Sept. 26, 1944. J. P. TARBOX 2,359,171

QUENCHING NOZZLE

Filed Aug. 5, 1943

Fig. 1.

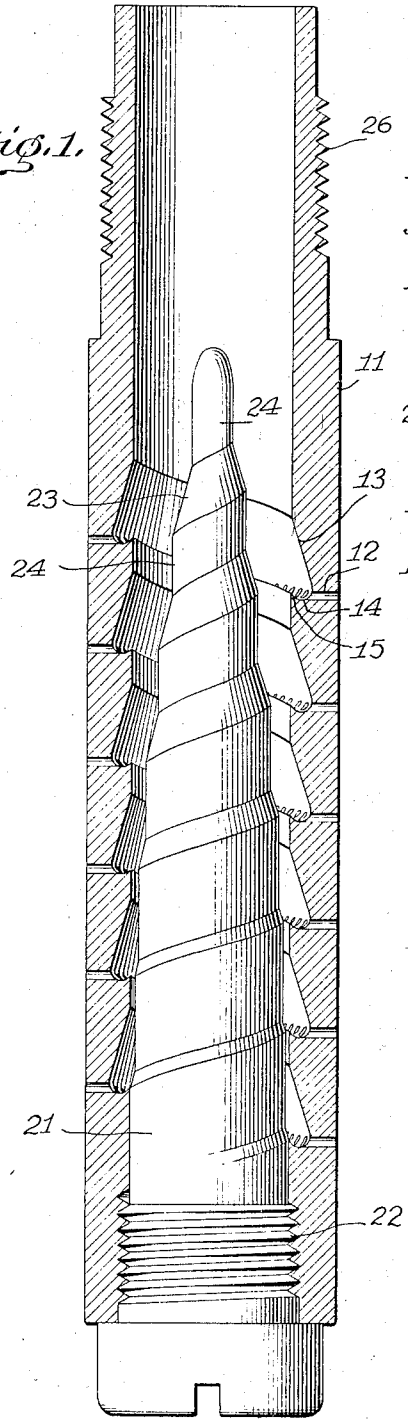


Fig. 3.

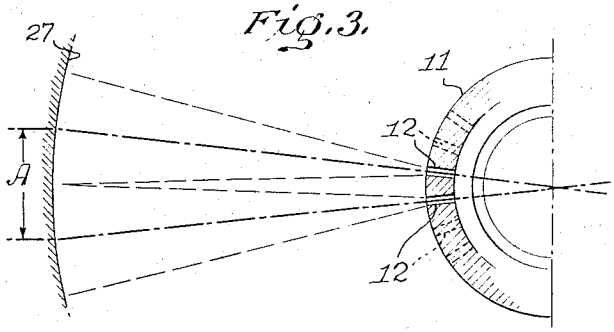


Fig. 4.

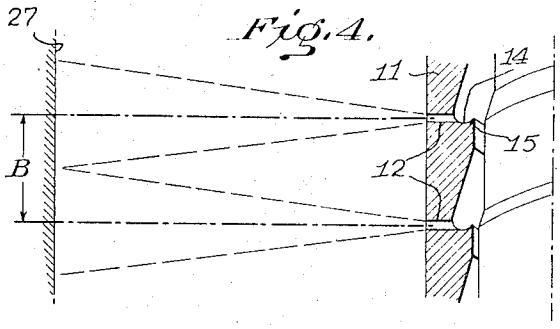
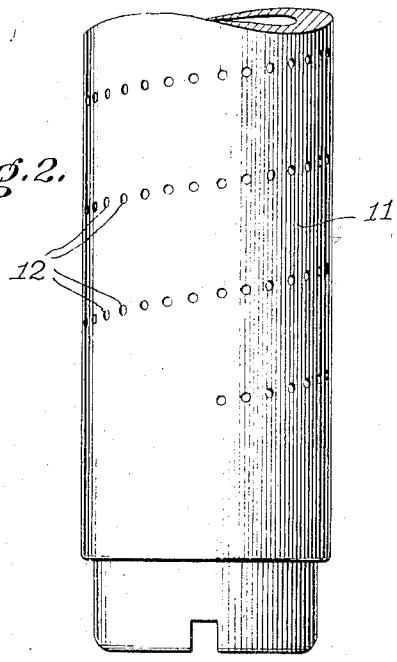


Fig. 2.



INVENTOR

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2,359,171

QUENCHING NOZZLE

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Application August 5, 1943, Serial No. 497,430

2 Claims. (Cl. 299—141)

This invention relates to quenching nozzles of the type shown in the patent to Howard E. Somes, 2,321,431, granted June 8, 1943, and an object is to provide an improved construction of that type of nozzle.

In hardening the inner surface of annular articles, such, for example, as wheel hubs or the like, the bore of the article is quickly raised to a critical temperature by a heating head positioned in the bore, whereupon the head is removed and the heated surface quickly and drastically quenched to harden it. The above-mentioned patent discloses a quench head formed by a hollow tube adapted to be positioned in the bore of an annular article, and having a series of circumferential rows of ports so spaced, circumferentially and axially, that streams of quenching fluid forced through the ports will impinge on the surrounding heated surface at points equally spaced both laterally and longitudinally of the surface. Relative rotation between the quench head and article is employed to obtain as uniform a rate of heat extraction throughout the heated surface as possible. In the patented nozzle the arrangement of the circumferential rows of ports causes the points of impingement to occur in similar rows on the heated surface and relative rotation does not change this condition.

A further object of this invention is to provide a nozzle of the type set forth constructed and arranged to have the points of impingement travel across the entire area of the heated surface upon relative rotation of the nozzle and workpiece so that every part of such surface is subjected to direct impingement of fresh quenching fluid during the quenching operation.

These and other objects which will be apparent are accomplished by the present invention, one embodiment of which is shown in the accompanying drawing in which:

Fig. 1 is a transverse sectional view through a quenching nozzle constructed in accordance with one embodiment of this invention;

Fig. 2 is a partial side elevation of the nozzle shown in Fig. 1, and

Figs. 3 and 4 are diagrams illustrating the operation of the nozzle shown in Fig. 1.

The present invention comprises a tubular member 11 having a series of ports 12 arranged spirally around the member. The inner bore of the member is provided with a spirally formed outwardly sloping wall 13 which follows the spirally arranged ports, sloping outwardly and downwardly and terminating in a spiral groove 14 formed on the inner wall and communicating with the inner ends of the ports 12. The surface of the groove 14 is curved and tangent on one side to the bottoms of the ports 12, while the inner side of the groove is formed with a sharp, upwardly facing shoulder 15. The shoulder, groove, and sloping surface all cooperate to direct fluid flowing downwardly through the tubular member 11 outwardly through the ports 12.

A metering pin 21 having a lower end 22 threaded into and closing the lower end of the tubular member 11 projects upwardly to a point above the ported area of the nozzle, and the pin is so formed as to provide a flow area in the nozzle which continuously decreases in the direction of fluid flow from the upper end of tube 11 toward the lower end. The pin is formed to cooperate with the interior construction of the tubular member 11 to substantially equalize the velocity and volume flow of fluid through each of the ports 12. For this purpose, the pin is provided with a spirally formed inclined surface 23 which gradually increases in diameter from the upper cylindrical end 24 of the pin where the diameter is least to the lower end of the pin opposite the last of the perforations 12 where the diameter is greatest. In this way, the pin is provided with a peripheral face 23 of continuously increasing diameter which follows the spiral arrangement of the ports 12 to gradually reduce the flow area through the tube in the direction of the fluid flow. The inclined tapered spiral face 23 directs fluid on to the surrounding spiral groove 14 and thence through the different ports along the groove.

In operation, the nozzle is positioned within an annular article, for example, the bore of a wheel hub 27, the inner wall of which is to be quenched and the inner diameter of which is considerably in excess of the diameter of the nozzle by an amount greater than is required for the discharge of quenching fluid. The article to be quenched should have an interior diameter such that the dimension A is equal to the dimension B of Figure 4.

Preferably, the circumferential spacing between adjacent ports and the pitch of the spiral formed by said ports is such, when the workpiece being quenched has a particular interior diameter, that the center of impingement of each stream upon the work surface is substantially equally spaced from the center of said impingement of each circumferentially adjacent stream and also substantially equally spaced from the center of impingement of each axially adjacent stream. In Figs. 3 and 4, the circumferential spacing A

between centers of impingement of adjacent streams is substantially equal to the axial spacing B between axially adjacent streams when the workpiece has a particular diameter. The cross sectional area of the passage for fluid should be such as to cause uniform distribution per unit of area to the respective ends of the heated surface being quenched. In the present embodiment this is done by forming the head with a spiral of sufficient length to extend the ports beyond the ends of the heated surface area. Quenching fluid is introduced into the nozzle through the upper end in the usual way, threads **26** being provided for connection to a suitable fluid supply line. The pressure within the tube is so distributed by the continuously contracting flow area as to produce substantial equal volume and velocity of flow through each of the ports **12**. The flow through each port is such per unit of time as to equate the extraction of heat per unit of area per unit of time by a given stream with that of each other stream. This produces a uniform heat extraction throughout the surface. As indicated in Figs. 3 and 4, because of the spiral arrangement of the ports **12**, it will be apparent that upon relative rotation between the nozzle and the surrounding workpiece every portion of the workpiece surface will be subjected to direct impingement of quenching fluid issuing from the ports **12**, and that such impingement will not be confined to certain lines or areas.

It will also be apparent that the invention can be variously modified and adapted within the scope of the appended claims.

What is claimed is:

1. A quenching nozzle for quenching an interior annular surface when said surface is spaced a particular distance from the nozzle, said distance being substantially in excess of that needed for removal of quenching fluid after its impingement on said surface, comprising a tubular member adapted to be inserted into the space surrounded by said surface and having ports arranged in a spiral pattern for directing a plurality of similar streams of quenching fluid radially outward on to the work surface, the circumferential spacing between adjacent ports and the pitch of the spiral formed by said ports being such that the center of impingement of each stream upon the work surface is substantially equally spaced from the center of impingement of each circumferentially adjacent stream and also substantially equally spaced from the center of impingement of each axially adjacent stream, in combination with means affecting a decrease of flow area longitudinally within said tubular member in the direction of liquid flow, whereby there is discharged through each port that quantity of quenching fluid per unit of time which substantially equates the extraction of heat per unit of area per unit of time from that area upon which the stream from the port impinges with the extraction of heat from each other unit of area upon which streams from the other ports impinge.

2. A quenching nozzle comprising a tubular member having a metering pin, said pin having a spiral shoulder of continuously increasing diameter providing the internal annular cross-section of said tubular member with a continuously constricting path of fluid flow from one end to another, whereby said shoulder produces a continuously decreasing flow area longitudinally within the tubular member in the direction of fluid flow, and a spirally arranged series of discharge ports in the tube associated with said spiral shoulder.

JOHN P. TARBOX.