United States Patent [19]

Randall

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[45] **Jan. 7, 1975**

[54] **PIPE QUENCH HEAD**

[75] Inventor: **George W. Randall,** Coraopolis, Pa.

[73] Assignee: **Armco Steel Corporation,** Butler County, Ohio

[22] Filed: **Nov. 8, 1973**

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Related U.S. Application Data

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[52] **U.S. Cl.** ..... **266/6 S,** 148/144

[51] **Int. Cl.** **C21d 9/08**

[58] **Field of Search** ..... 148/143, 144, 156, 152, 148/153; 134/64, 122, 199; 266/3 R, 4 S, 6 R, 6 S

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Primary Examiner—Gerald A. Dost

Attorney, Agent, or Firm—Melville, Strasser, Foster & Hoffman

[57] **ABSTRACT**

The pipe quench head comprises an outer shell mounted on a frame and an inner shell mounted in the outer shell and the two are removably fastened together by suitable fastening means. There will be a plurality of inner shells to suit a particular material size or range of sizes. Each such inner shell is a spool-like element having front and back end plates to seal with mating areas on the outer shell to form a closed end annulus between the outer shell, the inner shell and its end plates. Each inner shell has drilled holes radially around the circumference and laterally in its length to accept spray nozzles mounted radially on the inside surface. A pipe connection on the outer shell connects to a suitable pumping system, the space between the inner and outer shells thereby comprising a supply plenum to receive a continuous supply of water or other coolant.

11 Claims, 6 Drawing Figures

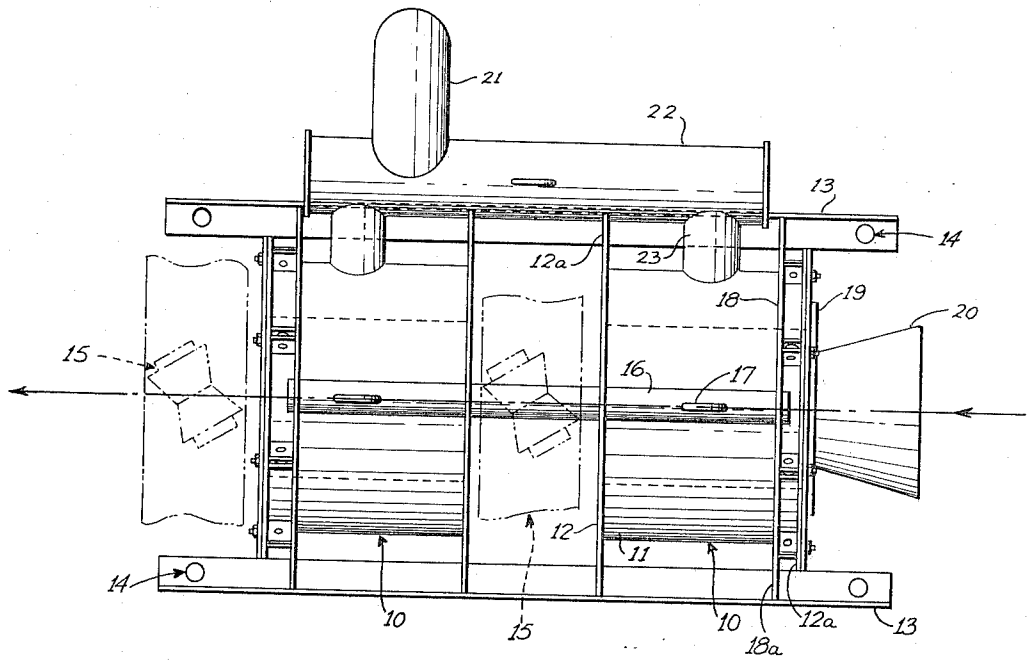


FIG. 1

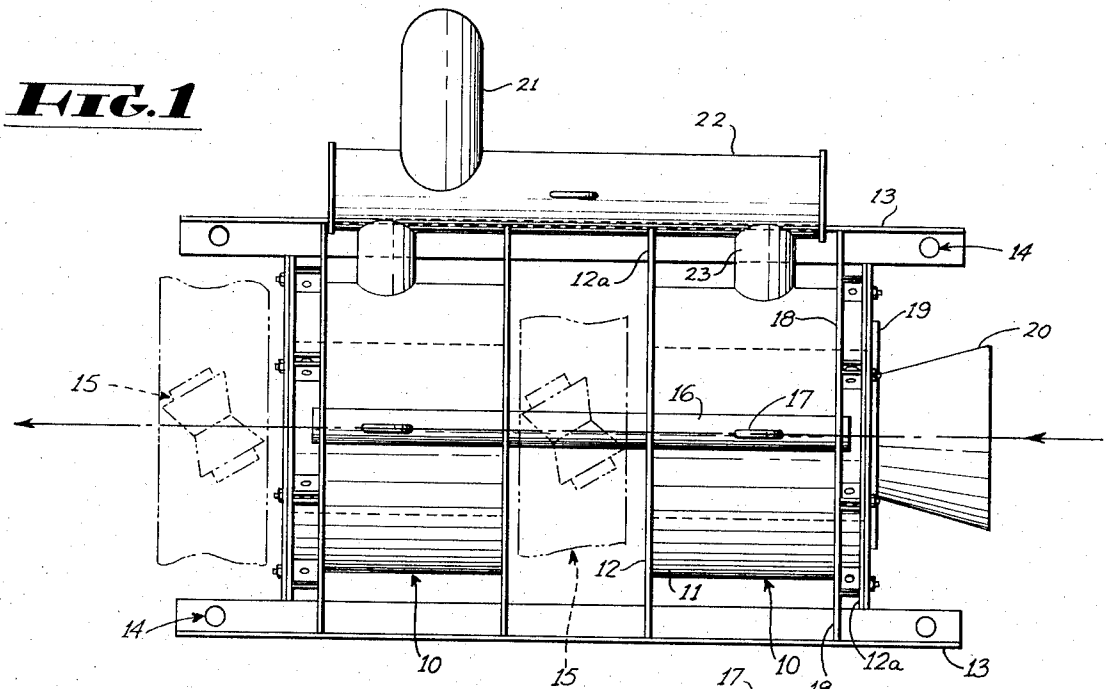


FIG. 2

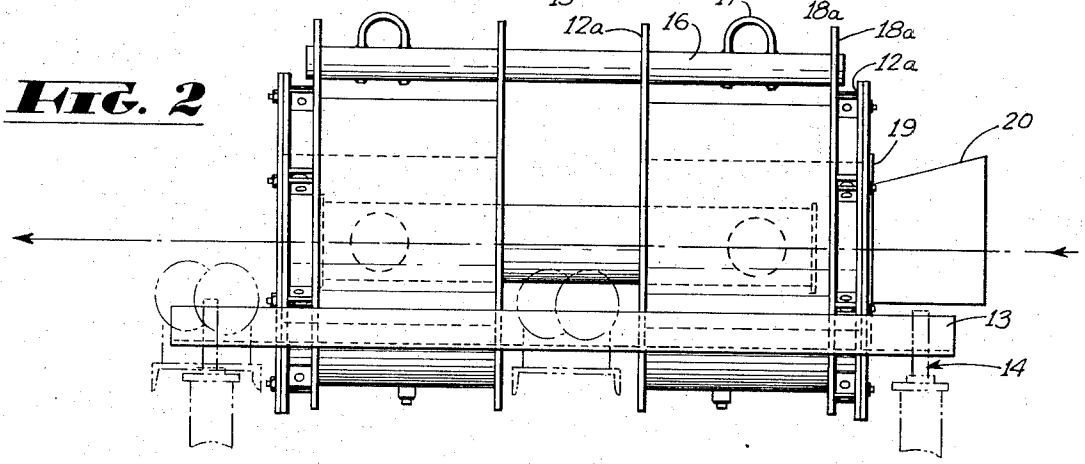
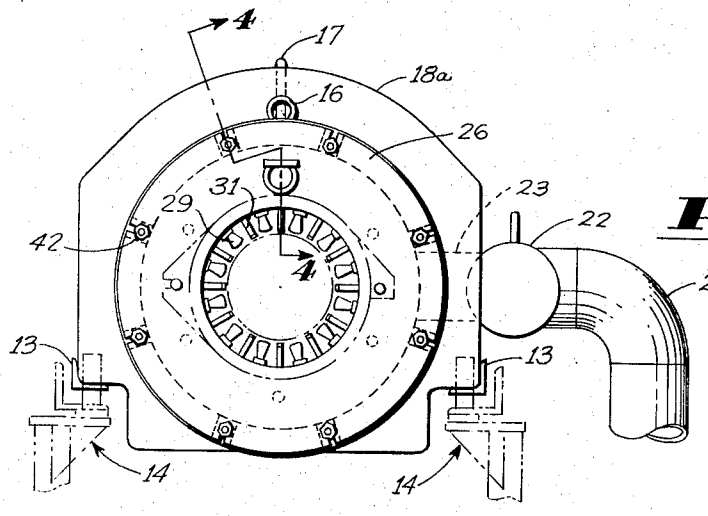


FIG. 3



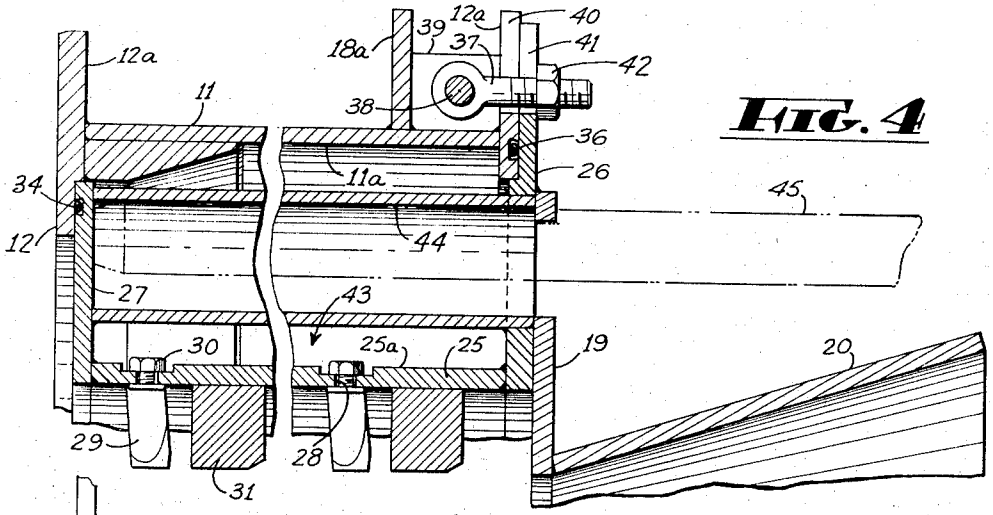


FIG. 4

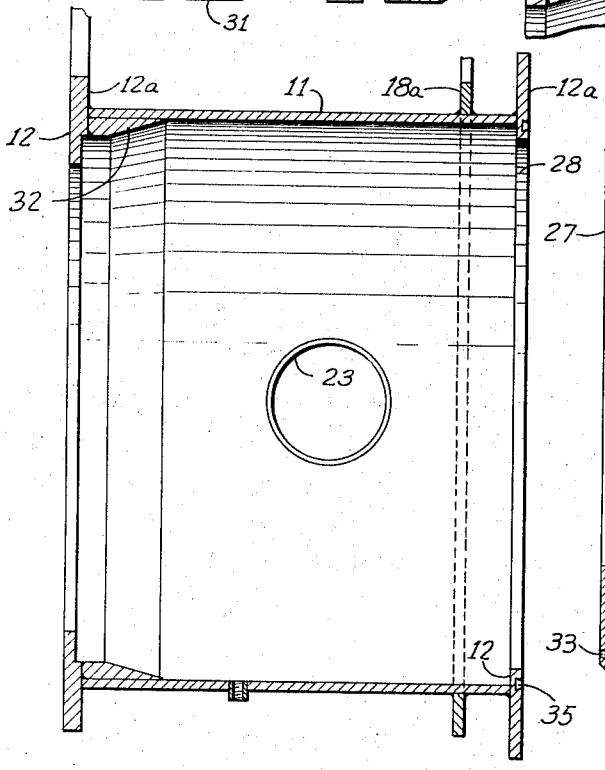


FIG. 5

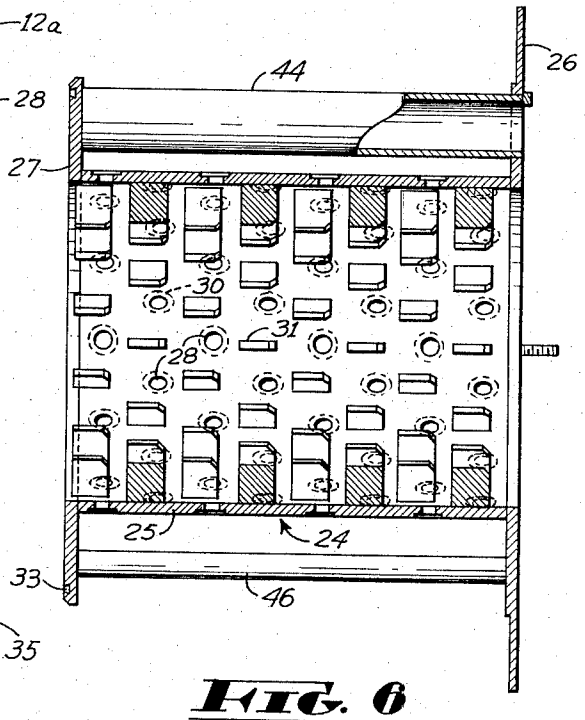


FIG. 6

PIPE QUENCH HEAD

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation application of application Ser. No. 231,155 in the name of the same inventor filed Mar. 2, 1972, and now abandoned and entitled PIPE QUENCH HEAD.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The quench head and system of this invention is particularly well suited for quenching pipe, bars or other like material requiring heat treating. Specifically, for example, the quench head may be used to quench seamless pipe rapidly as it comes out of heat treating apparatus. Such quenching must be fast so as to bring the pipe from its austenitic condition (stable at high temperatures) to its martensitic condition without substantial transformation to upper transformation products such as pearlite. It must also be uniform around the pipe circumference to avoid distortion.

2. Description of the Prior Art

Although no search of the prior United States patent art has been made, some of the heretofore common quench head systems are known. These have been comprised, for example, of spray nozzles mounted on a series of parallel pipe headers arranged circumferentially around the material to be quenched, or they have been comprised of pipe spray nozzles mounted radially around a series of circular pipe headers stacked in line laterally along the line of material to be quenched. Conventionally the spray nozzles have been threaded into a threaded header. These prior installations have been relatively inflexible.

An object achieved by this invention is the ability to maintain close proximity between the spray nozzle and the material, for better quenching. Another object achieved by this invention is the ability to clean and maintain the quench head, a factor which is not possible on conventional means of prior quench heads. A quench head of this invention provides equal distribution of the quenching solution to all spray nozzles. It provides access from both sides of the spray nozzle for easy cleaning. The invention provides complete access to the inside of the spray quench system for cleaning and other maintenance by providing a multitude of interchangeable inner shells, and close proximity of the spray nozzles to the material being quenched is permitted with a minimum number of major quench head parts.

SUMMARY OF THE INVENTION

Each quench head constructed according to this invention is comprised of an outer shell which, although of a given diameter, is preferably adjustable so that it may be centered about the material passing therethrough, and any one of a plurality of inner shells which, while constructed alike, have various inside diameters to accommodate different sized materials. The spray nozzles are located about the periphery of the inner shell which in itself is a spool-like element comprised of a centrally located conduit having a pair of flanges affixed thereto, one at either end. Although the diameter of the conduit in which the nozzles are located may vary in accordance with the material to be treated, the end flanges for all of these inner shells will be of the same outer diameter and configuration so that

they will cooperate with corresponding parts of the outer shell. Suitable sealing means are provided between these cooperating inner and outer shell parts so that the space between the outside of the inner shell conduit and the interior of the outer wall of the outer shell constitutes a supply plenum into which the coolant will be pumped. The inner and outer shells are releasably fastened together so that one inner shell may quickly be replaced by another when a change in the size of the material being treated occurs. By adjusting the outer shell with respect to the center line of the material being treated as it moves in a given direction, and by selecting the appropriate inner shell for that particular material, complete flexibility is imparted to the quench head with a minimum number of major quench head parts. Means such as porter bar are also provided by which the inner shell may readily be removed from which the outer shell when the releasable means are properly actuated. When an inner shell is so removed the entire exterior of the inner shell conduit is exposed whereby the nozzles may readily be cleaned or otherwise attended to. The nozzles have means extending interiorly of the shell conduit to properly direct the flow of coolant. Preferably guard means are affixed to the interior wall of the shell conduit to protect the nozzle means against possible damage should the material move out of its normal path of travel through the quench heads.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a quench head system according to this invention in which two quench heads embodying the teachings of this invention are employed.

FIG. 2 is a front elevation of the apparatus shown in FIG. 1.

FIG. 3 is an end view of the apparatus shown in FIGS. 1 and 2 but with certain parts removed. FIG. 4 is a fragmentary sectional view, broken along its length, taken along the line 4—4 of FIG. 3.

FIG. 5 is a sectional view of the outer shell constituting a part of the quench head of this invention.

FIG. 6 is a sectional view of the inner shell constituting a part of the quench head of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1 and 2 illustrate a quench head system comprised of a pair of the individual quench heads to be described in greater particularity in the consideration of FIGS. 4 through 6. Each quench head is generally indicated at 10. Each quench head 10 is comprised of an outer shell 11 located between a pair of flanges 12. Portions of the flanges 12 extend beyond the exterior of the outer shell 11 as indicated at 12*a* and are engaged within a pair of angle members 13 by which the quench head is supported. These frame members 13 are mounted on suitable jacks generally indicated at 14 and it will be understood by those skilled in that art that, by these jacks 14, the frame members 13 and quench head parts carried thereby may be moved vertically upwards or downwards as desired. In these FIGS. 1 and 2 means are generally indicated at 15 in dotted lines for moving the material to be quenched through the apparatus in the direction of the arrows seen in those FIGS. A carrying member 16 having loops 17 may also engage the flange portions 12*a* to aid in adjusting the vertical posi-

tion of the quench head or for changing its location in moving it from place to place. An additional quench head support flange **18, 18***a* may also be employed. In some instances it may also be desirable to employ a front plate **19** and hood **20** at the entrance end of the quench head **10.**

Coolant may be pumped into the quench head by means of a suitable pump (not shown) through a conduit **21** into a manifold **22** from which it may enter the quench head or heads via the conduit **23.** The conduit **23** extends through the wall of the outer shell **11,** see also FIG. **5.**

Referring now to FIGS. **4** and **6** the inner shell or spool-like element generally indicated at **24** will be described. An inner shell **24** is comprised of a tubular conduit **25** having flanges **26** and **27** fastened to its respective ends. In the preferred form of the invention the outer dimensions of the flanges **26** and **27** will be the same regardless of the diameter of the particular tubular conduit **25** engaged between them. The diameter of the flange **27** will be of such a size that it may pass through the opening **28** in the flange **12** at the right hand end, or entrance end, of the outer shell **11** as viewed in FIG. **5.** This flange **27,** however, will engage the flange **12** located at the exit end of the outer shell **11.** The flange **26,** however, is of such a size that it may engage the front portions of the flange **12, 12***a* located at the right hand side of the head as viewed in FIG. **5.**

As best seen in FIGS. **3, 4** and **6** the inner shell conduit **25** has a plurality of drilled holes **28** spaced radially around its circumference and laterally throughout its length to accept spray nozzles **29** mounted radially on the inside surface. These nozzle members **29** may be bolted in place by members **30** having orifices therethrough by means of which coolant inpinges on the nozzle members **29.** These members **29** are flat-like so as to spread the coolant as it passes through the members **30** and holes **28** towards the material being quenched. A plurality of protective devices **31** protrude from the interior of the conduit **25** and are spaced among the nozzle members **29** as to protect them from damage should the material passing through the interior of the conduit **25** for some reason get out of line.

It will be understood that all connections between the outer shell **11** and its flanges **12,** and between the inner shell conduit **25** and its flanges **26** and **27,** will be water tight as indicated by the weld marks and the like shown in these FIGS. This is also true of the member **32** fastened within the left hand side of the outer shell member **11** as viewed in FIG. **5.**

It is also imperative that there be water tight relationships established between the flanges **12** and **27** and between the flanges **12** and **26** when the inner shell **24** is located within the outer shell **11.** As noted in FIGS. **4, 5** and **6,** one way of achieving this is to provide a groove **33** in the flange **27** to carry a suitable gasket **34.** Similarly the right hand flange **12** (as seen in FIG. **5**) is provided with a groove **35** to receive a suitable gasket **36.** These gaskets, for example, as will be understood by those skilled in the art, may comprise O-rings or rings which have a U-shape in a cross section. In any event they are so sized as to be compressed when the inner shell is locked within the outer shell.

The locking arrangement may be accomplished in any suitable fashion, that illustrated in these FIGS. being a series of toggle bolts **37** (see FIG. **4**) pivotally mounted on rods **38** fixed between plates **39** secured between the flanges **18***a* and **12***a*, slots **40** and **41** being provided in the flanges **12** and **26** respectively. As shown in FIG. **4,** when the nut **42** is tightened with the toggle bolt **37** and inner shell **24** and outer shell **11** being in the position illustrated, the gasket **34** is pulled against the flange **12** while the flange **26** is pulled against the gasket **36.** In order to remove the inner shell from the outer shell it is necessary only to loosen the nut **42** so that the bolt **37** may be rotated counterclockwise as viewed in FIG. **4** until such time as the flange **26** may be pulled free.

When in the tightened position illustrated in FIG. **4** it will be apparent that there is a plenum chamber defined by the interior surface **11***a* of the outer shell **11** and the exterior surface **25***a* of the inner shell conduit **25** and the cooperating flanges **26 – 12** and **27 – 12.** This plenum chamber is generally indicated at **43.**

As best seen in FIGS. **3, 4** and **6** the inner shell **24** is provided with means by which it may readily be inserted and withdrawn into and out of the outer shell **11.** Such means comprises a tube-like member **44** extending between the flanges **26** and **27.** This member **44** will receive a porter bar of the type shown in phantom as indicated at **45.** The member **44** extends within the plenum chamber **43.** Preferably, however, there is only one of these members **44** and it does not unduly interrupt the capacity of the plenum chamber **43.** In some instances, particularly wherein the diameter of the inner shell conduit **24, 25** is relatively small, as a result of which there will be more of the flange portions **26** and **27** extending beyond the outside of the shell member **24, 25,** it may be desirable to provide reinforcing spacers **46** between such flanges **26** and **27** and this is shown in FIG. **6.** It will be understood that a plurality of these members **46** may be located radially around the exterior of the shell **24, 25.**

SUMMARY

The quench head comprises an outer shell **11** which will be used for all of the material to be quenched, regardless of its size. This quench head outer shell, however, is supported on frame work which is adjustable vertically to enable it to be centered about the particular material moving through the quench head by means of the roller means and the like **15** which are fixed in position. The inner, spool-like shell **24** will vary in size according to the size of the material being quenched. Thus, when small diameter material is being quenched, a spool having a conduit **25** of small size will be utilized and when material of larger diameter is being quenched a conduit **25** of larger diameter will be utilized in the spool-like, inner shell **24.** The diameters of the flanges **26** and **27,** however, of the inner shell **24** will remain constant so that they will mate properly with the flanges **12, 12***a* of the outer shell **11.** In those instances, however, wherein a relatively small conduit **25** is employed, brace members **46** may be located between the flanges **26** and **27** so as to make the spool-like, inner shell **24** rigid.

Although the invention has been described primarily in connection with the quenching of pipe, it will be understood that the apparatus may be used in connection with other materials; it does have particular utility, however, for treating cylindrical materials of more or less constant diameter. Each of the spool-like, inner shells **24** will handle a range of different diameter mate-

rials. When a change of range of diameters in the material being quenched is effected, it is necessary only to pull out the spool-like, inner shell 24 used for a given range and replace it with another member 24 to accommodate the new range being sent through the apparatus. When this is done the outer shell 11 is adjusted vertically so that it and the new inner shell will be located around the center line of the material to be treated. It will be readily apparent that this arrangement also makes it easy to clean the nozzle arrangement 28 – 30 since, when the inner shell 24 is pulled out from the outer shell 11 (in the arrangement shown this is accomplished by the porter bar 45 being inserted within the tubular member 44 and then withdrawn with the shell 24 thus supported thereon, the toggle bolts or other connecting means having first been loosened), such nozzle means are completely exposed for cleaning from either without or within the conduit 25 of the spool-like, inner shell 24. This ease of cleanability is an important part of this invention.

In pipe quenching operations like those previously referred to it is not uncommon to supply water to the manifold 22, and from there into the plenum chamber 43 via the conduits 23, at the rate of 3,000 gal. per minute. This water may be recirculated and cooled and the temperature can also be varied to adjust the rate of quench. In these operations pipe may be passed through a quench head at the rate of 12 to 150 feet per minute and usually this rate of travel will be the primary means by which the overall quench rate is adjusted. When a smaller size inner shell 24 is utilized it will have a fewer number of nozzles so that somewhat less water is actually used although the water pressure may remain the same. This feature of being able easily to switch from one size shell 24 to another is a distinct improvement over prior apparatus which required a complete replacement of the quench head when the size of material passing through the apparatus was changed.

Again with reference to the quenching of pipe it will be noted that the diameter of the inner shell conduit 25 is designed to provide a fixed distance between the spray nozzles 28 – 30 and the work to be quenched. The shells 24 will be designed for a pipe size range as, for example, one shell would accommodate pipe sizes 5 ½ inches O.D. through 7 ⅝ inches O.D. The maximum size would provide a minimum distance between the spray nozzles 28 – 30 and the pipe and the minimum pipe size would be regulated by the maximum distance practical between the spray nozzles 28 – 30 and the pipe diameter.

FIGS. 4 through 6 show the basic construction of an individual quench head. FIGS. 1 and 2 illustrate a system in which a pair of these heads may be employed. It is to be understood that the number of heads utilized depends on the quenching job to be performed. In some instances a single head may be sufficient. At other times it may be desirable to employ two, three or even more.

It will be apparent to those skilled in the art that modifications may be made in the structure shown and described without departing from the scope and spirit of the invention. Thus, for example, although the gasket arrangement utilized for effecting a fluid tight engagement between a selected inner shell 24 with the outer shell 11 has been illustrated as locating one gasket means 34 on the flange 27 and another gasket means 36 on the flange 12, it would be possible to reverse this arrangement or even to adopt some other. The toggle bolts 37 could be replaced by some other kind of clamping arrangement. All that is needed is some kind of quick release means by which the shells 24 and 11 may be pulled into fluid tight contact with one another via the gasket system selected. Thus, while the invention has been described in terms of particular structures and arrangements, these structures and arrangements are not to be considered a limitation on the invention except insofar as they are specifically set forth in the subjoined claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A quench head comprising: an outer shell (10) having a cylindrical housing (11) and a pair of flanges (12) extending at least inwardly of the periphery of said housing, a first of said flanges being located at one end of said housing and a second of said flanges being located at the other end of said housing, that portion of said first flange which extends inwardly of said housing forming a first abutment means and having a centrally located first opening therein, that portion of said second flange which extends inwardly of said housing forming at least a part of a second abutment means and having a centrally located second opening therein, said second opening being larger than said first opening; and a plurality of interchangeable inner shells (24), each of said inner shells having a cylindrical housing conduit (25) and a pair of flanges (26, 27) extending outwardly from the periphery of said conduit, a first (27) of said conduit flanges being located at one end of said conduit and being of such size as to be able to pass through said second opening and abut said first abutment means, the second (26) of said conduit flanges being located at the other end of said conduit and being of such size as to abut said second abutment means when said first conduit flange abuts said first abutment means, said conduit having a plurality of nozzle means (28 – 30) extending therethrough and projecting inwardly thereof, said cylindrical housing conduits different from each other only in diameter and the outer diameters of said first and second conduit flanges of all of said cylindrical housing conduits being the same; first gasket means (34) between said first conduit flange and said first abutment means, and second gasket means (36) between said second conduit flange and said second abutment means, there being a plenum chamber (43) defined by the outer wall of said conduit, the inner wall of said outer shell, and said conduit flanges and said abutment means; clamp means (37, 42) for releasably clamping said inner, spool-like shell to said outer shell; and entrance means (23) for admitting a supply of coolant to said plenum chamber; said conduit extending between said first and said second openings; whereby an inner shell may be selected from said plurality of interchangeable inner shells in accordance with the diameter size of the cylindrical housing conduit desired.

2. The quench head of claim 1 in which said nozzle means are located both circumferentially about said conduit and laterally thereof.

3. The quench head of claim 1 in which said nozzle means includes a member (29) which is relatively blade-like in configuration whereby to spread the cool-

ant as it passes interiorly of the conduit from the plenum chamber.

4. The quench head of claim **1** including brace means extending between said first and said second conduit flanges.

5. The quench head of claim **1** in which said inner, spool-like shell includes means (**44**) to receive a porter bar and the like for moving said inner, spool-like shell to and from said outer shall.

6. The quench head of claim **1** which said clamp means are located about the periphery of said second outer shell flange so as to clamp said second conduit flange to said second abutment means when said first conduit flange abuts said first abutment means.

7. The quench head of claim **1** including guard means (**31**) extending inwardly from the inner wall of said conduit.

8. A quench head system including at least one said quench head according to claim **1** and means (**15**) for moving material to be quenched along a path of travel centrally of said conduit, and including coolant moving means (**21**) for introducing coolant into said entrance means.

9. The system of claim **8** including means (**14**) for centering said outer shell about said path of travel.

10. The system of claim **8** including a plurality of the said quench heads according to claim **1**, means for moving material to be quenched along a path of travel, said path of travel passing through all of the said conduits of the said quench heads, and means for centering all of the said outer shells of the said quench heads about said path of travel.

11. The system of claim **10** including a manifold (**22**) between said coolant moving means and each of the said entrance means which admits coolant to its respective said plenum chamber of each of the said quench heads.

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