Oct. 18, 1949. S. PENNELLA 2,484,904

LEAK STOPPER FOR CONDENSER TUBES

Filed Oct. 3, 1946

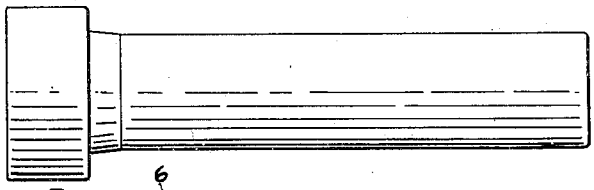

FIG. 1

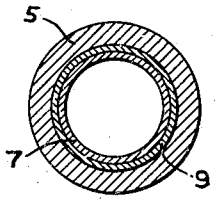

FIG. 3

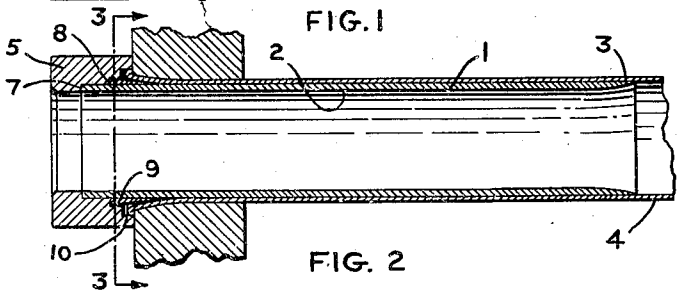

FIG. 2

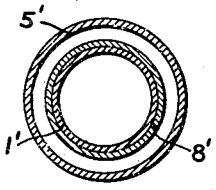

FIG. 5

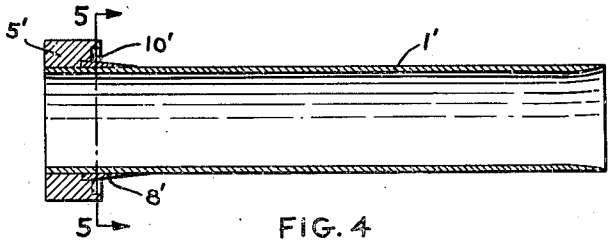

FIG. 4

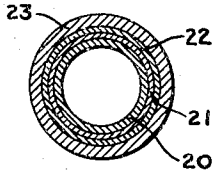

FIG. 7

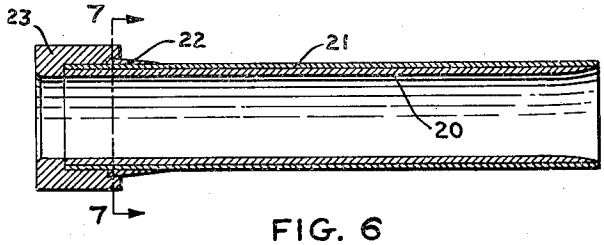

FIG. 6

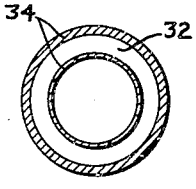

FIG. 9

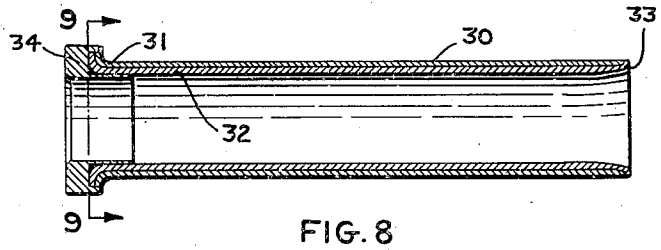

FIG. 8

SAMUEL PENNELLA
INVENTOR

By Robert Meyer

Attorney

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LEAK STOPPER FOR CONDENSER TUBES

Samuel Pennella, Pompton Lakes, N. J.

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11 Claims. (Cl. 285—54)

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This invention relates to surface condensers employed for condensing exhaust steam in power plants, etc., and more particularly to leak stopping inserts for insertion into a condenser tube for preventing leakage through openings formed in the tubes by corrosion or erosion.

The cooling water flowing through the tubes of a surface condenser causes failure of the inlet ends of the tubes, due to impingement, erosion, and electro-chemical corrosion, resulting in the eating away and perforation of the tube, causing leakage. Such action has been found by experience to be most severe in close proximity to the inlet end of the tube.

It is an object of the present invention to provide an insert or leak-stopping sleeve for insertion into the "eaten-away" end of the tube for effectively sealing any leaks therein, consequently prolonging the life of the tube as well as eliminating for a practical period of time the necessity for retubing the condenser.

It is necessary, to stop such leaks and prevent further deterioration of the tube, that the leak stopping insert fit the interior of the tube in fluid tight engagement, and necessary also that the act of forcing the insert into the tube not disrupt or break the corroded tube. An object of the present invention is to provide a novel, practical insert which can be readily forced into a corroded tube without disrupting or rupturing the tube structure, which will effectively stop all leaks in the tube and one which will not impair the heat transfer efficiency of the condenser by adversely affecting the cooling water flow through the tubes.

Another object of the present invention is to provide a leak stopper for condenser tubes, which is constructed of non-frangible material which will not break or crack either in handling or when subjected to the shocks, etc., encountered during the operation of a surface condensing, and which material is of sufficient hardness to permit it to be accurately machined, yet will swell or expand when wetted, so as to tightly fit within the condenser tube and form a fluid tight engagement with the interior of the condenser tube.

The present invention is an improvement on the leak stopper for condenser tubes described and claimed in my prior Patent Number 2,262,042, dated November 11, 1941.

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 drawings, showing a leak stopper for condenser

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tubes of a preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Figure 1 is a side elevation of the improved leak stopper for condenser tubes.

Figure 2 is a longitudinal section through the leak stopper.

Figure 3 is a cross-section taken on the line 3—3 of Figure 1.

Figure 4 is a longitudinal section through a modified form of the leak stopper.

Figure 5 is a cross-section taken on line 5—5 of Figure 4.

Figure 6 is a longitudinal section through a further modified form of the leak stopper.

Figure 7 is a cross-section on line 7—7 of Figure 6.

Figure 8 is a longitudinal section through a still further modified form of the leak stopper, and

Figure 9 is a cross-section on line 9—9 of Figure 8.

Referring more particularly to the drawings the improved leak stopper shown in Figures 1 to 3 inclusive of the drawings includes a tube or sleeve 1 which is constructed of a hard, non-frangible fiber or fibrous material which will swell slightly when wetted. The internal bore 2 of the sleeve 1 tapers to a knife edge at its outlet end as shown at 3 so as to prevent eddy forming shoulders where the water passing through the sleeve 1 enters a condenser tube, shown at 4 in Figure 3 of the drawings.

The inlet end of the sleeve 1 extends into a flow guiding head 5, which is preferably made of a hard non-frangible fiber, or of a composition of fiber and plastic to provide a hard wear resisting flow guiding head of material which is non-conducting of electrical current so as to prevent the corrosion action of electrolysis on the head and between the head and the condenser tube 4 as well as the condenser tube sheet indicated at 6 in Figure 3 of the drawings. The inlet end of the sleeve 1 abuts a shoulder 7 formed in the head 5 and the head 5 has a second shoulder 8 formed therein against which the outer end of a sealing ring 9 abuts. The sealing ring 9 is wedge shaped in cross-section, that is its wall tapers to a knife edge at its inner end for fitting snugly into the slightly enlarged inlet end of a condenser tube which is expanded and rolled to form a fluid tight seal with the tube sheet 6. The sealing ring 9 is constructed of a hard fibrous material which will swell when wetted and it is preferably formed of

material which will have quicker swelling action than the material of which the sleeve 1 is formed so that it will quickly form a fluid tight seal between the condenser tube 4 and the sleeve 1 when the latter is inserted into a condenser tube.

The inner end of the flow guiding head 5 is provided with an annular cut out portion 10 which receives therein the head on a rolled ended condenser tube, when the leak stopping insert is inserted into the tube with the inner end of the head 5 in flat abutting engagement with the tube sheet 6 of a condenser (not shown).

By making the sleeve 1 of material which will swell when wetted the sleeve may be made with an outside diameter that will enable the leak stopping insert to be driven into a condenser tube by the hand of a workman, or by a light hammer blow, and the tapered sealing ring will form a temporary seal with the expanded end of the condenser tube until such time as the sleeve 1 and the sealing rings 6 are swollen by being wetted by circulating water to form the firm and complete fluid seal between the leak stopping insert and the tube and to seal any holes in the inlet end of the tube. The head 5 will form a flow guiding extension for the inlet of the condenser tube which will protect the tube and the surrounding portion of the tube sheet from electrolytic action and at the same time provide a long wearing non-corroding entrance for the circulating water into the condenser tube.

By making the sleeve or tube 1 of a hard non-frangible fibrous material the disadvantages of the employment of a sealing adhesive such as is necessary with the use of frangible plastic inserts will be eliminated as well as the danger of breakage of the insert during shipping, handling or insertion into a condenser tube, and also it will be free from the danger of breakage when contacted by small stones or similar foreign material which often is contained in the circulating cooling water of a condenser.

The modified form of the invention shown in Figures 4 and 5 of the drawings is the same as the form shown in Figures 1 to 3 except that the sleeve 1' extends completely through the head 5' and has its inlet end flush with the outer end or face of the flow guiding inlet head 5'. The head 5' is provided with a recess 10' to receive the rolled end of a condenser tube therein and a sealing ring 8' is provided which is the same as the sealing ring 8 and has its outer end abutting against an internal shoulder formed in the bore of the head 5'.

Figures 6 and 7 of the drawings shows a further modified form of the leak stopper in which a metal tube 20 is inserted in and extends throughout the length of the tube or sleeve 21. The tube or sleeve 21 is constructed of hard compact fiber which will swell when wetted and its inlet end is surrounded with a sealing ring 22. The sealing ring is wedge shaped in cross-section the same as the sealing ring 9 so that it will fit with a wedge fit in the expanded end of a condenser tube and form an initial fluid tight seal which will be increased and extended into a firm tight seal upon the swelling of the fiber tube or sleeve 21, and the sealing ring 22 when they are wetted by circulating cooling water in the condenser. The inner bore of the metal sleeve 20 tapers to a knife edge at its outlet end. The metal tube or sleeve 20 prevents the fiber sleeve 21 from expanding inwardly.

A flow guiding head 23 is mounted upon the inlet ends of the sleeves or tubes 20 and 21 and upon the inlet end of the sealing ring 22. The head 22 like the heads 5 and 5' is made of a composition of fiber and plastic, or a non-frangible, tough plastic which will resist erosion by water and serve as a non-conductor of chemical electricity and consequently form a protector against electrolytic action. The modified form of the leak stopping insert may be used in connection with condenser tubes which are expanded into a tube sheet or ones which are sealed in a tube sheet by packing and ferrules.

The modified form shown in Figures 8 and 9 of the drawings is quite similar to the form shown in Figures 6 and 7 differing therefrom principally in that the fiber sealing ring is eliminated and that the inlet end of the fiber tube 30 is enlarged and tapers for a short distance inwardly of the enlarged end as clearly shown at 31 so as to provide a gradually decreasing cross-sectional area inwardly from the enlarged end for the purpose of providing a wedging initial sealing contact with the interior of a condenser tube.

A metal sleeve 32 is inserted in the fiber tube or sleeve 30 and has its outlet end outturned as shown at 33 to form an abutment to limit longitudinal expansion of the fiber tube. The sleeves 20 and 30 are preferably made of the same metal as is used in condenser tubes.

A flow guiding inlet head 34 is mounted upon the inlet ends of the sleeves or tubes 30 are preferably made of the same metal as is used in condenser tubes.

A flow guiding inlet head 34 is mounted upon the inlet ends of the sleeves or tubes 30 and 32 and is of the same material and construction as the head 23.

In all forms of the invention, the inlet flow guiding heads engage against the inlet or water box sides of a tube sheet of a condenser (not shown) and extend into the water box to provide a protective inlet for the condenser tubes.

What is claimed is:

1. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, said insert having its inner diameter tapering to a knife edge at its outlet end, and a flow guiding inlet head on the inlet end of said tubular insert, said inlet head being constructed of material which is non-swelling when wetted and is non-conducting of chemical electricity.

2. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, said insert having its inner diameter tapering to a knife edge at its outlet end, and a flow guiding inlet head on the inlet end of said tubular insert, said inlet head being constructed of material which is non-swelling when wetted and is non-conducting of chemical electricity, and a sealing sleeve of material which will swell when wetted mounted about the inlet of said tubular insert.

3. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, said insert having its inner diameter tapering to a knife edge at its outlet end, and a flow guiding inlet head on the inlet end of said tubular insert, said inlet head being constructed of material which is non-swelling when wetted and non-conducting of

chemical electricity, and a sealing sleeve of material which will swell when wetted mounted about the inlet of said tubular insert, said sealing sleeve being tapered to decrease in thickness from its inlet to its outlet end.

4. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, said insert having its inner diameter tapering to a knife edge at its outlet end, and a flow guiding inlet head on the inlet end of said tubular insert, said inlet head being constructed of material which is non-swelling when wetted and is non-conducting of chemical electricity, said flow guiding head provided with an internal annular shoulder against which the inlet end of said tubular insert abuts.

5. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, said insert having its inner diameter tapering to a knife edge at its outlet end, and a flow guiding inlet head on the inlet end of said tubular insert, said inlet head being constructed of material which is non-swelling when wetted and is non-conducting of chemical electricity, and a metal sleeve inserted in and extending throughout the length of said tubular insert.

6. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, said insert having its inner diameter tapering to a knife edge at its outlet end, and a flow guiding inlet head on the inlet end of said tubular insert, said inlet head being constructed of material which is non-swelling when wetted and is non-conducting of chemical electricity, and a metal sleeve inserted in and extending throughout the length of said tubular insert, and means formed on the outlet end of said metal sleeve to limit longitudinal expansion of said tubular insert.

7. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, a flow guiding head on the inlet end of said tubular insert and constructed of material which is non-swelling when wetted and is non-conducting of chemical electricity, said head having a bore of equal diameter with the diameter of said tubular insert and provided with an internal enlarged bore portion for receiving the inlet end of said tubular insert.

8. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, a flow guiding head on the inlet end of said tubular insert and constructed of material which is non-swelling when wetted and is non-conducting of chemical electricity, said head having a bore of equal diameter with the diameter of said tubular insert, and provided with an internal enlarged bore portion for receiving the inlet end of said tubular insert, and a sealing ring about the inlet end of said tubular insert, said sealing ring being of material which will swell when wetted and being substantially wedge shaped in longitudinal section.

9. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, said insert having its inner diameter tapering to a knife edge at its outlet end, and a flow guiding inlet head on the inlet end of said tubular insert, said inlet head being constructed of material which is non-swelling when wetted and is non-conducting of chemical electricity, the inlet end of said tubular insert being gradually tapered to provide a wedge fit with the inlet end of a condenser tube.

10. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, said insert having its inner diameter tapering to a knife edge at its outlet end, and a flow guiding inlet head on the inlet end of said tubular insert, said inlet head being constructed of material which is non-swelling when wetted and is non-conducting of chemical electricity, the inlet end of said tubular insert being gradually tapered to provide a wedge fit with the inlet end of a condenser tube, and a metal sleeve inserted in and extending throughout said tubular insert.

11. Means for stopping leaks in a condenser tube perforated by corrosion or erosion comprising a tubular insert of a hard compact fibrous material subject to swelling when wetted, said insert having its inner diameter tapering to a knife edge at its outlet end, and a flow guiding inlet head on the inlet end of said tubular insert, said inlet head being constructed of material which is non-swelling when wetted and non-conducting of chemical electricity, the inlet end of said tubular insert being gradually tapered to provide a wedge fit with the inlet end of a condenser tube, and a metal sleeve inserted in and extending throughout said tubular insert, and means formed upon the outlet end of said metal sleeve to limit longitudinal expansion of said tubular insert.

SAMUEL PENNELLA.

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