Aug. 18, 1925.

1,550,157

R. T. GILLETTE

PROGRESSIVE SYSTEM OF BRAZING

Filed Jan. 2, 1924

Fig. 1.

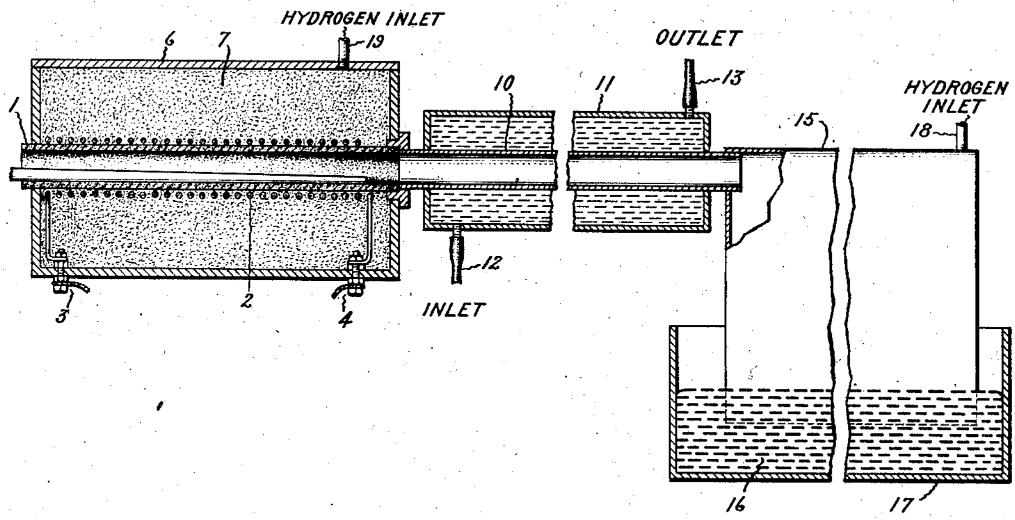


Fig. 2.

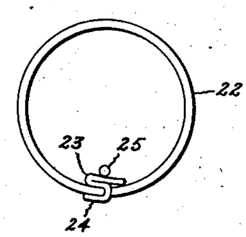
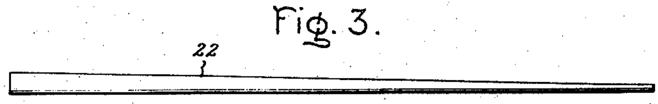


Fig. 3.



Inventor:
Robert T. Gillette.

by

His Attorney.

Patented Aug. 18, 1925. 1,550,157

UNITED STATES PATENT OFFICE.

ROBERT T. GILLETTE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

PROGRESSIVE SYSTEM OF BRAZING.

Application filed January 2, 1924. Serial No. 683,966.

To all whom it may concern:

Be it known that I, Robert T. Gillette, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Progressive Systems of Brazing, of which the following is a specification.

My invention relates to the manufacture of seamed metal tubing and more particularly to the process of brazing the seam in tubes which taper and which are composed of a relatively high carbon steel.

Tapered steel tubes are useful in the construction of a large variety of articles among which may be mentioned golf sticks and fishing rods. In the case of articles like the latter which are normally subjected only to a bending stress, steel tubes with an open seam have been found quite satisfactory but where the article is subjected to severe tortional stresses, as is the case for instance with golf sticks, such tubes have been found to be entirely inadequate. In order to obtain the desired strength to withstand the tortional stresses met with, coupled with lightness, resort was had to seamless tapered steel tubes. Such tubes were made by swaging down straight seamless tubes but when a steel was used which could be tempered it required such frequent annealing that the cost of these operations in addition to the high initial cost of the seamless tubing became excessive. A golf club constructed in this manner is disclosed in Patent No. 976,267 to Arthur F. Knight.

In order to reduce the cost of construction it has been proposed to use a seamed tapered tube and copper-braze the seam in the presence of hydrogen. When a furnace is used which is long enough to accommodate the entire tube and the temperature of the furnace is substantially uniform throughout the length of the tube and sufficiently high to bring the large end of the tube quickly to the melting point of the copper brazing strip, the small end of the tube will be heated to a higher temperature than necessary or desirable and will usually be found to be in such a condition that it will not subsequently take a proper temper. This may be due to the reduction of the amount of carbon in the over-heated portion of the tube. Unless great care is used, the small end of the tube may reach such a temperature as to actually melt the steel.

An object of my invention therefore is to provide an improved process by which the aforesaid difficulties are overcome and by which seamed, tapering tubes of steel may be successfully and expeditiously brazed without injury to or change in the carbon of the steel composing the tubes. My invention comprises briefly a progressive system of brazing in accordance with which the tube to be brazed is moved through the hot zone of a relatively short hydrogen furnace at a speed in accordance with the melting of the brazing material.

My invention will be better understood by reference to the accompanying specification and drawing and its scope will be pointed out in the appended claims.

Figure 1 is a longitudinal section of an electric furnace suitable for carrying out my brazing process with a portion of a tube therein; Figure 2 is an enlarged view of the larger end of a tube when ready for insertion in the furnace, and Fig. 3 is a view of the entire tapered tube.

Referring to Fig. 1, a heating chamber is provided by a tube 1 of fused alumina, such as alundum, around which is a resistance heater 2 having terminals 3 and 4. The heater 2 may consist of a refractory metal such as molybdenum or tungsten or if desired, iron wire or nichrome wire may be used. The tube 1 is held in a casing 6 and the space around the tube and heater is filled with a suitable refractory heat insulating material 7 such as powdered alumina, silica or the like.

Secured to the casing 6 and in line with the heating tube 1 is a cooling tube 10 having a water jacket 11 surrounding it and connected by inlet and outlet pipe 12 and 13 respectively to provide a continuous circulation of water therethrough. The outer end of tube 10 projects into chamber 15 which is closed except at the bottom where it dips beneath the surface of a bath of oil 16 contained in a vessel 17. An essential feature of this furnace is the provision for the passage of a reducing gas therethrough and in contact with the work. Hydrogen has been found to be most suitable for this purpose and provision is made at 18 for connecting the furnace with a source of supply of that gas. The hydrogen passes from the connection 18 into the chamber 15 and from thence through the cooling tube 10 and through the heating tube 1 at the mouth of which it escapes. To prevent oxidation of the heater, the casing 6 is preferably also provided with one or more inlets 19 which may be connected to the same source of hydrogen. The gas admitted through this inlet or inlets fills the casing and by reason of the porous nature of the alundum tube 1 eventually finds its way into the interior of the tube and escapes at its mouth together with the gas which enters at 18.

Tubes such as that shown at 22 in Fig. 3 are first formed up from sheet steel blanks to the desired size and shape by rolling or by suitable dies. Between the abutting edges of the seam a T-shaped steel strip 23 is then inserted with that portion corresponding to the cross member of the T lying against the inner wall of the tube and with that portion corresponding to the shank of the T lying between the abutting edges of the tube in the manner illustrated by Fig. 2. The strip 23 may be formed up from sheet steel of a smaller gauge than that of the tube but for the best results should have the same chemical composition and elasticity as the steel of the tube. At intervals the strip is provided with extensions forming lugs 24 which are bent over against the exterior of the tube after an arbor having the proper taper has been pushed into the tube to press the strip firmly against the inner wall of the tube. A strip 25 of copper or other suitable brazing material is then inserted in the tube and with the brazing strip 25 preferably lying in contact with the T-shaped strip 23 the tube is subjected to a temperature sufficient to melt the brazing material while in an atmosphere of hydrogen or other reducing gas. The construction of the tube and the method of making the same just described are disclosed in the co-pending application of William R. Emmet and Samuel T. Thorpe Serial No. 518,483, filed Nov. 28, 1921.

For carrying out my invention I employ a furnace such as described above which is of relatively short length so that the zone of greatest heat is accordingly short in length. The tube prepared as described above with the T-shaped strip 23 and the strip 25 of copper or other brazing material in place is then inserted in the mouth of tube 1 of the furnace. In order to expedite the brazing process, the hot zone of the furnace is preferably maintained at a temperature appreciably hotter than that necessary to melt the copper strip and it has been found desirable to carry the temperature even up to the point where it would cause serious injury to the steel of the tube if the same portion of the tube is allowed to remain in the hot zone after coming up to the temperature necessary to melt the copper. It is not essential, however, in the carrying out of my process that great care be exercised in maintaining the temperature of the furnace uniform or at any particular degree of heat. This feature is of practical importance since the difference between the temperature necessary to melt the brazing material and the temperature at which the tube will be injured is fairly small. Where the tube is not tapered and is bodily placed in a furnace the temperature of which must be sufficient to effect a braze and yet be insufficient to injure the tube the furnace temperature must be closely regulated. With tapered tubes the permissible range of temperature is still further narrowed. In accordance with my invention, however, the heating of the tube is dependent upon the movement of the tube so that a higher furnace temperature may be maintained, a more uniformly successful braze may be made and the operation much more speedily effected. Good results have been obtained with copper brazing when the hot zone of the furnace was maintained at a temperature of from 1200° C. to 1300° C. The operator is readily able to see into the open end of the furnace and to observe the various color changes of that portion of the tube in the hot zone. As the entering end of the tube is pushed forward into the hot zone it is soon raised to the temperature at which the copper at that portion in the presence of the reducing gas melts and flows into every part of the seam and unites with the steel of the tube and of the strip 23 probably forming an alloy therewith. As rapidly as that portion of the tube in the hot zone is observed to reach the required temperature to melt the copper, the tube is pushed on a little further, thus bringing a fresh portion of the tube up to a brazing temperature and carrying the previously brazed portion of the tube into a cooler section of the furnace and eventually into the water jacketed part. By constantly observing that portion of the tube lying within the hot zone the operator knows just how rapidly to advance the tube in order that each portion shall be raised to the required temperature and without subjecting any portion to such an overheating as would result in driving out the carbon of the steel. Should the copper upon melting tend to form globules or pools, a slight shaking or jarring of the tube will cause the pools of copper to spread out in the desired manner. After passing through the hot portion of the furnace the tube is pushed on into the water jacketed tube 10 where it is cooled sufficiently to allow it to be pushed on to the point where it will drop into the oil bath

16. After the tubes are removed from the oil bath the lugs 24 may be filed or ground off to give the tubes a smooth, finished surface at the seam, and the tubes may then be tempered as desired without in any way affecting the seam.

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

1. The method of brazing the seam of a seamed metal tube having the brazing material along the seam by means of a furnace producing a temperature greater than that necessary to melt the brazing material and sufficiently great to injure the tube if applied indefinitely which consists in passing the tube longitudinally through the furnace at such a rate that the braze is progressively effected without injury to the tube.

2. The method of brazing the seam of a seamed metal tube having brazing material adjacent the seam by means of a hydrogen furnace providing a relatively short hot zone which consists in passing the tube longitudinally through the furnace at a rate determined by the progressive melting of the strip.

3. The method of brazing the seam of a tapering seamed steel tube having brazing material adjacent the seam by means of a hydrogen furnace having a hot zone maintained at a temperature high enough to cause injury to the steel of the tube which consists in passing the tube longitudinally through the furnace at a variable rate such that each successive portion of the tube is heated only to a temperature sufficient to melt the brazing material.

4. The method of brazing the seam of a tapering seamed steel tube by means of a hydrogen furnace which consists in placing a strip of the brazing material along the seam and passing the tube and strip through the furnace at a variable rate such that each successive portion of the tube and strip are heated only to a temperature sufficient to melt the strip.

5. The method of copper-brazing the seam of a tapering seamed steel tube by means of a hydrogen furnace having a localized hot zone, which consists in placing a strip of copper along the seam and passing the tube longitudinally through the hot zone of the furnace, the rate of movement being so varied that tube and strip are progressively heated to the brazing temperature and immediately cooled.

6. The method of brazing the seam of a seamed steel tube having a wall varying longitudinally in cross sectional area and having brazing material adjacent the seam by means of a hydrogen furnace maintained at a temperature high enough to cause injury to the steel of the tube which consists in passing the tube longitudinally through the furnace at a varying rate depending upon the time required for the successive portions of the tube to reach the brazing temperature.

In witness whereof I have hereunto set my hand this 31st day of December, 1923.

ROBERT T. GILLETTE.