Nov. 20, 1962 M. A. NYE ET AL 3,064,798

LIQUID AND VAPOR COOLING OF WIRE DRAWBLOCK

Filed Aug. 1, 1960 2 Sheets-Sheet 1

FIG. 1

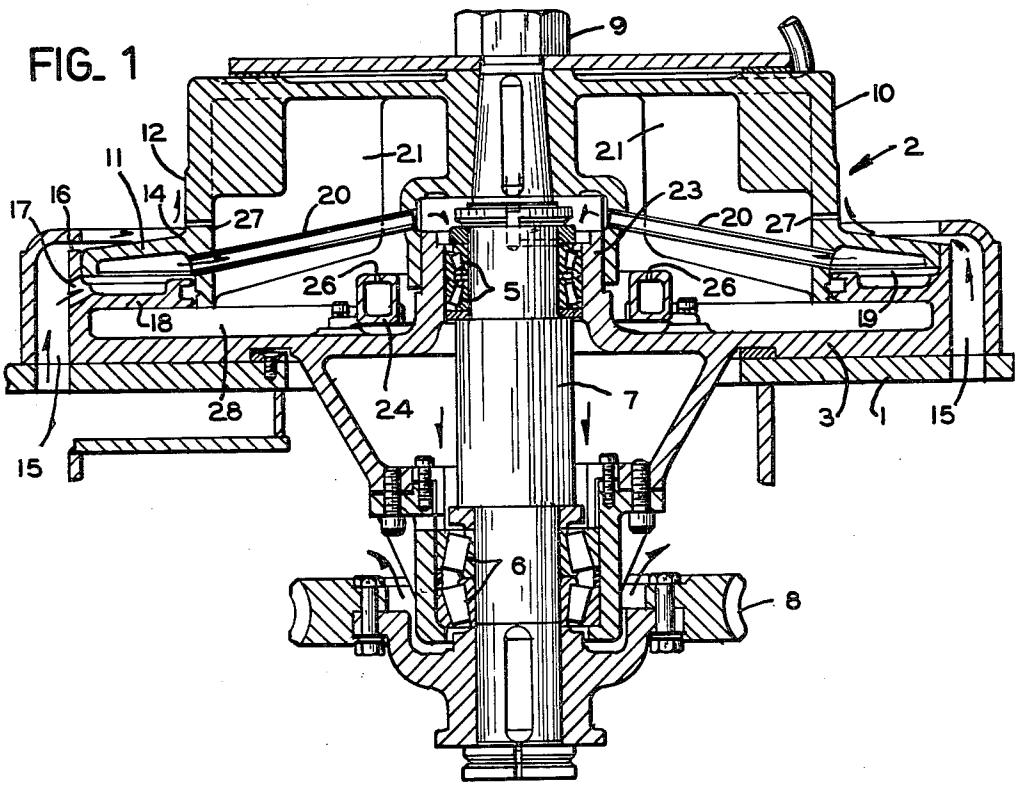
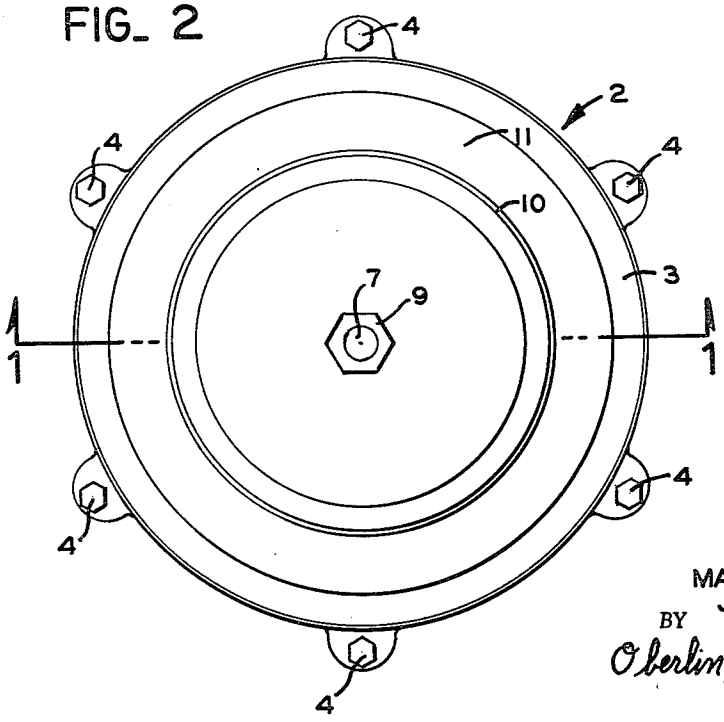


FIG. 2



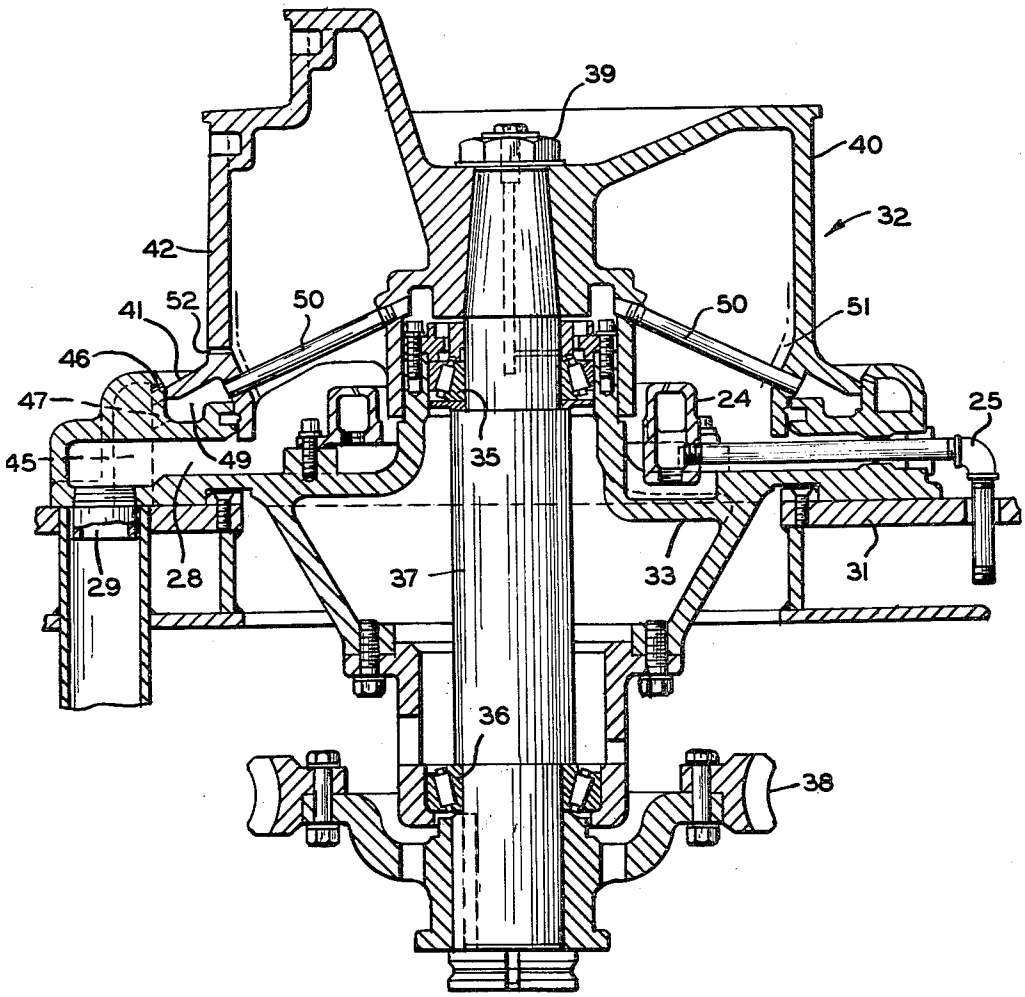
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FIG. 3



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LIQUID AND VAPOR COOLING OF WIRE DRAWBLOCK

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The present invention relates generally as indicated to liquid and vapor cooling of wire drawblocks and the like.

As wire is drawn through a die, it becomes highly heated and if the wire passes through successive dies without being cooled therebetween, such heating may become excessive with resultant injury to the wire. Hitherto, it has been the practice to provide air currents on the exterior of the wire drawblock or drum which sweep across the apron thereof and impinge on the wire wound around the block and to provide water or other liquid sprays impinging on the interior of the block to extract heat from the side wall of the block and from the wire wrapped therearound. However, such methods of cooling the wire do not utilize the cooling media to their full advantage whereby the wire is not cooled sufficiently except by greatly increasing the volume of air and liquid flow or by employing chilled air and/or a liquid refrigerant such as brine. Moreover, it is common practice to draw wire at a rate which may well exceed 4000 ft./min. and therefore the wire must be cooled during the very short period of time that it is in contact with the block. Furthermore, in the case of round wire, the wire only has line contact with the block, which at least in part, accounts for the relatively low efficiency of heat extraction from the wire by the coolant circulated through the block.

Accordingly, it is a principal object of this invention to provide an efficient liquid and vapor cooling system for hollow drawblocks in which a liquid coolant is employed for the two-fold purpose of extracting heat from the block, and thus from the wire wrapped therearound, and also from the wire itself, the latter mode of heat extraction preferably being employed first to substantially decrease the wire temperature by bringing the coolant into contact with the hot wire at the time that the wire initially contacts the block, or shortly thereafter, whereby the coolant immediately vaporizes and extracts a large amount of heat from the wire due to its heat of vaporization (538.7 calories/gram in the case of water), and the former mode of heat extraction preferably following in such manner that the fresh coolant flows along the interior wall of the block and is effective further to cool the wire before it leaves the block.

It is another object of this invention to provide a hollow drawblock which has radial openings through its wire-contacting wall through which the coolant from the interior of the drawblock flows for direct contact with the hot wire, thereby causing immediate vaporization of the coolant and consequent extraction of a large amount of heat from the wire.

Another object of this invention is to provide a wire drawblock assembly having a drawblock journalled for rotation about its central axis, and a novel form of coolant system which includes a coolant supply pipe, a manifold disposed in fixed position within the drawblock and provided with a series of orifices through which the coolant is discharged as a spray or jet, as desired, against the interior of the block for flow in thin sheet form along the interior side wall of the block so as to extract heat from the wire wrapped around the block.

It is another object of this invention to provide a liquid and vapor-cooled drawblock assembly in which the interior of the drawblock is shaped so as to accumulate a

pool of coolant in the region of radial openings in the side wall of the block for flow of coolant, as by centrifugal force, from the pool and through such openings directly against the heated wire wrapped around the block.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

In said annexed drawings:

FIG. 1 is an enlarged vertical central cross-section view taken substantially along the line 1—1, FIG. 2, showing one form of liquid and vapor-cooled drawblock assembly according to the present invention;

FIG. 2 is a top plan view of the drawblock assembly as viewed from the top of FIG. 1; and

FIG. 3 is a central vertical cross-section view similar to FIG. 1 except showing another embodiment of the invention.

Referring now more particularly to the drawings and first to FIGS. 1 to 2, there is provided the base 1 of the wire drawing machine having secured thereon one or more drawblock assemblies 2 with corresponding adjacent dies (not shown) through which wire is drawn by the respective drawblocks. Each drawblock assembly 2 includes a bearing plate 3 secured as by bolts 4 to base 1 and provided with oppositely disposed tapered roller bearings 5 and 6 for journalling the drawblock drive shaft 7 for rotation about its central vertically disposed axis. Keyed on the lower end of said drive shaft 7 is a worm wheel 8 or the like by which the shaft 7 is adapted to be driven.

Keyed on the tapered upper end of the drive shaft 7 and held thereon by the nut 9 screwed onto the upper end of the drive shaft is a wire drawblock 10 which has the usual tapered flange or apron 11 and the coaxial, upwardly extending, and generally cylindrical side wall 12. As known in the art wire or the like is adapted to be helically wrapped around the drawblock 10, starting at the junction 14 between apron 11 and side wall 12, and upon exerting a tension on the free upper end of the wire, the drawblock 10 will be effective to draw the wire through a die. The bottom coil of wire continuously forces the coils thereabove upwardly. Such drawing of the wire heats the same and in many cases, the temperature of the wire may be say, 400 to 600° F. after each reduction and unless the wire is cooled after each stage of reduction such heating will continue to increase to the point where it is injurious to the final properties of the wire.

The drawblock 10 herein is hollow and the plate 3 which mounts the bearings 5 and 6 forms with the base 1 an air manifold 15 to which air under pressure is supplied from a suitable source (not shown). The upper end of the manifold 15 terminates in an annular gap 16 from which the air sweeps radially inwardly across the apron 11 and thence upwardly around the wire which is adapated to be wrapped around the side wall 12 of the drawback 10 as shown by the flow arrows. The bearing support plate 3 is also provided with a series of openings 17 leading to the annular space between the inwardly directed flange 18 and the apron 11 so as to provide a secondary manifold 19 from which the air passes through a series of radial tubes 20 that are secured in the drawblock 10, whereby cooling air is supplied for

downward flow through the bearings 5 and 6 as shown by the arrows in FIG. 1.

The drawblock 10 is formed with a plurality of radial reinforcing and heat extracting webs 21 and bolted around the upstanding boss 23 for the upper bearings 5 is an annular liquid coolant manifold 24 which has a radial inlet pipe 25 for coolant under pressure (see FIG. 3). The upper wall of the manifold 24 is formed with a series of uniformly spaced orifices 26 therethrough, (eight, ten, or twelve in number, for example). The orifices 26 for the present purpose may be of 1/16" to 3/16" diameter, preferably about 1/8" diameter. These orifices 26 are inclined generally toward the upper corner of the drawblock 10. Thus, as the drawblock rotates, the coolant jets supplied into the pockets between successive vanes or webs 21 will by centrifugal force and gravity be caused to flow downwardly along the side wall 12 as a thin sheet thereby to extract heat from the side wall 12 of the block 10 and from the wire wrapped therearound. As such sheet of coolant flows downwardly along the interior of the side wall 12 of the drawblock 10, it will, of course, have been heated to some degree and will flow under the influence of centrifugal force through the several (eight, in number for example) radial openings 27 through the wall of the drawblock at, or just above, the junction 14 where the wire is at its highest temperature and first comes into contact with the drawblock 10. Preferably, water is used as the coolant and, therefore, when the several streams of warm water flowing through the orifices 27 contact the wire, the water is immediately vaporized, whereby a great deal of heat is extracted from the wire and the wire is dry right after contact by the water. The excess coolant which does not flow outwardly through the radial orifices 27 gravitates into the sump 28 which then is provided with an appropriate drain 29 (see FIG. 3) for conducting the spent coolant into a sewer or into a cooling tank for recirculation.

Referring now to the other form of drawblock assembly as shown in FIG. 3, the same is basically of the same construction as that shown in FIGS. 1 and 2, i.e., it comprises a fixed base 31 on which the drawblock assembly 32 is mounted by means of a bearing plate 33 with top and bottom antifriction bearings 35 and 36 for the drawblock drive shaft 37, the latter having thereon the worm drive wheel 38 at its lower end and the nut 39 at its upper end for holding the drawblock 40. As in FIGS. 1 and 2, the FIG. 3 assembly also includes the air blast and liquid cooling means, the air blast sweeping along the apron 41 and side wall 42 from manifold 45 and air gap or orifices 46 and passing through openings 47 into the secondary manifold 49 and through tubes 50 to cool the bearings 35 and 36.

One principal difference between the FIG. 3 construction and that of FIGS. 1 and 2 is that the side wall 42 of the drawblock 40 flares inwardly adjacent its lower end whereby a pool 51 of the coolant collects thereat as it flows down by gravity in sheet form along the side wall 42. Thus, there is a continuous supply of coolant in such pool 51 for flow through the radiating orifices 52 for discharge of coolant directly onto the wire for vaporization and effective cooling of the wire while yet leaving the wire perfectly dry. The coolant manifold 24, supply pipe 25, sump 28, and drain 29 may be of the same construction as that shown in FIG. 1.

In conclusion, therefore, it can be seen that the present invention utilizes not only air blast cooling of the wire and liquid cooling by conduction through the drawblock, but in addition, vapor cooling which is very efficient and fast because the cooling liquid directly contacts the heated wire and is thereby immediately vaporized to extract great amount of heat from the wire at the time that it first comes into contact with the drawblock.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

We therefore particularly point out and distinctly claim as our invention:

1. Means for cooling wire and the like after it has been drawn through a die by a rotary drawblock, said drawblock being hollow and including a side wall around which wire is adapted to be wrapped for drawing; means for supplying liquid coolant into said drawblock to extract heat from such side wall; said drawblock being formed with an opening through which the coolant flows to the exterior of such wall into direct contact with such wire.

2. The cooling means of claim 1 wherein such opening is disposed adjacent the junction of such side wall with an apron formed on said drawblock thereby to extract heat from the wire as it initially contacts said drawblock following said drawing operation.

3. The cooling means of claim 1 wherein said drawblock has a fixed annular manifold therein provided with a series of orifices for supplying coolant to the interior of such side wall for flow by centrifugal force and gravity as a thin sheet axially along such side wall.

4. The cooling means of claim 1 wherein said cooling means also comprises means for inducing flow of a gaseous medium around the exterior of said drawblock to sweep over the wire wrapped therearound.

5. The cooling means of claim 1 wherein said cooling means also comprises means for inducing flow of a gaseous medium around the exterior of said drawblock to sweep over the wire wrapped therearound; and wherein bearing means are provided for journalling said drawblock, said bearing means having passages leading thereto for flow of such gaseous medium therethrough.

6. The method of cooling heated wire as it travels lineally around a wire drawblock which comprises circulating a liquid coolant through the block to extract heat from the side wall thereof around which the wire is helically wrapped; and bringing such coolant into direct contact with the wire to extract heat directly therefrom.

7. The method of claim 6 wherein said coolant has a vaporization temperature less than the temperature of the wire to be cooled.

8. The method of claim 6 wherein said coolant is brought into contact with the wire at the zone where the wire initially contacts the draw block.

9. The method of claim 6 wherein the coolant first flows by centrifugal force and gravity as a thin sheet along the interior of the wall of the block contacted by the wire and then flows radially through an opening in such wall to contact the wire.

10. The method of claim 6 wherein the wire on the exterior of the block is impinged by a gaseous cooling medium.

11. The method of claim 6 wherein the wire on the exterior of the block is impinged by a gaseous cooling medium, and wherein bearings journalling said block also have such gaseous medium circulated therethrough.

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