly adapted for use as a feed-water preheater in a high-pressure energy conversion system.

It is an object of the invention to provide a preheater construction capable of withstanding the tremendous expansive stresses encountered in connection with a steam system operating at pressures of the order of one thousand pounds per square inch. Other objects include the provision of a mechanically strong preheater which has sufficiently small weight and volume to favor its use in a steam locomotive or other propulsion vehicle where these factors are at a premium.

Particular features of the invention which contribute to the accomplishment of these results include the incorporation of several stages of preheating in a single casing, an improved casing structure and an improved connection and arrangement of the feed-water conduits within the casing. Other features will be apparent upon consideration of the following description taken in connection with the drawing in which the single figure is a sectional view of a preheater construction suitably embodying the invention.

The illustrated construction comprises an elongated casing including a plurality of separate sections adapted to receive heating fluid at various pressures and conduits running longitudinally of the casing for receiving feed-water or a corresponding fluid to be heated. In the use contemplated, the conduits may be required to transmit water at a pressure as high as from 1500 to 2500 lbs. per square inch.

The casing comprises a pair of end sections 10 and 11 and one or more intermediate sections, of which only a single section, numbered 12, is shown. The various sections are separated from one another by means of partitions 13 and 14 which are clamped between flanges 16 and 17 attached to the casing sections and held in place by bolts 15 or other externally accessible removable securing means. In connection with each section there is provided an escape duct 18 which may lead to a common safety valve (not shown) operable in case of excessive and unpredictable pressures being generated within the casing.

The casing as a whole is provided at its extremities with rounded end walls 19 and 20 which are shown as being welded to the casing so as to impart a maximum of mechanical strength thereto. Relatively small openings provided in these end walls are closed by bulbous manifold headers 22 and 23, which thus form parts of the walls. As shown the headers are secured in place by means of flanges 25 and 26, which are welded to the headers and removably joined to the casing wall by means of externally accessible bolting connections. It will be seen that since the end sections of the casing are separably connected both to the headers 22 and 23 and to the partitions 13 and 14, they may be removed in case of need by simply severing the external pipe connections and opening the bolted joints. Furthermore, after such removal the interiors of the various intermediate casing sections may be reached conveniently.

Due to their relatively small size and generally rounded or bulbous shape, the headers 22 and 23 are well adapted to stand very high pressures. Correspondingly high strength is realized in connection with the feed-water conduction system by utilizing for this purpose a plurality of small diameter conduits 27, 28, 29 and 30 traversing all of the casing sections and extending between the manifold headers. In accordance with the invention, each conduit comprises one or more sinuously convoluted or helical portions and, preferably, includes such a portion within each of the casing sections. The inherent flexibility of such an arrangement permits the stresses created by the passage of high pressure fluid to be equalized and in part relieved without danger of mechanical rupture. As a result, even with pressures on the order of 2500 pounds per square inch, it is possible to avoid the expense and complication of providing a separate expansion permitting device such as a manifold header movably mounted within the external casing.

According to the indicated arrangement, the various feed-water conduits 27, 28, 29 and 30 are arranged in parallel concentric convolutions. In order to assure uniform water heating and incidentally uniform expansion of the individual conduits, it is desirable to reverse the relative positions or order of concentricity of the conduits at one or more points along the length of the casing and preferably in each casing section. This feature is illustrated, for example, by the conduit arrangements shown respectively to the left and to the right of the partition 13. In this connection, it will be seen that the conduit 27 which assumes the innermost position in the casing section 10 is brought to the outermost position in the casing section 12 and that the positions of the remaining conduits are correspondingly reversed.

It will also be noted that those portions of the conduits which lie in one casing section are joined to those which lie in the next casing section by

means of fused metal connections indicated at 31 and 32, respectively. The connections 31 are so placed that when the casing section 10 is taken off, the connections may be severed and the partition 13 removed by sliding it to the left. Such removal is made possible by means of packing sleeves 33 which permit relative motion of the conduits and partition but prevent the leakage of steam between the casing sections. After the partition is lifted off, the interior of the intermediate casing section is rendered accessible so that any necessary repairs can be made. If the remainder of the conduit connections are arranged in similar fashion, all of the casing sections can be opened in the same way with a minimum of mechanical difficulty.

In using my invention in connection with feed-water preheating as, for example, in a high pressure steam locomotive system, the feed-water may be introduced into the manifold header 23 from the condenser of the circulating system. After flowing through the casing, the heater water is withdrawn from the manifold header 22 from which it may be led into the high pressure boiler. In its passage through the preheater, the feed-water is in counterflow to heating fluid which may be supplied, for example, by extraction from the various stages of a steam turbine. Thus, steam at high pressure, say 400 lbs., may be introduced into the casing section 10 through an inlet connection 35. The water formed by condensation of this steam may be continuously removed by draining into a steam trap 36 which connects with the casing by a drainage duct 37 and a pressure equalizing connection 38. The steam trap may be of conventional construction and is adapted to permit passage of water without permitting escape of uncondensed steam from the casing section 10. The water removed through the trap is led into the intermediate casing section 12 through a duct 39 by which it is returned to the circulating system in such a manner as not to be required to flow over the conduit surfaces. By means of a second inlet pipe 40, steam at a pressure below that of the first casing section is introduced into the intermediate casing section 12 from which it is removed through another steam trap 42 in the manner already described. In this case, however, the end casing section 20, into which water from the trap 42 is led through a conduit 43, comprises a so-called "drip cooler" adapted to be entirely filled with liquid condensate. While the heat content of the liquid is low with respect to that of the steam as introduced into the preceding casing sections, it is still high enough with respect to the incoming feed-water so that an appreciable increase in economy is realized by the disposition indicated. From this last heat exchange section the outgoing water is drawn through the steam trap 46 from which it may be returned to the main condenser or if desired, to another portion of the circulating system.

The preheater construction described in the foregoing has been found to be particularly suited for use in connection with a steam locomotive in which the boiler pressure is in excess of 1500 pounds per square inch. This pressure can be handled with safety by the feed-water connections illustrated, while the preheater as a whole is characterized by a compactness and low weight which makes it perfectly adaptable to the requirements of modern locomotive design.

While I have described the invention in terms of a particular structure, many modifications may be made without departure from the invention. I therefore aim in the appended claims to cover all such equivalent embodiments as come within the true spirit and scope of the foregoing disclosure.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A preheater comprising an elongated multi-section casing, partitions interposed between adjacent casing sections for effecting a fluid tight separation thereof, a plurality of conduits traversing all the casing sections and having concentric helically formed portions within each casing section, the order of concentricity being reversed in adjacent sections, a bulbous inlet manifold extending through and forming a closure for one end of said casing for conducting fluid to be heated in said plurality of conduits, a bulbous outlet manifold extending through and forming a closure for the other end of said elongated casing for conducting heated fluid from said plurality of conduits, means for supplying heating elastic fluid at high temperature to said casing section at said outlet end, means for conducting heating elastic fluid at a lower temperature to an intermediate casing section, means for conducting condensate from said outlet end section into said intermediate section, means for conducting condensate from said intermediate section to the inlet end section, such condensate comprising the heating fluid for said inlet end section and means for conducting condensate from said last mentioned section.

2. A preheater comprising an elongated multi-section casing, partitions interposed between adjacent casing sections for effecting a fluid tight separation thereof, a plurality of conduits traversing all of the casing sections, an inlet manifold at one end of said casing for conducting fluid to be heated in said plurality of conduits, an outlet manifold at the other end of said elongated casing for conducting heated fluid from said plurality of conduits, means for supplying heating elastic fluid at high temperature to the casing section at the outlet end, means for conducting heating elastic fluid at a lower temperature to an intermediate casing section, means for conducting condensate from said casing section at said outlet end into said intermediate section, means for conducting condensate from said intermediate section to the inlet end section, such condensate comprising the heating fluid for said inlet end section and means for conducting condensate from said last mentioned section.

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