Jan. 20, 1953 Q. M. BLOOM 2,625,944

QUENCHING APPARATUS

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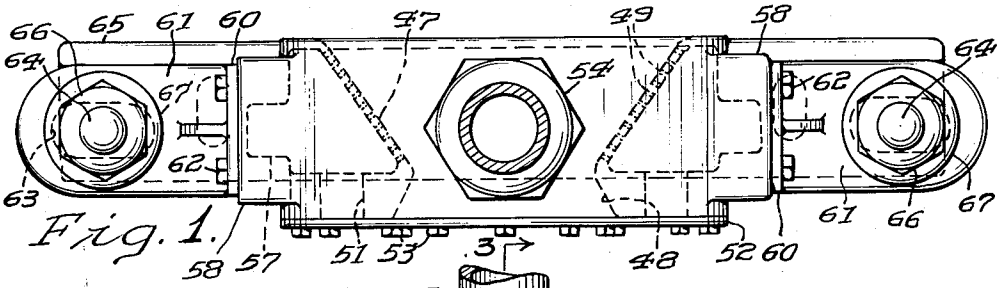


Fig. 1.

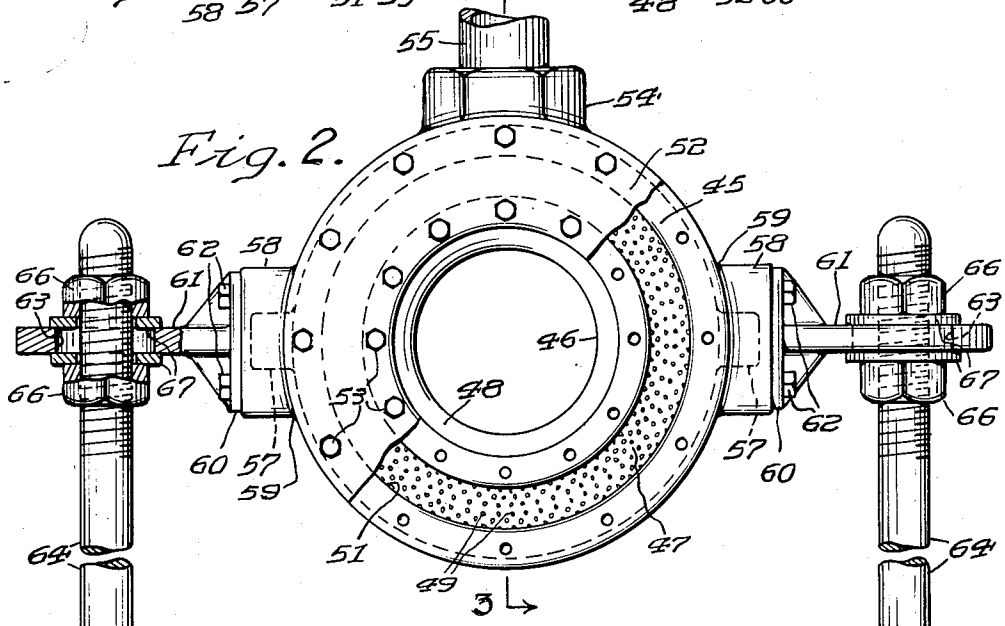


Fig. 2.

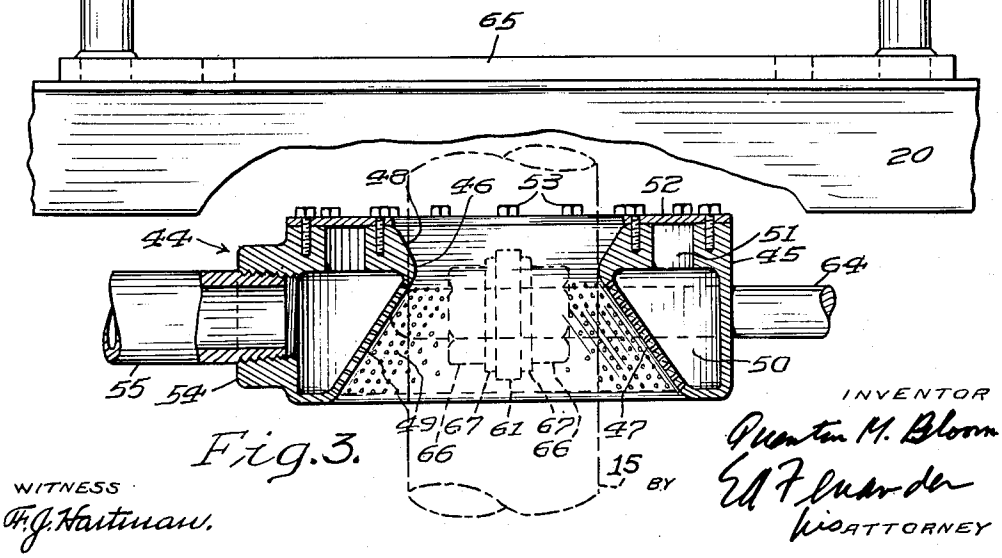


Fig. 3.

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QUENCHING APPARATUS

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2 Claims. (Cl. 134—199)

1

My invention relates to heat treating, and is especially concerned with the rapid cooling and quenching of heated work with the aid of a quenching medium.

In many heat treating operations it is imperative to effect rapid and uniform cooling and quenching of work immediately after the application of heat is completed and the desired heating of the work to a predetermined high temperature is effected.

In accordance with my invention, successive portions of the heated work are rapidly cooled as they emerge from a furnace chamber by quenching fluid discharged from the quench head. This may be accomplished by providing a multiplicity of small openings in a relatively small area of the quench head through which a large group or compacted bundle of tiny streams of quenching fluid is discharged at a relatively high velocity toward and against the entire peripheral surface of successive portions of the work moving relative thereto.

In effecting cooling and quenching of work which is being moved in a horizontal direction, it is undesirable to confine the quenching fluid as this tends to form a pool in which only the lower part of the work may be immersed, thereby resulting in nonuniform cooling of the work. In order to avoid confinement of the quenching fluid at the region at which it is applied to the work, the quenching fluid is directed at an acute angle to the work surface and in a direction from the region at which heating of the work is effected. Not only does this permit the quenching fluid to pass rapidly from the work surfaces against which it is directed, but the several rows of tiny streams disposed alongside of each other in the direction of movement of the work act against the surfaces thereof for a longer interval of time than when the streams are normal to the work surfaces.

Fig. 1 is an enlarged top plan view of the quench head;

Fig. 2 is an end view of the quench head, partly broken away and in section, and

Fig. 3 is a sectional view taken at line 3—3 of Fig. 2.

As shown most clearly in Fig. 3, the quench head 44 comprises a hollow ring or annular-shaped member 45 having the inner peripheral surface thereof in the form of a venturi having a narrow throat 46 and outwardly flaring conical-shaped walls 47 and 48, respectively, projecting in opposite directions therefrom.

The wall 47 is provided with a multiplicity of

2

small apertures or openings 49 through which a quenching fluid is discharged from a chamber 50 formed in the hollow member 45. Adjacent the wall 48 the member 45 is provided with an annular slot 51 which communicates with the chamber 50 and affords access to the latter for cleaning the apertures 49 and removing foreign matter tending to accumulate within the member 45. A flat annular-shaped plate 52 is removably secured by cap screws 53 to the face of member 45 having the slot 51, and a suitable gasket (not shown) may be provided between the plate 52 and member 45 to insure a fluid-tight seal to close off the slot 51.

The top of the member 45 is formed with an enlarged boss 54 having a threaded opening therein to receive a conduit 55 through which a quenching fluid, such as water, for example, is supplied to the quench head 44. A valve may be connected in the conduit 55 to regulate the pressure at which the quenching fluid is delivered to the quench head 44.

The member 45 at opposite sides thereof is formed with lugs 57 which receive and position enlarged bosses 58 secured at 59 in any suitable manner, as by welding, for example, to the outer cylindrical face of the member 45. The bosses 58 are provided on the member 45 to facilitate securing the quench head 44 in position on a bed-plate 20, and suitable adjustments are provided so that the quench head 44 can be accurately aligned with work 15 passing through it.

In the embodiment illustrated this is accomplished by removably securing the flanged ends 60 of horizontally disposed brackets 61 by cap screws 62 to the outer surfaces of the bosses 58. The brackets 61 are formed with openings 63 through which extend upwardly extending arms 64 having the lower ends thereof fixed to a cross bar 65. The arms 64 and cross bar 65 constitute a supporting frame for the quench head 44 which is mounted on the bed-plate 20 in any suitable manner (not shown).

The upper ends of the arms 64 are threaded to receive lock nuts 66 which bear against washers 67 provided at the opposing surfaces of the brackets 61. As best seen in Fig. 2, the openings 63 in brackets 61 are considerably larger in size than the arms 64 extending therethrough, so that the quench head 44 can be shifted and adjusted in a horizontal direction in a plane transverse to the direction of movement of the work.

The washers 67 overlie the peripheral edges of the openings 63 of the brackets 61 which can be raised and lowered by moving the lock nuts 66

up and down on the vertical arms 64. This vertical adjustment of the quench head 44, coupled with the horizontal adjustment just described, provides the necessary adjustments for accurately positioning and aligning the quench head 44 with the work.

Successive longitudinal portions of the heated work are rapidly and uniformly cooled by the multiplicity of small and tiny streams of quenching fluid which are applied uniformly about the entire peripheral surface of the work. The apertures 49 through which the tiny streams of fluid are discharged are formed closely adjacent to one another and in a relatively small overall area, so that the individual streams spread upon contacting the work surfaces and merge into one another to form a solid envelop of quenching fluid to which successive longitudinal portions of the heated work are subjected. The apertures 49 are preferably of uniform cross section throughout their entire length, and the total cross sectional area of all of the apertures is less than the cross sectional area of the conduit 55 through which the quenching fluid is delivered to the quench head 44. In this way turbulence of the quenching fluid is avoided and tiny solid streams of fluid are produced each of which is individually applied to the peripheral surface of the work.

By applying the tiny streams of quenching fluid at an acute angle to the work in a direction of its movement, rather than normal thereto, the tendency to form a pool at the bottom part of the work is avoided. If such a pool of quenching fluid could form the bottom portion of the work might be immersed therein and non-uniform cooling of the work would result. However, by producing a compact bundle of tiny streams of quenching fluid which extends over a relatively short longitudinal distance of the work, and applying the tiny streams of fluid at an acute angle to the work in a direction of its movement, the likelihood of confining the quenching fluid is avoided so that no pool of quenching fluid can form.

In the instant embodiment the tiny streams of quenching fluid are applied to the work in the direction of its movement at an acute angle of approximately 35°. However, this angle may vary and go as high as 45° and still effectively avoid confinement of the quenching fluid to prevent the formation of a pool in which the bottom portion of the work may be immersed.

By applying several rows of tiny streams of quenching fluid disposed alongside of one another at an acute angle to the work in the manner just described, the streams of fluid act agaist the work surfaces for a longer interval of time than when the streams of fluid are applied normal to the work surfaces. When the acute angle at which the tiny streams of fluid are applied to the work is decreased, the interval of time that the quenching fluid is applied to successive longitudinal portions thereof increases. However, the difference in the velocity at which the first and last rows of streams of fluid impinge the work becomes greater as the acute angle at which the streams are directed against the work become smaller. In most instances it has been found that by applying the tiny streams of quenching fluid to the work at an acute angle of from 25° to 35°, satisfactory quenching and cooling is accomplished which is rapid and uniform; and in such range the velocity at which the last row of streams of fluid impinges the work is sufficiently high to effect its proportionate share of the cooling of the work.

By providing the annular-shaped quench head 44 having the inner peripheral surface thereof in the form of a venturi, not only are the tiny streams of quenching fluid applied at an acute angle to the work in the direction of its movement, but a passage is provided for the work which is of such shape that the quench head 44 can be positioned closely adjacent to the place in which the work is heated.

In order that the improvements embodied in quench head 44 of the invention may be better understood, reference to a quench head which has been constructed for quenching and cooling work up to 3" in diameter may be helpful. In such a quench head generally like that illustrated and described, the overall diameter of the quench head 44 is about 11" and the overall width or depth is about 4". The annular slot 51 is about 1" wide, the diameter of the throat 46 about 4", and the diameter of the row of aperatures 49 furthest removed from the throat 46 is about 8". Twelve rows of apertures $\frac{1}{16}$" in diameter are provided along the outwardly flaring wall 47 which is about 3" long. Each row of apertures 49 is formed with forty apertures to provide a total of four hundred eighty apertures. In this instance the total overall area of the apertures is about 73% of the inlet pipe area through which quenching fluid is supplied to the quench head.

In the operation of the quench head just referred to when water is employed as the quenching medium, the water is supplied at a delivery pressure of about 30 pounds per square inch. Even when suitable strainers are provided in the water supply line, foreign matter will tend to accumulate or clog the apertures 49. With such a large number of apertures provided, the fact that some of the apertures may become clogged is not too serious because the delivery pressure of the quenching fluid can be increased when this becomes noticeable without adversely affecting the rapid cooling and quenching of work. Moreover, by providing the annular-shaped member 45 having the slot 51, the back plate 52 can be removed and easy access is afforded to the chamber 50 to remove any foreign matter therein and clean the apertures 49. The member 45 is preferably cast in a single piece and provides a simple and inexpensive quench head which is reliable in operation.

In view of the foregoing, it should now be apparent that an improvement has been provided for quenching and cooling heated work, especially work being moved horizontally past a region of heating. The quench head 44 can be adjusted both vertically and horizontally in a plane transverse to the movement of the work so that it can be accurately positioned and aligned with the work.

Although a single embodiment of the invention has been shown and described, it will be apparent to those skilled in the art that various modifications and changes may be made without departing from the spirit and scope of the invention. Thus, suitable mechanism may be provided whereby the horizontal and vertical adjustments of the quench head may be accomplished by a simple turning movement of cranks or levers. It is therefore contemplated to cover

all modifications and changes which come within the spirit of the invention, as pointed out in the following claims.

What is claimed is:

1. A quench head comprising means forming an annular-shaped hollow structure provided with an inlet for a quenching fluid and through which elongated work is adapted to pass continuously, the inner peripheral surface of said structure including a conical-shaped wall flaring outwardly in the direction of movement of work through the head, said wall being perforated with a plurality of rows of openings for discharging quenching fluid from the interior of said structure onto successive longitudinal portions of the work at an acute angle thereto in the direction of movement of the work, a frame on which said structure is mounted, and means for adjusting said structure on said frame in a number of different directions in a plane transverse to the direction of movement of the work.

2. A quench head comprising means forming an annular-shaped hollow structure provided with an inlet adapted to be connected to a source of supply of quenching fluid and through which work of elongated extent is adapted to pass continuously in a generally horizontal direction, said means including a detachably secured member to afford access to the interior of the structure, the inner peripheral surface of said structure being perforated for discharging quenching fluid from the interior of said structure onto successive longitudinal surface portions of the work, a frame on which said structure is mounted, and means associated with said frame for adjusting said structure up and down and sidewise in a plane transverse to the direction of movement of the work whereby it may be positioned perpendicular thereto.

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