Jan. 5, 1943. S. MALKE 2,307,694

QUENCHING DEVICE

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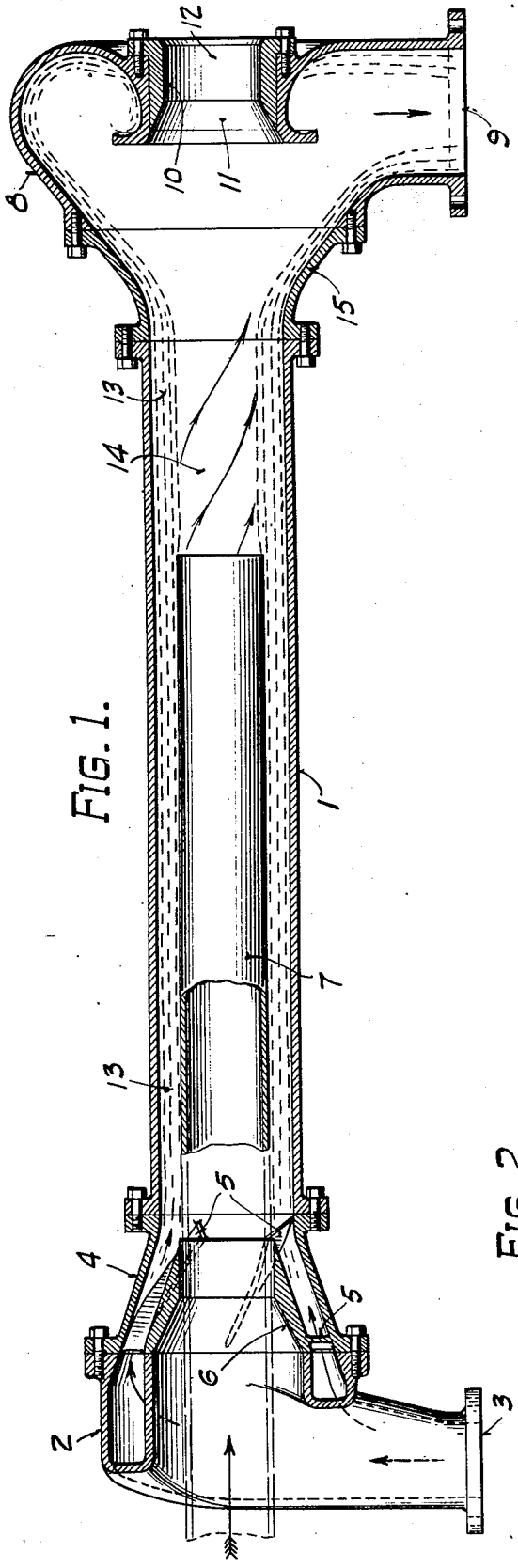


FIG. 1.

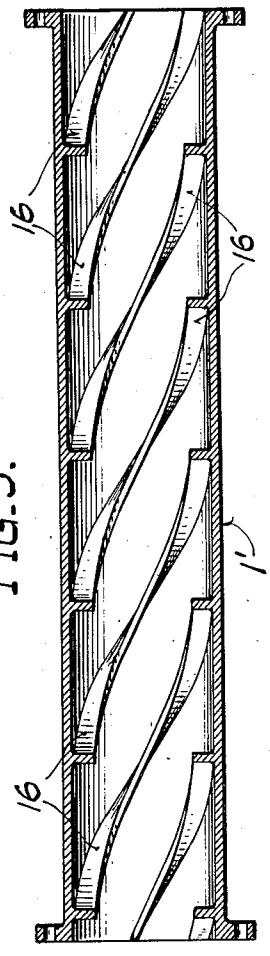


FIG. 3.

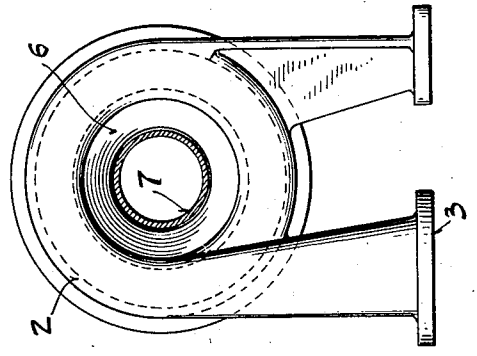


FIG. 2.

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QUENCHING DEVICE

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4 Claims. (Cl. 266—6)

This invention relates to a quenching device for applying water or other suitable liquid quenching medium to long metal pipes or bars in order to quickly cool them.

An object of the invention is to provide an improved device for progressively quenching long metal pipes or bars.

Another object of the invention is to provide a device of this character in which there is no tendency for the water or other quenching medium to enter into the inside of a pipe and pass backward in a direction opposite the direction of motion of the pipe.

A further object is to provide an apparatus for applying a liquid quenching medium to the surface of a cylindrical body moving longitudinally through the apparatus, and to effectively remove the heated liquid from the region of quenching.

These and other objects of the invention will be clear from the following detailed description and the accompanying drawing in which:

Figure 1 is a longitudinal section through one embodiment of the invention;

Fig. 2 is an end elevation looking from left to right in Fig. 1; and

Fig. 3 is a section through a modified form of the central section or barrel.

In some methods for the manufacture of pipe or tubing, one of the steps involved is hot reduction from a large diameter to a smaller diameter in hot swaging or reducing machines. While not limited thereto, the device of this invention is particularly adapted to the quenching of hot pipe coming from a swaging machine in order to cool it rapidly and improve its physical properties. The normal procedure is for the pipe to pass through the swaging machine horizontally. The quenching of the pipe should also be done while the pipe is horizontal in order to avoid the extensive handling that would be required if the pipe were turned on end and quenched by dipping vertically into a quenching bath.

The provision of a device to apply water to all parts of the external surface of a horizontally disposed pipe involves a number of problems due to the conditions which must be satisfied. In a device of this character, it is important to supply a large amount of water to quickly cool the pipe; to insure uniform application of the water to the pipe to give a uniform quenching action at all points; to prevent the passage of water backwards into the pipe coming from the swaging machine or the furnace in which the pipe is heated; and to provide for rapid removal of the heated water. Water is the quenching medium which will ordinarily be employed, but it is to be understood that other liquids can be used and that the essential features of the invention are independent of the particular quenching medium which is chosen.

The quenching device of this invention comprises a central barrel 1 positioned horizontally at a suitable height to receive pipe coming from the hot swaging machine. The swaging machine and feed rolls and feeders for moving the pipe through the quenching device are not shown in the drawing as they form no part of this invention. In the arrangement shown in Fig. 1 the swaging machine would be at the left and pipe would pass through the quenching device from left to right.

The entrance end of the quenching device has a scroll casing 2 which receives water from the inlet 3 connected to a pump or other means for supplying water in sufficient quantity. The scroll casing distributes water to the guide section 4 positioned between it and the barrel 1. The guide section is provided with vanes 5 set at an angle to the axis of the barrel to impart a spiral or whirling motion to the water. The tapered opening 6 serves to guide the pipe 7 into the quenching device as it approaches from the left.

At the opposite end of the barrel 1, a second scroll casing 8 of greater diameter than the barrel is provided to discharge water through the outlet 9. An adapter 10, which supports the pipe at the discharge end of the device, fits into the scroll casing and has a tapered opening 11 to guide the leading end of the pipe through the opening 12 in the adapter. This opening is preferably of such a size as to closely surround the pipe that is to be quenched.

When water is admitted to the inlet 3, it emerges from the guide section 4 with a longitudinal component of velocity (from left to right) and with a transverse or rotary component of velocity. This last should be sufficiently high to cause the water 13 to hug the inside surface of the barrel 1 and leave an open central space 14 which is free from water. Fairly moderate velocities are sufficient to do this. If, for example, the rotary component of the water velocity is 10 feet per second and the inside diameter of the barrel 1 is one foot, the centripetal acceleration is 6.25 times gravity and water at the top of the barrel will cling to it instead of dropping down.

At the exit end, the water spreads outwardly into scroll casing 8 due to its rotation and is discharged through the outlet 9. When no pipe is going through the quenching device, the water

passes from the entrance end to the exit end while clinging closely to the inside surfaces of the barrel 1 and scroll casing 8, leaving an open space in the center. There is no loss of water through the open ends of the two scroll casings. When a pipe 7 is introduced into the quenching device, the water is confined in the annular space between it and the barrel 1, whirling around the pipe and passing longitudinally along it, thus insuring a rapid and uniform quench. There is no tendency for water to pass backward through the pipe since the longitudinal component of water flow is in the same direction as the forward motion of the pipe. When only a single pipe is passed through the device, water can enter the pipe after its trailing end has passed the guide section 4, but the water thus entering passes through cooled pipe in a direction away from the swaging machine and furnace and can do no damage. In continuous operation, one pipe will follow after another with no gap or only a small gap between them, and there will be but little tendency for water to enter the leaving pipe.

Different size barrels are used for the treatment of different sizes of pipe. The longitudinal component of water velocity is determined by the volume rate of flow and the area of the annulus between the inside of the barrel and the outside of the pipe. The volume rate of flow being fixed at a value sufficient to cool the pipe in its passage through the quenching device, the diameter of the barrel is chosen so that for any size pipe the longitudinal component of water velocity will have a desired value.

The scroll casings 2 and 8 are preferably made of sufficient size to be suitable for handling the largest size pipe that is to be quenched. A different size barrel 1, guide section 4, and connecting section 15 is provided for each smaller size of pipe that is to be quenched. A different size of adapter 10 will also be provided for each of the smaller sizes of pipes.

In the embodiment of the invention just described, the barrel 1 is smooth on its inner surface. In the modified construction shown in Fig. 3, the barrel 1' is provided with spiral vanes 16, which may extend over its entire length, or over only a part of the length. These will help to maintain the whirling motion imparted to the water by the guide section 4 and may be used if desired.

The invention is not limited to the quenching of pipe that have been reduced in diameter in a hot swaging machine but can be used for quenching heated pipe or solid bars or rods of substantially circular section irrespective of their previous treatment. It is also to be understood that while the device is preferably mounted with its axis horizontal to treat pipes or bars passing through it horizontally, it can also be mounted vertically if desired, with the water inlet at the upper end and the outlet at the bottom end. In this position it is adapted to quench cylindrical bodies lowered through it vertically, and the important advantages of the invention are retained in that the quenching will be quick and uniform, while the water will be prevented by its rotation from passing out through the hole provided at the lower end for the exit of the pipe. In such a case, it may be desirable to decrease the diameter of the barrel from the upper end to the lower end in view of the increased longitudinal velocity imparted to the falling water by the action of gravity.

I claim:

1. A device for applying a liquid medium to the external surface of a cylindrical body as the latter is moved longitudinally therethrough comprising a tubular barrel with an inside diameter larger than the external diameter of the cylindrical body, means at one end of the tubular barrel for introducing liquid adjacent its inner surface with a component of velocity along the axis of the barrel and a substantial component of velocity at right angles thereto in a direction circumferential of the barrel, said means having an axial opening to admit the cylindrical body, and an enlarged chamber at the opposite end of the barrel having an axial opening to permit the passage of the cylindrical body and a separate opening at the outer circumference of the chamber for the outlet of liquid.

2. A device for applying a liquid quenching medium to the external surface of a heated tube as the latter is moved longitudinally therethrough, comprising a scroll casing having an axial opening to admit the heated tube and guide vanes to impart to the liquid a substantial component of velocity in a circumferential direction about the axis of the guide section, a barrel secured to the guide section coaxial therewith and having an inside diameter greater than the outside diameter of the tube, and a second scroll casing secured to the opposite end of the barrel, said latter casing being of greater transverse dimensions than the barrel and having an axial opening to permit the passage of the tube and a separate opening at the outer circumference thereof for the outlet of water.

3. An apparatus for progressively quenching longitudinal metallic tubular bodies of cylindrical shape by applying a cooling liquid thereto as said bodies are moved successively through the apparatus, comprising tubular means surrounding the longitudinally moving body for a length at least as great as that of the temperature gradient required for the given dimensions and composition of the body, the speed of its movement and the temperatures involved, said means providing with the moving body a restricted passage for the cooling fluid longitudinally of the body, means for supplying cooling fluid at the end adjacent the entrance for the body of said surrounding means at a rate of flow to substantially fill the circumferential space between the said surrounding means and the moving body being cooled, and means to give to the fluid a longitudinal component and a circumferential component to provide a spiral movement of the fluid around the moving body to more uniformly cool it and to provide a longitudinal flow of the fluid in the direction of the moving body.

4. An apparatus for progressively quenching stock of cylindrical shape by applying cooling liquid thereto as the stock passes through the apparatus, comprising a circumferential header for applying a sheet of cooling liquid around the stock to be quenched, said liquid flowing in a spiral direction longitudinally and around the stock in the longitudinal direction of movement of the latter, a receiving header for the liquid as it leaves the stock, and means for coupling said headers to any one of a plurality of interchangeable tubular bodies of different diameters corresponding to different sizes of stock to be quenched for confining the cooling liquid as it flows in contact with the stock from said first named header to said second named header.

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