Jan. 5, 1954 R. A. GEHR ET AL 2,664,901

QUENCHING DEVICE

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Fig. 1.

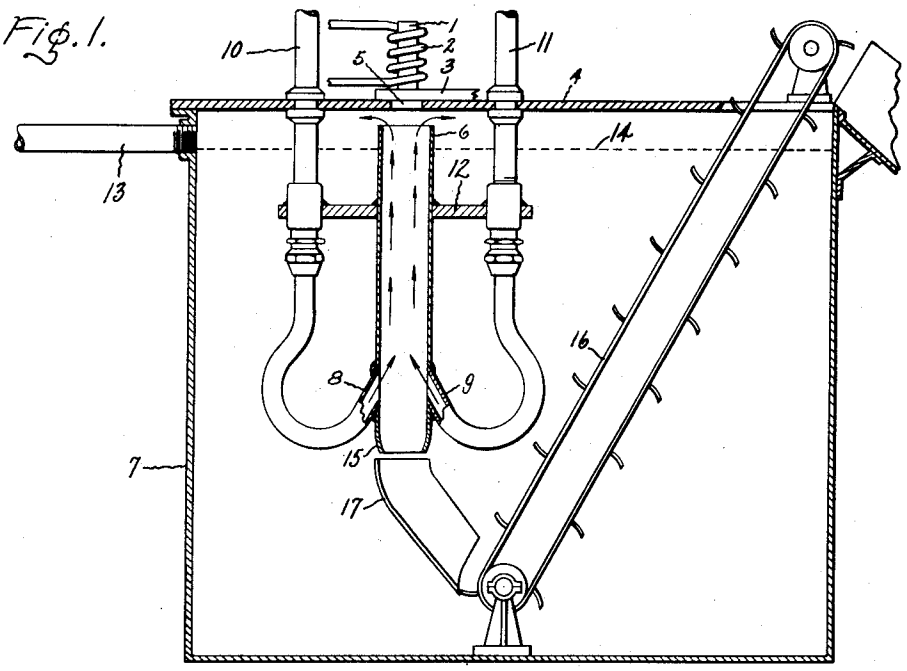


Fig. 2.

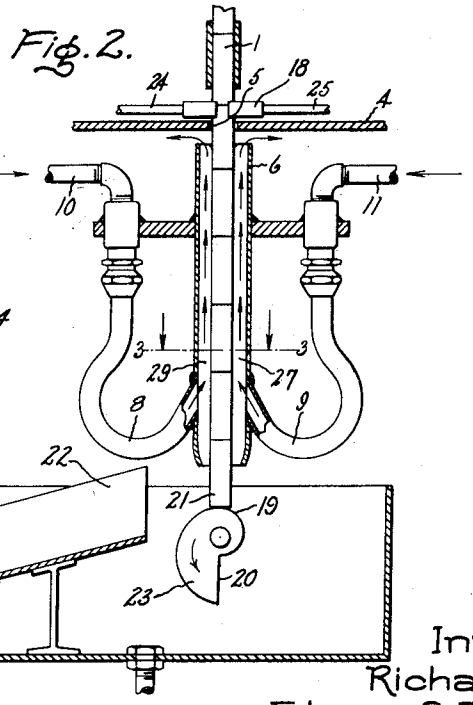


Fig. 4.

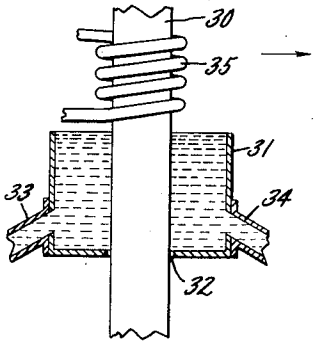
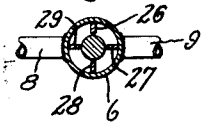


Fig. 3.



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QUENCHING DEVICE

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2 Claims. (Cl. 134—105)

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Our invention relates to quenching devices, more particularly to devices for quenching a heated article as it is moved from a heater such as a high frequency induction heater, and has for its object simple and reliable means for providing a cooling fluid for quenching the article as it is moved through the quenching device.

More particularly, our invention relates to the quenching of metallic articles such as steel articles for hardening purposes as they are delivered from an electric heater, particularly a high frequency induction heater. It is especially useful in the quenching of small steel parts or articles, such as wrist pins, which are passed in succession through the high frequency heater, although it may be used in the quenching of large parts. In quenching devices an ample supply of cooling fluid, such as water, is required. The water should be in motion to carry away the steam which is formed while at the same time the water must be kept out of the high frequency heater so as to prevent cooling of the article while it is in the heater.

In carrying out our invention in one form, we provide a tube which is mounted in an upright position directly below the heater so that the heated articles may be dropped from the heater through the tube, or passed continuously through the tube by suitable feeding means. The cooling water is supplied to the tube at its lower end by conduit means which directs the water upward under pressure so that the quenching tube is filled with water even though the tube is open at its lower end, and the water overflows from the top of the tube without coming into contact with the heater.

For a more complete understanding of our invention, reference should be had to the accompanying drawing, Fig. 1 of which is a simplified view mainly in section of high frequency heating and quenching means embodying our invention and in which the heated articles are dropped one by one through the quenching device; Fig. 2 is a view similar to Fig. 1 but showing our invention as applied to a continuous type of heater; Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2 looking in the direction of the arrows, while Fig. 4 is a sectional view showing our invention as applied to the quenching of long shafts.

Referring to Fig. 1 of the drawing, in this form of our invention the metallic article 1 to be heated, which may be a cylindrical steel slug such as a wrist pin, is heated by means of a high frequency induction heating coil 2 and then dropped by moving to the right hand a suitable sliding support 3 for the article 1. The slidable support 3 rests on a suitable supporting plate 4 provided with an aperture 5 directly below the article 1 and slightly larger than the article, through which

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aperture the article drops when the sliding support 3 is moved to one side.

In accordance with our invention, we provide a tubular duct member 6 which is supported in a vertical position by the plate 4, which plate forms the top or cover of a tank 7 so that the tube is suspended from the plate 4 in the tank with the upper end of the tube just below and in concentric relation with the aperture 5. A suitable cooling fluid, such as water, is fed into the tube at its lower end by means of two conduits or pipes 8 and 9 which are connected to the tube at diametrically opposite points and extend at their points of junction with the tube at acute angles with the vertical. Water is supplied to the conduits 8 and 9 from a suitable pressure supply source by means of pipes 10 and 11 which extend downward through the cover 4 and are connected respectively with the conduits. The pipes 10 and 11 are secured to the cover 4 so as to form supports for the tube 6. A cross bracket support 12 is provided near the upper end of the tube between the pipes and the tube.

Preferably as shown, the conduits 8 and 9 extend upward at an angle of substantially thirty degrees with the vertical at their points of connection with the tube at its lower end whereby each conduit supplies to the tube a jet of water directed upward and inward at that angle with the vertical toward the center line of the tube, the two jets engaging each other at the center of the tube. The upwardly directed jets produce a flow of water upward through the tube and out over the top into the tank. An overflow pipe 13 is provided for the tank in position to maintain a water level 14, as indicated, in the tank which is somewhat below but substantially as high as the upper end of the tube 6. Some water will flow downward out of the lower end of the tube and this downward flow is restricted by reducing the size of the pipe at its lower end as indicated by the reference numeral 15.

We have found that the water in the tank offers an appreciable resistance to the downward flow of water through the tube due to the water pressure at the bottom. By means of suitable valves (not shown) in the supply pipes 10 and 11, the pressure and the amount of water supplied can be regulated as desired to produce a uniform flow of water upward through the tube and out over the top of the tube into the tank. This smooth, even overflow from the top of the pipe prevents splashing as the articles 1 are dropped into it so that the water is prevented from coming in contact with the top of the tank and prevented from splashing up through the aperture 5 in contact with the heater coil when the support 3 is withdrawn. Moreover, the upward flow of water in the tube tends to break the fall of the article and thereby prolong the

time during which the article is cooled by the upwardly moving column of water. If desired, the tube may be entirely immersed in the water in the tank with its upper end slightly below the water level 14.

In the operation of the heater shown in Fig. 1, the coil 2 is supplied with current at a suitable high frequency, such as 530,000 cycles a second, and when the article 1 has been heated to the desired temperature the support 3 is moved to one side to drop the article into the quench tube 6. Suitable conveyor means 16 may be provided for removing the articles from the tank, the articles being conveyed from the lower end of the tube 6 by means of a chute 17 to the conveyor.

We have found that the upwardly moving water in the tube 6 effectively quenches the article and condenses and carries away the steam formed by the quenching. Splashing of water is prevented by the movement and turbulence of the water at the top of the tube. By reason of the relatively large amount of water coming into contact with the articles, a very thorough and quick quenching action is obtained. The diameter of the tube is chosen with respect to the diameter of the articles so as to provide an abundance of rapidly moving water, its diameter as shown being somewhat more than twice the diameter of the article. Likewise, the diameters of the supply conduits 8 and 9 are selected to provide an adequate water supply with sufficient pressure to maintain the desired upward movement through the tube.

In the modified form of our invention shown in Fig. 2, the heated articles are fed downward continuously through a single turn heating coil or loop 18, the articles being stacked in end to end relation and the lowermost article resting on a feed cam 19 which may be turned continuously, as by a suitable motor (not shown) in a counterclockwise direction as indicated by the arrow. As the cam 19 turns, the stack of articles is fed downward gradually, and finally, when the radial face 20 on the cam engages the lowermost article 21, this article is carried by the cam toward the left hand into a chute 22. The lower end of the next article then rests on the point 23 of the cam which is uppermost. Thus, as the cam rotates, the articles are gradually fed downward, each article being heated by the heating coil and then quenched. The coil 18 is hollow and is supplied with cooling water by means of pipes 24 and 25 to which high frequency electric supply connections may be made.

When the tube is not immersed in water, as shown in Fig. 2, higher water supply pressures are required to maintain the upward flow of water through the tube 6 and a greater amount of water escapes from the lower end of the tube.

Preferably, in the form of our invention shown in Fig. 2, the tube 6 is provided, as shown in Fig. 3, with four radial guide vanes 26, 27, 28 and 29, which vanes are suitably secured, as by brazing, to the inner wall of the tube and extend lengthwise thereof. The vanes are spaced apart at their inner radial ends or edges to provide for free passage of the column of articles 1 while holding the articles in concentric relation with the tube. Preferably, as shown, two diametrically opposite vanes 27 and 29 extend across the orifices of the conduits 8 and 9 so that water is supplied to all four sections of the tube formed by the vanes.

As shown in Fig. 4, our quenching device may

also be used in the quenching of long shafts or rods. In this application the shaft 30, which is upright, extends through a cylindrical container 31 in concentric relation therewith and through an aperture 32 in the bottom of the container, the walls of the aperture fitting closely around the shaft to prevent the escape of water around the shaft while providing for the desired freedom of axial movement of the shaft with respect to the container 31. Water is fed into the bottom of the container 31 at suitable angles and pressure by conduits 33 and 34 thereby to provide jets directed upward toward the center line of the container, the water flowing upward and out over the top of the container. A suitable high frequency heating coil 35 is provided just above the water level. In this form of our invention, relative movement between the shaft and the container 31 and heating coil may be obtained by moving either the shaft or the heating and quenching apparatus as desired.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A quenching device comprising a tank for cooling fluid, a duct member open at each end mounted in an upright position in said tank, cooling fluid supply means connected to the lower end of said member for supplying cooling fluid to said member so as to produce a flow of cooling fluid upward through said member with overflow of cooling fluid from the top of said member, overflow means for said tank for maintaining a level of cooling fluid in said tank at least substantially immersing said tubular member, and means for moving a heated article to be quenched in a downward direction through said duct member.

2. A quenching device comprising a tank for cooling fluid provided with a cover having an aperture through which heated articles may be dropped into the tank, a tubular member open at each end mounted in an upright position in said tank with its upper end below said aperture, conduit means connected to the lower end of said tubular member for supplying a plurality of upwardly directed jets of cooling fluid to said member thereby to produce a flow of cooling fluid upward through said tubular member with overflow of cooling fluid from the top of said tubular member and consequent turbulence of the cooling fluid at the top of said tubular member to prevent splashing of the cooling fluid by heated articles dropped through said aperture into the upper end of said tubular member, and overflow means for said tank for maintaining a level of cooling fluid in said tank at least substantially as high as the upper end of said tubular member.

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EDMON S. FRESHWATER.

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