

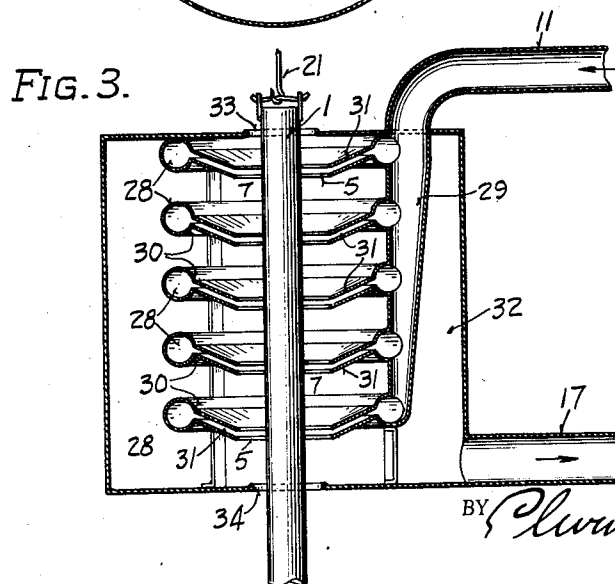
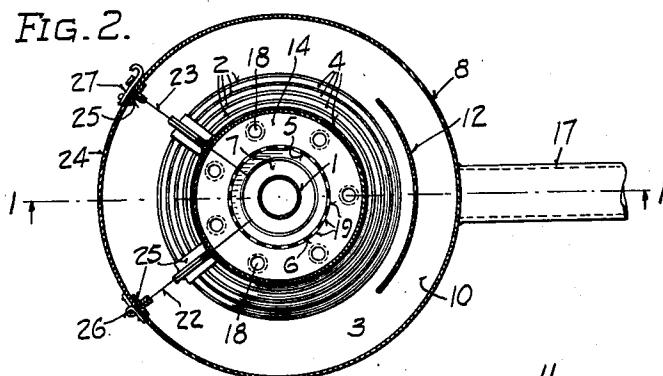
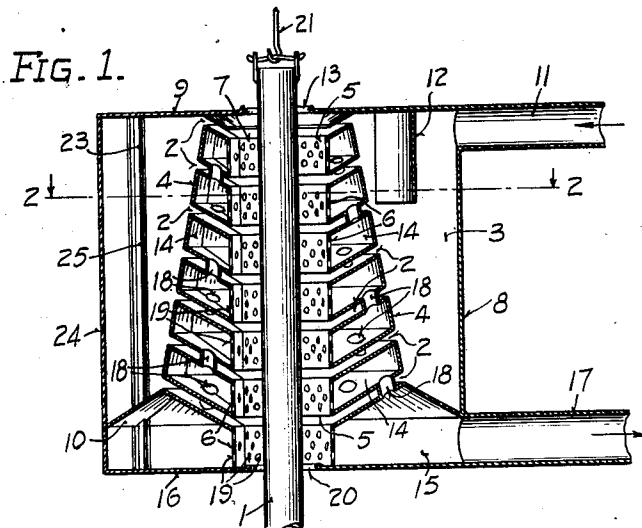
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METHOD OF AND APPARATUS FOR COOLING HEATED ARTICLES

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METHOD OF AND APPARATUS FOR
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This invention relates to a method of and apparatus for cooling heated articles with a gaseous heat absorbing fluid.

More particularly the invention relates to a method of and apparatus for air quenching enameled pipe.

Steel pipe to which a coat of vitreous enamel is to be fused is raised to a temperature of about 1750° F. in the enameling furnace. In order that the steel of the finished pipe may have a high degree of strength, it is desirable, after the enameling operation, to subject the hot pipe to a quenching operation.

The object of this invention is to provide a method of and apparatus for cooling heated articles rapidly with a gaseous heat absorbing fluid.

More particularly, the object is to provide a method of and apparatus for air quenching enameled steel pipe.

Another object of the invention is to provide a method of and apparatus for obtaining a uniformly good grain structure in the steel of an enameled steel pipe.

A further object is to provide a method of and apparatus for blowing cold air upon a heated surface without having the air heated by contact with one portion of the surface mix with the cold air blown upon an adjacent portion.

Further objects will appear from a consideration of the following description in connection with the accompanying drawing, in which:

Figure 1 is a view in vertical section taken on the line 1—1 of Fig. 2 showing an air quenching apparatus made in accordance with the present invention, a portion of a pipe being shown in side elevation at a point in its passage therethrough;

Fig. 2 is a view in horizontal section of the apparatus taken on the line 2—2 of Fig. 1; and

Fig. 3 is a view similar to Fig. 1 showing a modified embodiment of the invention having a plurality of air distributing chambers.

To quench a hot steel pipe with a cold gaseous fluid of relatively low specific heat, such as air, a great quantity of the fluid is blown upon the pipe and methods are adopted to apply the cold fluid to the hot surface as directly and uniformly as possible.

This is accomplished in the embodiment of the invention shown in Figs. 1 and 2 of the drawing by directing a plurality of closely adjacent streams of cold air converging upon the surface of a hot pipe 1 to be quenched uniformly from all directions around its circumference from a corresponding number of closely adjacent in-

wardly converging annular tuyères 2. The tuyères 2 are disposed vertically one above another in axial alignment. They vary in diameter according to the design of the plenum chamber 3, hereinafter described, and are united at their outer edges by steeply inclined annular air tight walls 4. They are provided with central annular orifices 5 of greater diameter than the pipe 1 to be quenched. Cylindrical walls 6 unite the tuyères adjacent the orifices 5, forming a cooling chamber 7 through which the pipe 1 may be lifted. The tuyères 2 are set at an angle to the axis of the pipe 1 to cause a scrubbing action between the air stream and the surface of the pipe, but they may be disposed perpendicularly thereto if desired.

The air blown upon the pipe 1 is preferably supplied to the tuyères 2 from a surrounding plenum chamber 3. The plenum chamber 3 comprises an outer air retaining wall 8, a flat annular upper head 9, the walls 4 connecting the tuyères, and an extension of the lower wall of the lower tuyère 2. It is shaped to maintain the desired air pressure around each of the tuyères 2 opening from it. An inlet duct 11 is provided for conveying a large volume of cold air to the plenum chamber 3 from a blower fan (not shown). The incoming air is distributed throughout the plenum chamber 3 by a baffle plate 12.

The upper head 9 has an opening 13 axially aligned with the orifices 5 to allow the passage of the pipe 1.

When cold air discharged from a tuyère 2 contacts with a hot pipe, the heat absorbed from the pipe causes the temperature of the air to rise and its volume to increase. It is therefore desirable to provide means for removing the heated air so as to prevent it from mixing with the cold air blown in from adjacent tuyères.

In the present embodiment the heated air is removed adjacent its point of contact with the pipe 1 through a plurality of exhaust chambers 14 conveniently formed in the spaces between the adjacent tuyères 2, the outer steeply inclined annular walls 4 and the inner cylindrical walls 6 connecting said tuyères. An enlarged exhaust chamber 15 is formed by the underside of the lowest tuyère 2, the wall 10 connecting this tuyère to the outer cylindrical wall 8, the lower portion of the wall 8, a lower head 16 and the lowest cylindrical wall 6. This exhaust chamber 15 is connected by an exhaust duct 17 to an exhaust fan (not shown).

The several exhaust chambers 14 communicate with each other and with the enlarged exhaust chamber 15 by passages 18 through the tuyères 2. The passages 18 are designed to so spread the air moving past them in the tuyères 2 that the jets of air delivered from the orifices 5 will impinge uniformly on all portions of the circumference of the pipe 1.

The walls 6 have perforations 19. The cross-sectional area and the number of the perforations 19, and the cross-sectional area and the number of the passages 18, are so chosen that when the apparatus is in operation the suction created by the exhaust fan is properly proportioned between the several exhaust chambers 14 to withdraw the air blown upon the pipe 1 by each tuyère through the exhaust chamber 14 adjacent to it.

The tuyères 2 are disposed to blow the air streams upon the pipe 1 at an angle such that there is no suction created which draws heated air of one stream into the cold air of an adjacent stream.

The lower head 16 has an opening 20 therein which is axially aligned with the orifices 5 to permit the passage of the pipe 1 into the cooling chamber 7. In order to cool the pipe uniformly, provision is made for moving it transversely of the tuyères at a substantially constant speed. The pipe 1 is moved by means of the carrying arm 21 and some suitable actuating means not shown since such devices are well known in the art.

To provide means to admit the carrying arm 21 laterally into the cooling chamber 7, one side of the apparatus is cut through radially at 22 and 23, the sector so cut forming a door 24. The edges of the apparatus where cut at 22 and 23 may be reinforced by angle irons 25. The outer wall 8 of the door 24 is provided with hinges 26 and with a latch 27. The angle irons 25 reinforcing the edges at 22 and 23 form joints sufficiently air tight to prevent any substantial leakage of air therethrough when the apparatus is in operation.

In operation, the door 24 is opened and a carrying arm 21, supporting a pipe 1 in its passage through an enameling furnace (not shown), is moved therethrough to the center of the cooling chamber 7. The door 24 is then closed and a vertical motion imparted to the carrying arm 21 to lift the pipe 1 endwise through the cooling chamber 7. The operation may also be carried out by lowering the pipe 1 through the cooling chamber 7.

A large volume of relatively cold air, delivered by the blower fan through the inlet duct 11 enters the plenum chamber 3 where it is evenly distributed by the baffle plate 12. From the plenum chamber 3 the air enters into the tuyères 2 which direct it from their orifices 5 in a plurality of inwardly converging annular streams upon the pipe 1. Having impinged upon the surface of the pipe 1 and become heated by contact therewith, the air passes through the perforated walls 6 into the exhaust chambers 14 adjacent to the tuyères from which it is discharged. From thence the air travels downward through the passages 18 in the tuyères, through the several exhaust chambers 14 into the enlarged exhaust chamber 15, and finally out through the exhaust duct 17.

It will be apparent that by the method and apparatus above set forth, a hot pipe may be

quenched uniformly throughout its full length. The pipe is presented to the cooling action of a plurality of streams of cold air, and the air heated by contact with the pipe is withdrawn adjacent its point of application and does not dilute the cold air. A maximum contact is obtained between the cold air supplied and the hot surface upon which it is blown. Uniform quenching throughout the length of the pipe and around its circumference is obtained by moving the pipe transversely through the plurality of inwardly converging annular streams of air. By thus efficiently using a large volume of cold air blown upon an article to be cooled, it is possible to use gaseous fluids of relatively low specific heat, such as air, for quenching purposes.

The method and apparatus described is capable of many modifications.

One modification is set forth in Fig. 3, in which a plurality of axially aligned annular air distributing ducts 28 are spaced vertically above one another at relatively short intervals. Air is supplied to these air distributing ducts 28 by an inlet pipe 11 and a header 29. The inner wall 30 of each air distributing duct 28 opens into an inwardly converging annular tuyère 31. The mouths 5 of the tuyères 31 form axially aligned circular openings through which a pipe 1 supported from a carrying hook 21 may be moved. The air distributing ducts 28 and tuyères 31 are enclosed in a drum shaped exhaust chamber 32 having openings 33 and 34 through which the pipe 1 to be quenched may pass. The exhaust chamber 32 is provided with a suction duct 17 by which the air emitted from the tuyères 31 is exhausted.

In operation a pipe 1 supported at one end by a carrying arm 21 is moved endwise through the cooling chamber 7 in the apparatus, entrance being had through opening 33 or 34. A large volume of air is conveyed from a blower fan (not shown) through the inlet duct 11 to the header 29 where it is distributed to the annular air distributing ducts 28. From the air distributing ducts 28, the air passes through the tuyères 31 which direct it in uniform inwardly converging streams upon the surface of the pipe 1. Having impinged upon the pipe 1 and become heated thereby, the air is withdrawn adjacent its point of application, passing between the tuyères 31 into the exhaust chamber 32 and out through the exhaust duct 17.

The apparatus and method are not limited to the specific embodiments set forth above, and they may be adapted to quench or cool other articles of regular or irregular shape within the scope of the appended claims.

I claim:

1. The method of cooling a heated article which comprises directing a relatively cool fluid in a plurality of separate streams against the surface of the article to be cooled while moving the article relatively past each fluid stream in succession, the streams extending to impinge upon the full width of the article, and removing the cooling fluid after it has impinged upon the article from a position in between said streams at a rate which will substantially prevent interference of the streams.

2. The method of cooling a heated cylindrical article which comprises directing a plurality of streams of relatively cool air against the outer surface of the article, each stream extending circumferentially of the article and being directed toward the central axis of the article being

cooled, moving the article longitudinally through the successive streams of air, and removing the air that impinges upon the article from a position between said streams of air.

5 3. The method of quenching a heated pipe comprising, establishing a plurality of spaced axially aligned centripetally moving streams of relatively cold air, moving a pipe transversely through said streams of air, and removing the
10 air that impinges upon the pipe adjacent the stream of air that furnishes it.

4. An apparatus for cooling heated articles with a gaseous heat absorbing fluid comprising, fluid
15 conducting means for directing a plurality of streams of gaseous heat absorbing fluid upon the surface of an article to be cooled, means for withdrawing the fluid adjacent its point of application to the article being cooled and between said
20 streams, and means for causing relative movement between the article being cooled and the fluid conducting means.

5. An apparatus for air quenching heated pipe comprising, a cooling chamber for receiving a
25 pipe, air conducting means for directing a plurality of streams of relatively cold air into the cooling chamber, and means for exhausting the air from the cooling chamber out between the air
conducting means after the air has impinged upon the surface of a pipe in the cooling chamber.

30 6. An apparatus for air quenching heated pipe comprising, a cooling chamber for the passage therethrough of a pipe, a plurality of air conducting means surrounding the cooling chamber and opening into it for discharging a plurality of in-
35 wardly converging streams of air, and exhaust means for removing the air discharged from each air conducting means out adjacent the point of application of the air to a pipe passing through the cooling chamber.

40 7. An apparatus for quenching a heated article, in combination, a plurality of annular tuyères disposed to constitute a substantially cylindrical

quenching chamber, means for moving a heated article to be quenched longitudinally through the quenching chamber, a source of air under pressure connected to the tuyères to establish in-
5 wardly converging annular jets of air impinging upon the article to be quenched, exhaust chambers between the tuyères opening into the quenching chamber, and means for exhausting the air through the exhaust chambers after it has been
10 heated by contact with the article being quenched.

8. An apparatus for cooling heated articles comprising means to direct a cooling fluid in a plurality of streams extending to impinge upon
15 substantially the full width of the article as the latter is moved past said means, said streams being spaced from each other, and means for withdrawing the fluid from positions in between
said streams after the same has impinged upon the article.

9. An apparatus for cooling heated articles 20 comprising means to direct a cooling fluid in a plurality of streams extending to impinge upon substantially the full width of the article as the latter is moved past said means, said streams
25 being spaced from each other, means for withdrawing the fluid from positions in between said streams after the same has impinged upon the article, and means for moving the article relative to said fluid directing means to effect cooling of
30 the article.

10. An apparatus for cooling heated cylindrical articles comprising means to direct a cool fluid in a plurality of streams extending circumferentially of the article and spaced longitudinally
35 of the article, means disposed to withdraw the cooling fluid from positions in between said streams after the same has impinged upon the surface of the article, and means for moving the article longitudinally and relative to said fluid directing means.

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