Feb. 5, 1946. S. PENNELLA 2,394,402

SURFACE CONDENSER

Filed March 20, 1943

Fig. 1

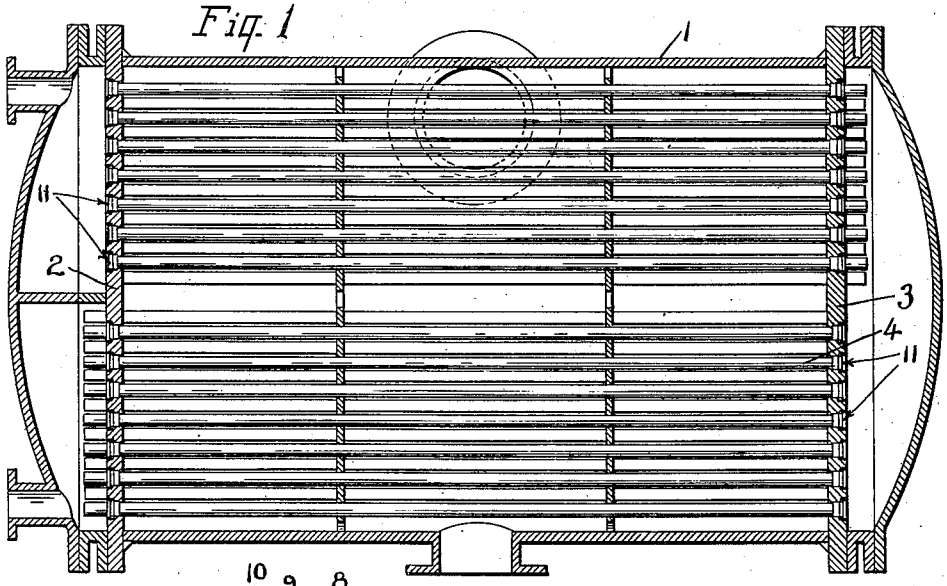


Fig. 2

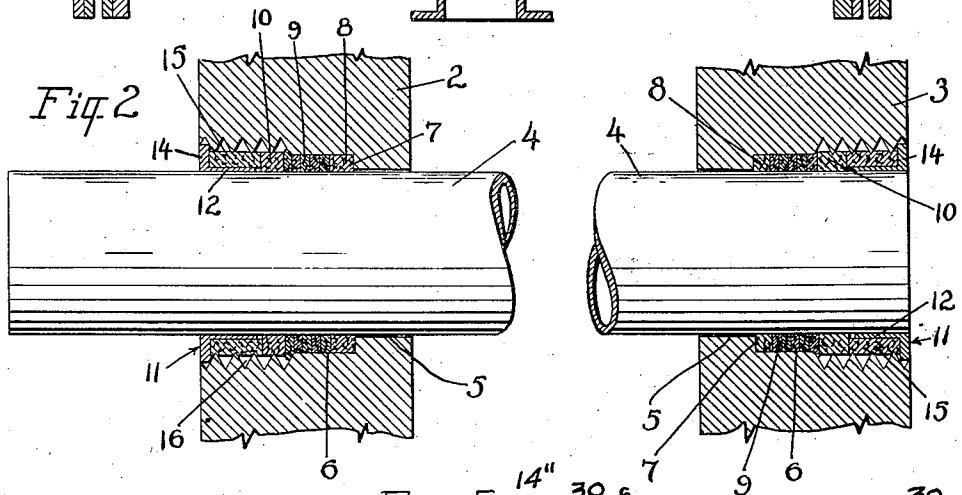


Fig. 3

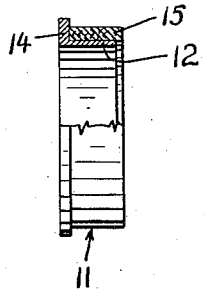


Fig. 4

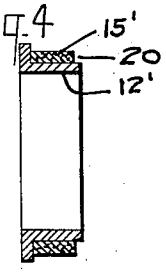


Fig. 5

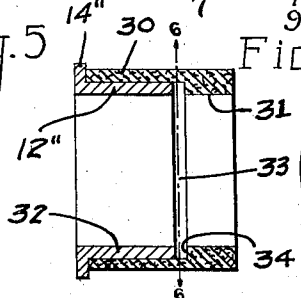
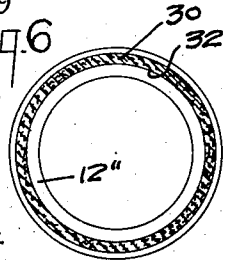


Fig. 6



Samuel Pennella

INVENTOR

BY Robert Meyer

ATTORNEY

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2,394,402

SURFACE CONDENSER

Samuel Pennella, East Orange, N. J.

Application March 20, 1943, Serial No. 479,831

2 Claims. (Cl. 285—45)

This invention relates to surface condensers and more particularly to means for and a manner of mounting the tubes in the tube sheets or tube heads of a condenser.

It is the universally accepted practice in condenser construction to seal the water circulating tubes at the tube heads to provide fluid-tight connection either by rolling the ends of the tubes or by employing a combination of packing and ferrules threaded into the tube heads. The rolling of the tube ends frequently causes local crystallization of the tubes resulting in relatively quick deterioration of the tubes and also an expensive operation in re-tubing a condenser both as to labor cost and loss of tubes. With the threaded ferrule type of mounting, one such structure of which is shown in my earlier Patent No. 2,298,154, issued October 6, 1942, it is necessary to thread both the tube sheet and the ferrule and since commercial condensers usually contain thousands of such tubes this is an expensive operation. Further, such ferrules require special tools and a relatively large labor cost to install them in a condenser.

It is an object of the present invention to provide a simple relatively inexpensive quickly installed type of ferrule and packing combination by means of which condenser tubes may be sealed in tight connection with condenser tube sheets, thereby materially reducing the cost of tubing or retubing a condenser as well as reducing the labor and time element required for such work.

Another object of the present invention is to provide a ferrule and packing structure which is particularly adaptable for use in condensers constructed in accordance with my invention disclosed in said patent, No. 2,298,154, in that it will permit the driving of the tubes through the packing or sealed structure for renewal of the inlet ends of the tubes without disrupting the seal.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawing, showing a surface condenser of the preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawing:

Figure 1 is a longitudinal section through a condenser constructed in accordance with the present invention.

Figure 2 is a fragmentary enlarged longitudinal section through the combined ferrule and packing structure showing it assembled in connection with a condenser tube and tube sheets.

Figure 3 is a detailed view partly in section and partly in elevation of the improved ferrule employed in the present invention.

Figure 4 is a cross section through a modified form of this invention.

Figure 5 is a longitudinal section through a further modified form of the invention.

Figure 6 is a cross-section taken on the line 6—6 of Figure 5.

Referring more particularly to the drawing, 1 indicates a condenser of any approved type employing tube heads or tube sheets 2 and 3 and the tubes 4 through which the cooling water circulates for condensing the steam which is delivered to the condenser.

The present invention relates specifically to the manner of holding the tubes 4 in the tube sheets or heads 2 and 3 and forming a fluid-tight seal between the tubes and tube heads so as to prevent water from leaking from the water boxes of the condenser past the tubes into the condensing space and polluting the condensate as well as to prevent air from passing into the condensing space with the resulting pollution of the condensate.

As is usual, in the construction of condensers the tube sheets 2 and 3 are provided with openings or holes 5 through which the tubes 4 extend and these holes 5 are countersunk as shown at 6 providing enlarged portions of the holes and annular shoulders 7 at the inner ends of the countersinks.

A fiber ring 8 is first inserted in the countersunk portions 6 of each of the holes 5 against the shoulders 7, and next a packing 9 of coiled corset lacing is inserted in the countersunk portion against the fiber rings 8. A second fiber ring 10 is then inserted into the countersunk portions 6 of the openings 5 against the outer ends of the corset lacing packing 9 after which a ferrule structure 11 is driven into the outer open end of the countersunk portion. The ferrule 11 has metal sleeve 12 having an annular flange 14 on its outer end and the internal diameter of the sleeve 12 is such as to snugly fit over the tube 4. A sleeve 15 of highly compressed fiber which will swell when wetted is tightly driven upon the outer surface of the sleeve 12 of the ferrule 11, and the outer diameter of this fiber sleeve 15 is such that it will require administration of relatively light forces to drive it into the countersunk portion of the opening 5. The ferrule 11 is of sufficient length that when it is properly driven into place

in the countersunk portion 6 it will hold the fiber washers 8 and 10 and the corset lacing packing 9 snugly in place, and when the fiber sleeve 15 and the fiber rings 8 and 10 are wetted, as they will be upon the initial starting of operation of the condenser, it will swell so as to form fluid-tight sealing engagement with the bore of the countersunk portion 6 and with the outer surface of the tube 4.

If it is so desired, and in fact it is preferable, a portion of the length of the wall of the countersunk portion 6 inwardly of its outer open end may be roughened as shown at 16. This roughening may take the form of threads or any suitable type of roughening preferably sinuous groove so as to provide an irregular surface into which the fiber sleeve 15 will expand upon swelling to form a more secure fluid-tight seal about the tube 4 and between the tube and tube sheet.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

In Figure 4 of the drawing a modified form of the ferrule is shown which differs from the structure shown in Figures 1 to 3 inclusive only in that the sleeve 15' of compressed fiber which will swell when wetted is shorter than the metal sleeve 12', providing a space indicated at 20 at the inner end of the fiber ring 15' and between the fiber ring 10 so as to accommodate longitudinal expansion of the fiber ring 15' without causing disruption of the complete packing assembly.

In Figures 5 and 6 a further modified form of the invention is shown.

In this latter modified form a flanged sleeve 12'' which has an annular outer flange 14'' is employed which is substantially of the same construction as the metal sleeve 12 and flange 14. A fiber sleeve 30 is employed in this latter modified form and replaces the fiber sleeve 15 and fiber ring 10 providing a single fiber element replacing the two elements and consequently facilitating the assembly of the packing structure about a condenser tube.

The fiber ring 30 is drilled or bored to two different diameters, namely, the bore 31 is of such size as to fit snugly about a tube of a condenser or similar heat exchanger as shown at 4 in Figure 2, while the remaining portion of the sleeve is bored to fit snugly about the metal sleeve 12''. The bore 32 which fits about the metal sleeve 12'' is longer than the sleeve so as to provide a space 33 between the inner end of the sleeve 12'' and the shoulder 34 formed at the junction of the bores 31 and 32, thus providing a space to accommodate longitudinal expansion of fiber sleeve 30 when it is wetted.

What is claimed is:

1. In a surface condenser, tube sheets, water circulating tubes, said tube sheets provided with countersunk holes to receive the ends of said tubes, the inner surface of at least part of the countersunk portions of said holes being roughened, seal-forming ferrules inserted into the countersunk portions of said holes about said tubes, said ferrules including metal carrying sleeves, fiber sleeves about said carrying bodies, said fiber sleeves being made of highly compressed fiber which will swell upon wetting to provide fluid-tight seals between the ferrules and the roughened portions of the openings, said fiber sleeves being constructed to form an open space within the ferrule structure to permit longitudinal expansion of the fiber sleeves upon wetting.

2. In a surface condenser, tube sheets, water circulating tubes, said tube sheets provided with countersunk holes to receive the ends of said tubes, the inner surface of at least part of the countersunk portions of said holes being roughened, seal-forming ferrules inserted into the countersunk portions of said holes about said tubes, said ferrules including metal carrying sleeves, fiber sleeves about said carrying bodies, said fiber sleeves being made of highly compressed fiber which will swell upon wetting to provide fluid-tight seals between the ferrules and the roughened portions of the openings, said fiber sleeves having a portion of their lengths bored to one diameter to fit about said tubes, and the remaining portion bored to fit about said metal carrying sleeves, the portion of the sleeve bored to fit about said carrying sleeves being longer than the carrying sleeve to provide a space to permit longitudinal swelling of the sleeve upon wetting.

SAMUEL PENNELLA.