June 19, 1951 S. PENNELLA 2,557,360

PROTECTIVE FERRULE FOR HEAT EXCHANGER TUBES

Filed April 5, 1948

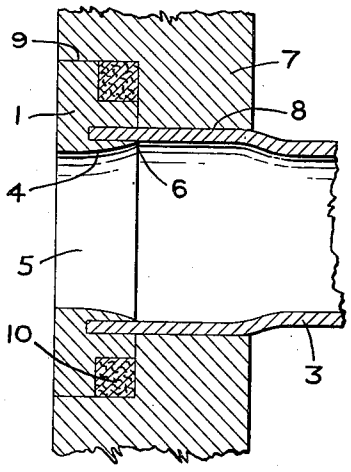


FIG. 1

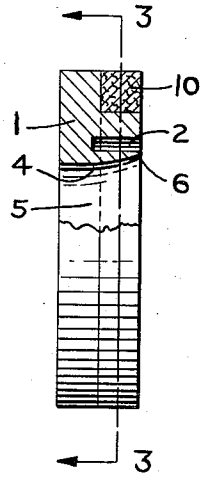


FIG. 2

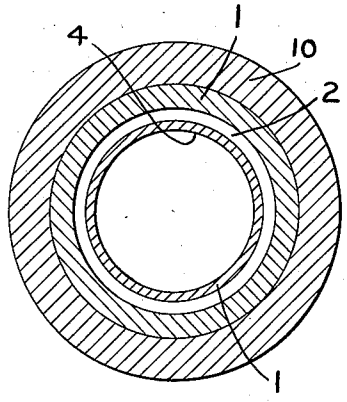


FIG. 3

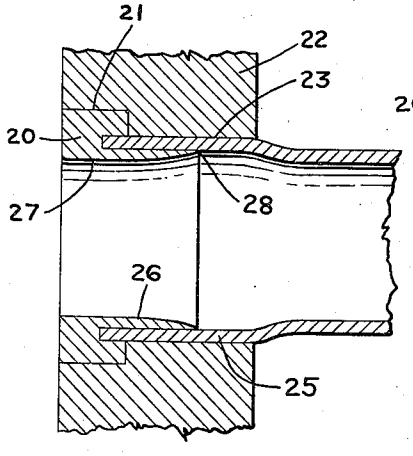


FIG. 4

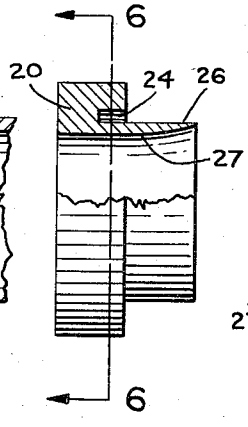


FIG. 5

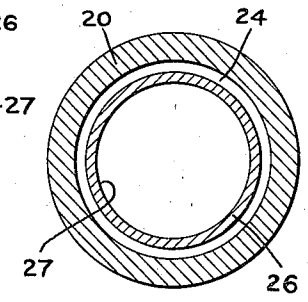


FIG. 6

SAMUEL PENNELLA
INVENTOR.

BY Robert Meyer
Attorney

Patented June 19, 1951 2,557,360

UNITED STATES PATENT OFFICE

2,557,360

PROTECTIVE FERRULE FOR HEAT EXCHANGER TUBES

Samuel Pennella, Pompton Lakes, N. J.

Application April 5, 1948, Serial No. 18,937

2 Claims. (Cl. 285—56)

1

This invention relates to heat exchangers such as surface condensers for condensing exhaust steam in power plants and more particularly to a protecting ferrule for protecting the inlet ends of the tubes of such an apparatus, being particularly adaptable for use in connection with tubes which are expanded into the tube sheet.

The tubes of condensers are connected in fluid tight seals with the tube head in a number of ways, such as by the use of packing with ferrules, expanding the tube end into the tube receiving opening in the tube sheet and belling or rolling the extreme end of the tube.

In many installations the expanded tube end with its rolled extreme end is preferable but it has a number of disadvantages among which are that the expanding and rolling of the tube leave the inlet end of the tube larger than the diameter of the major length of the tube allowing coke, stones or other solid foreign matter to enter the tube inlet and become lodged in the tube at the terminus of the expanded portion causing interference with the water flow through the tube and augmenting the erosion and corrosion of the tube. Then also the rolling of the extreme ends of the tubes stresses and strains the metal and causes crystallization resulting in an early breakdown of the rolled end of the tube with the resultant leakage.

The tubes of a surface condenser are made of a different metal than the tube sheets with the result that during operation of the condenser an electrolytic action is set up which causes deterioration of the tubes.

The retubing of a surface condenser is an expensive operation, as to labor costs, costs of new tubes and losses due to shut down of the condenser.

It is an object of the present invention to provide means for connecting condenser or heat exchanger tubes to their tube sheets which will embody all of the advantages of expanding the tubes in the tube sheets and will overcome the disadvantages of such construction by preventing the entrance of solid foreign matter into the tube when the foreign matter size is such as to prevent its passage completely through the tube; will eliminate the necessity of rolling the extreme ends of the tubes; will provide a firm fluid tight seal between a tube and tube sheet at all times, and being of a material which is non-conductive of electricity will prevent electrolytic action between the tube sheet and tube end, and will also protect the inlet ends of the tubes from acids and other corroding agents which may be in the water circulated through the condenser.

Another advantage of the present invention is that the protective sealing ferrules are made of material which will swell slightly when it becomes wetted and thus as the tube wears during use the ferrule will swell proportionally to the decrease in size of tube and maintain a tight seal at all times.

2

Another object of the invention is to provide an improved tube protecting ferrule as specified which may be quickly, easily, and inexpensively applied, without the use of skilled labor.

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 protecting ferrule for heat exchanger 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 section through the improved tube protecting ferrule showing it in a fragment of a tube sheet.

Figure 2 is a view partly in edge elevation and partly in section of the improved tube protecting ferrule.

Figure 3 is a section on line 3—3 of Figure 2.

Figure 4 is a section of a modified form of the tube protecting ferrule showing it in use in a fragment of a tube sheet.

Figure 5 is a view partly in edge elevation and partly in section of the modified form of the tube protecting ferrule.

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

Referring to the drawings, and more particularly to the form of the invention shown in Figures 1 to 3, the improved protective ferrule for heat exchanger tubes comprises an annular or ring-like body 1 which is formed of any suitable material, preferably a plastic composition which is insulating or non-conductive of electrical currents and which will swell slightly when wetted. There are a number of such materials on the market, some manufactured by the Bakelite Corporation, and other companies engaged in the manufacture of hard thermo-setting plastics.

The annular or ring-like body 1 is provided with an inwardly extending annular recess 2 extending inwardly from its inner end and forming an annular recess for receiving the end of a condenser or heat exchanger tube as indicated at 3. The inner surface 4 of the body 1, that forms the wall for the bore 5 of the ferrule, tapers outwardly as it progresses towards the inner side of the ferrule so as to form substantially a knife edge, indicated at 6, where the extreme inner portion of the wall 4 contacts the inner surface of the tube 3.

The tube sheet 7 of the condenser or heat exchanger (not shown) is provided with a bore 8 into which the tube 3 extends and also with a

counterbore 9 extending inwardly from the outer face of the tube sheet 7. The tube protecting ferrule 1 has a driving fit into the counterbore 9, as clearly shown in Figure 1 of the drawings, and when inserted in proper place its outer surface is flush with the outer surface of the tube sheet. The outer perimeter of the annular or ring-like body 1 is cut away preferably at the innermost corner to form an annular recess in which is sealed a sealing ring 10. The sealing ring 10 is formed of a hard pressed fibrous material such as compressed wood fiber, paper, or the like, which is more readily susceptible to swelling when wetted than is the material of which the ferrule body 1 is formed, and when this sealing ring 10 becomes wetted it will swell forming a tight seal between the ferrule 1 and the tube sheet 7.

In installing, the tube 3 has its end inserted into the opening 8 in the tube sheet 7 and the portion of the tube 3 within the opening 8 is expanded in the usual manner to form a fluid tight seal with the tube sheet. However, the tube 3 is of such length that its outermost end terminates short of the outer face of the tube sheet, as clearly shown in Figure 1 of the drawings. Thus the end of the tube extends into the counterbore 9. The ferrule is then placed in the counterbore with the end of the tube in the recessed tube and is driven into place by a sharp blow of a hammer, mallet, or the like. It will be noted that the bore of the ferrule is of less diameter than the bore of the major length of the tube 3 and thus, hard or solid pieces of foreign material of a size too large to pass completely through the tube 3 will be prevented from entering the tube and clogging it. Such entrance and clogging would be permitted without this feature of the ferrule, because in expanding the end of the tube into the tube sheet its internal diameter is slightly increased which would allow foreign particles to enter the expanded end of the tube and become lodged therein due to their inability to pass completely through the tube. By making the body 1 of electrical current insulating material the tube 3, at its entrance end, will be completely insulated from the tube sheet and thus electrolytic action caused by the flow of the circulating water over the two metals in contact, will be eliminated with its resultant deterioration of the tubes. The ferrule being constructed of a hard, compact plastic material will also protect the inlet end of the tube 3 from corrosive and erosive action of chemicals which might be contained in the circulating water. The swelling of the ring 10 and of the ferrule 1 are confined within the limits of the counterbore 9. However, as the tube 3 begins to wear or reduce in thickness through long continued use these elements will have a tendency to swell to a greater extent than ordinarily, being released for swelling in a degree equal to the reduction in the thickness of the tube and consequently a tight seal about the tube and tube sheet will be maintained at all times.

Figures 4, 5, and 6 show a modified form of the improved ferrule.

In this form the ferrule is formed completely of one piece and comprises the annular or ring-like body 20 which fits into the counterbore 21 in the tube sheet 22 at and surrounding the outer end of the tube receiving opening 23. The annular ring-like body 20 has an annular recess 24 extending thereinto from its inner side which receives the end of the tube 25. The tube 25 is

expanded into the opening 23 and its end projects into the counterbore a sufficient distance to be firmly engaged within the annular recess 24. The body 20 has a sleeve-like extension 26 formed thereon which projects into the tube 25 beyond the inner edge of the main body 20. The bore 27 of the ferrule 20 is smaller in diameter than the normal major length bore of the tube 25 and the ferrule 20 is also made of material which is non-conductive of electrical currents and which will swell slightly when wetted so that its advantages and actions are the same as those above described in connection with the ferrule 1. The sleeve 26 tapers to a knife-like edge 28 at its inner end, as clearly shown in Figures 4 and 5.

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.

What is claimed is:

1. A protecting ferrule for the inlet ends of heat exchanger tubes comprising an annular body of hard compact fibrous plastic material which is non-conductive of electrical currents and which will swell slightly when wetted. said annular body having an annular recess extending inwardly from one edge thereof for receiving the end of a heat exchanger tube, the inner wall of the bore of said annular body tapering outwardly as it approaches the outlet end of the body to provide substantially a knife edge at the outlet end of the body, said annular body having a portion thereof cut away at its outer perimeter to provide an annular space and a sealing ring of hard compact fibrous material capable of swelling when wetted seated in said annular space.

2. The combination with a tube sheet and a tube of a heat exchanger, said tube sheet provided with a tube receiving opening and with a smooth bore counterbore about the outer end of said opening, said tube extending through said opening and partially through said counterbore and being expanded in said opening into fluid tight engagement with the tube sheet, a protecting ferrule having a driving fit in said counterbore and provided with an annular recess opening out through its inner end for receiving therein the portion of the tube which projects into said counterbore, said ferrule having its outer surface cut away to provide an annular space, and a sealing ring of hard compact fibrous material capable of swelling when wetted in said annular space and contacting said tube sheet, the diameter of the bore of said protecting ferrule being less than the internal diameter of the tube, said protecting ferrule completely enclosing the outer end of the tube and having its inner surface tapering outwardly as it approaches the outlet end of the ferrule to provide substantially a knife edge at the outlet end of the ferrule.

SAMUEL PENNELLA.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,099,026	Markel	Nov. 16, 1937
2,225,615	Bay	Dec. 24, 1940
2,252,274	Rossheim	Aug. 12, 1941
2,394,402	Pennella	Feb. 5, 1946