Sept. 20, 1966 G. SCHWARZE ET AL 3,273,572

CONTINUOUS COOLING OF METAL SLABS AND THE LIKE IN A WATER BATH

Filed Feb. 10, 1964 4 Sheets-Sheet 1

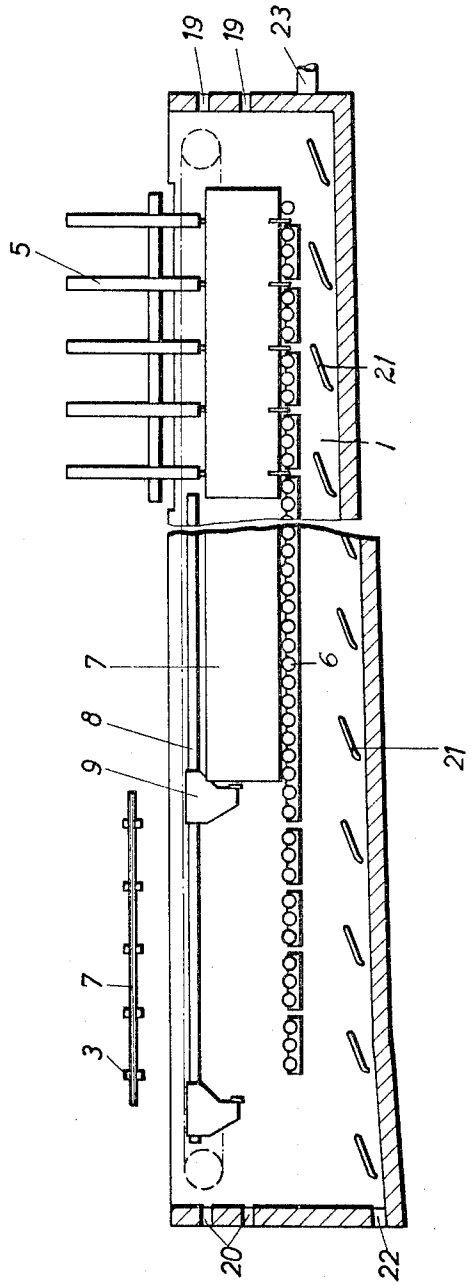


Fig. 1

CONTINUOUS COOLING OF METAL SLABS AND THE LIKE IN A WATER BATH

Filed Feb. 10, 1964 4 Sheets-Sheet 2

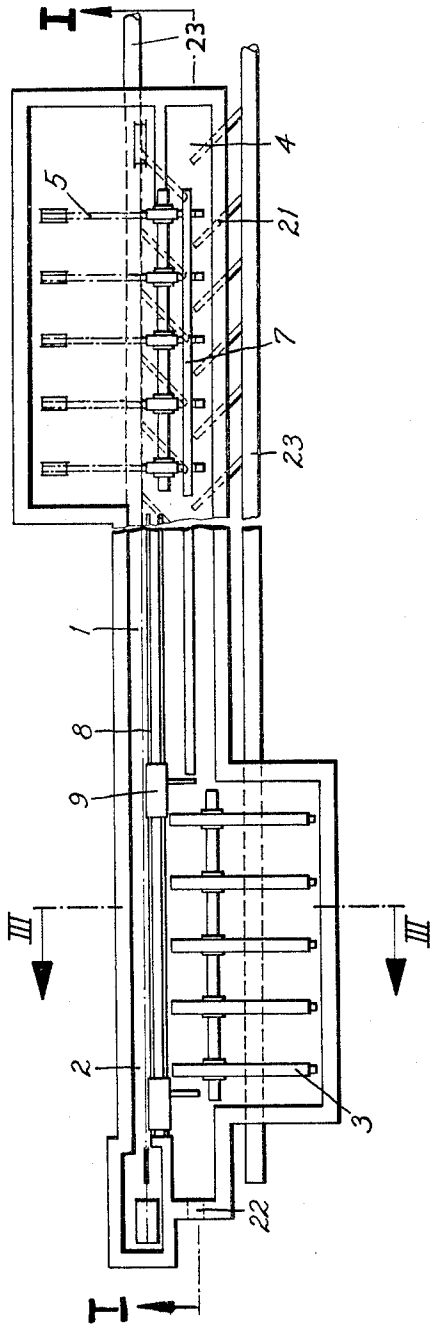


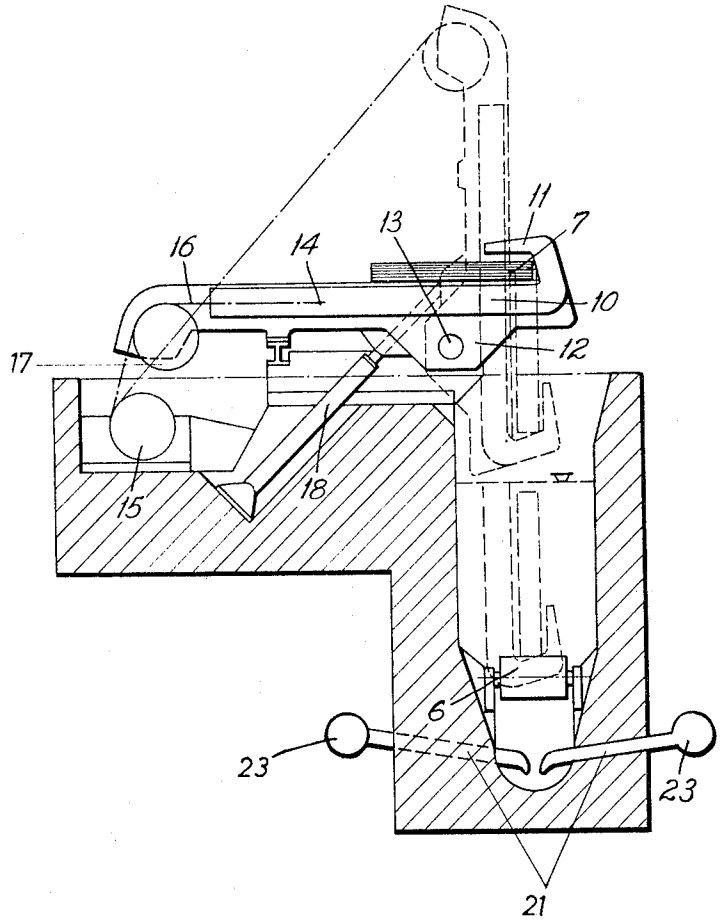
Fig.2

Sept. 20, 1966 G. SCHWARZE ET AL 3,273,572

CONTINUOUS COOLING OF METAL SLABS AND THE LIKE IN A WATER BATH

Filed Feb. 10, 1964 4 Sheets-Sheet 3

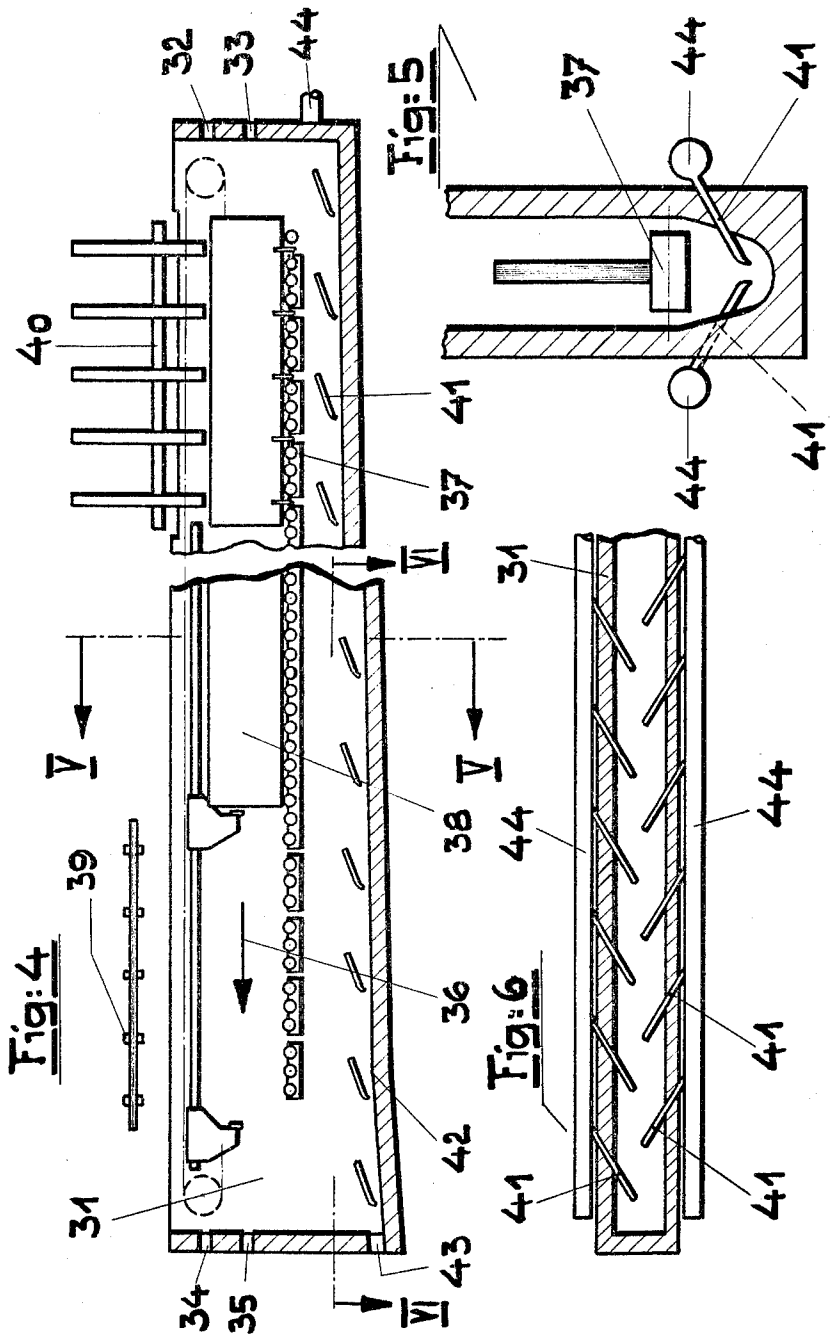
Fig.3



Sept. 20, 1966 G. SCHWARZE ET AL 3,273,572

CONTINUOUS COOLING OF METAL SLABS AND THE LIKE IN A WATER BATH

Filed Feb. 10, 1964 4 Sheets-Sheet 4



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3,273,572

CONTINUOUS COOLING OF METAL SLABS AND THE LIKE IN A WATER BATH

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5 Claims. (Cl. 134—104)

This invention relates to an apparatus for the continuous cooling of slabs, semi-finished flats, and thick plates of metal, in a water bath. The cooling of such rolled stock is effected in a known manner in a trough filled with water, combined with an appliance which takes up the stock to be cooled from a live-roller feeding table, lowers it into the water bath, takes it out again after the cooling has been effected, and thereupon supplies it to a live-roller discharge table. These known take-up appliances comprise rotating or rockable arms. It is also known to extend through the water bath a conveyor belt, which takes up the slabs at one end, guides them through the water bath to cool them, and delivers them to a further conveyor at the other end. Finally it is also known to deposit the slabs upon a lifting table arranged in the water bath, whereupon they are brought into the water bath by lowering the lifting table. In the case of all these known methods of cooling, and the apparatus connected therewith, the slabs or the like are not engaged uniformly on both sides by the cooling medium during the immersing operation. The surface of the slabs or flats facing the surface of the liquid is already wetted by the liquid, while the corresponding surface region on the side facing away from the water bath is still not subjected to any cooling effected by the water bath. The consequence of this is that owing to the unequal cooling of the two sides a distortion of the slabs or the like is effected.

The object of this invention is to obviate these defects, which are inherent in the known cooling appliances with respect to the material to be cooled, and at the same time to obtain an increase in the cooling action of the water bath. According to the invention this result is achieved by immersing the slabs, flats or thick plates in the cooling liquid in a vertical or approximately vertical position. Owing to the material to be cooled being immersed vertically in the water bath it is engaged uniformly on both sides by the cooling medium, so that any distortion of the same is precluded. Moreover the steam arising on the immersed surface can escape freely in an upward direction, so that no heat-insulating cushion of steam can form underneath the material that is being cooled.

The cooling material is preferably transported from a delivery station to a removal station in the water bath in a vertical or approximately vertical position, and preferably in a longitudinal direction, in order to keep the volume of the water bath as small as possible.

Apparatus for carrying out the method of cooling according to the invention, with the material to be cooled being preferably supplied in a horizontal position by means of a live-roller table, may advantageously consist of arms rockable about a horizontal axis and displaceable parallel to the latter. The tilting or rocking movement of the arms into the vertical position is advantageously effected by the weight of the cooling material resting upon them. The displacement of the arms transversely to their tilting or rocking axis is obtained in an advantageous manner by their being guided upon slides, which execute the tilting or rocking movement about a stationary axis. The lowering of the arms into the water bath is likewise advantageously effected by the weight of the slabs or the like resting upon them.

To enable the speed of immersion of the cooling material to be regulated, the arms are operatively connected with a pulling line provided with a braking device. This pulling line serves at the same time to bring the arms back again into their initial position, and also to effect the tilting movement of the slide. The traction rope is here guided over a deflecting roller arranged on the slide. As a regulating member for the tilting operation of the slide there serves a power piston operatively connected with the slide.

In a further development of the invention, the water bath that accommodates the slabs or flats in a vertical position is constructed as a narrow trough, which is equipped with conveying means for transporting the slabs or the like in a vertical position to the point of removal. These conveying means are formed either by positively driven rollers arranged horizontally or at an inclination to the bottom of the trough, or by loose rollers in conjunction with driving means extending over the transport path and provided with tappets or cams for engaging the cooling material. As driving means there may advantageously be employed a chain drive arranged outside the cooling liquid and provided with cams or tappets for carrying cooling material along.

The removing appliance for the slabs or flats, arranged at one end of the trough may advantageously be of the same constructional design as the delivery appliance for supplying the cooling material, arranged at the other end of the trough.

The length of the trough depends upon the time required for cooling the given material through the requisite range of temperature. An especially intensive cooling is obtained if the cooling-water inlet is located at the removal end of the trough and the cooling-water outlet at the delivery end.

For the removal, in a simple manner, of the scale accumulating at the bottom of the water bath during the cooling of the material, according to a further development of the invention, pressure-water connections for scavenging the scale away are arranged in the vicinity of the bottom of the trough. These pressure-water connections may advantageously be formed by injection nozzles.

Two constructional examples of the invention are illustrated in the accompanying drawings, in which:

FIGURE 1 shows a section on the line I—I in FIGURE 2;

FIGURE 2 shows the associated plan; and

FIGURE 3 shows a section on the line III—III in FIGURE 2, representing the delivery appliance;

FIGURE 4 shows a longitudinal section through another constructional example;

FIGURE 5 a section on the line V—V in FIGURE 4; and

FIGURE 6 a section on the line VI—VI in FIGURE 4.

In FIGURES 1, 2 and 3, an elongated water bath **1** has, at the end **2**, a delivery appliance **3**, and, at the end **4**, a removal appliance **5**. In the water bath, near the bottom, loose rollers **6** are provided for transporting slabs **7**. By tappets or cams **9** secured to a pulling line **8** the slabs are conveyed from the delivery end **2** of the water bath to the removal end **4**. As shown in FIGURE 3, the delivery appliance consists of arms **10**, which are bent at their ends into the shape of hooks **11**. They are longitudinally displaceable upon a slide **12**, which is rockable about the pivot **13**. By the weight of the slab **7** resting upon the arms **10**, the slides **12**, jointly with the arms **10**, are tilted into a vertical position, as represented in dotted lines.

In order that the tilting of the members in question may be controllable, the arms **10** are connected, at the points **14**, by way of a traction rope **16**, with a traction drum **15**. The traction rope **16** is guided over a deflect-

ing pulley **17**, which is mounted on the slide **12**. The traction drum **15** is provided with a braking device, not shown, by which the speed of tilting of the participating members can be regulated.

By the additional arrangement of a power piston and cylinder **18**, which is attached to the slide **12**, it is ensured that the lowering of the arms **10**, together with the material to be cooled, into the water bath, only begins when the material to be cooled has reached the vertical position. The arrangement of this power piston is primarily required when the arms **10** are not arrestable upon the slide. In this case, a lowering movement of the arms would otherwise occur already during the tilting operation, if the weight of the participating means that effect the tilting movement is greater than the tractive effort to be exerted by the pulling line **15**, for the purpose of obtaining the counter-torque required for controlling the tilting motion. The power piston here serves for increasing the tilting moment, so that the pull required of the pulling line is sufficient for obtaining the corresponding counter-torque, for the purpose of holding the weight of the arms, including the material to be cooled, in its initial position with respect to the slide, until the tilting movement is concluded. By further releasing of the pulling-line brake, the arms, together with the material to be cooled, are thereupon let down vertically into the water bath. In FIGURE 3, the lowered position of the arms, with the slab, is represented in dotted lines.

After the slab has been let down into the water bath it rests upon the loose rollers **6**, and is advanced by the tappets or cams **9** out of the region of the delivery appliance in the direction of the removal appliance. Thereupon the arms are pushed back by the pulling line into their original position, and are brought, by tilting the slides, into the horizontal position for the accommodation of fresh material to be cooled. During this tilting back, the power piston **18** serves as a braking or controlling device.

As soon as the first slab has reached the removal appliance **5**, it is taken up by the arms, which have meanwhile been lowered, and is turned over, by the pulling line, into the horizontal position for further transport.

The trough **1** is currently being traversed by cooling liquid, which enters, at the removal end, through inlet apertures **19**, and emerges, at the delivery end, through outlet apertures **20**.

Underneath the transport rollers **6**, along the trough, near the bottom, in alternate sequence, on the two sides, are arranged water-injecting nozzles **21**, which drive the scale that flakes off from the cooling material towards an outlet aperture **22**. These water-injecting nozzles are connected to pressure-water pipes **23** arranged on both sides of the trough.

In the constructional example illustrated in FIGURES 4 to 6, the water bath **31** is provided at one end, with cooling connections **32** and **33**. At the opposite end are arranged outlets **34** and **35** for the discharge of the cooling water. This gives rise to a flow of cooling water in the direction of the arrow **36**. The cooling material **38**, for instance slabs, flats or thick plates, rests upon transport rollers **37**, and is conveyed upon them from the delivery appliance **39** to the removing appliance **40**. Underneath the conveying rollers **37** (FIGURE 5) pressure-water nozzles **41** are arranged in alternating sequence on the two sides of the channel at equal distances apart. The bottom **42** of the water bath is inclined downwards towards the outlet **43**. The scavenging of the scale to the outlet **43** is thereby promoted. The pressure-water nozzles **41** are also inclined towards the bottom outlet **43**, in order that a current of scavenging water flowing in this direction may be provided. The pressure-water nozzles are connected to pressure-water pipes **44**, which are located, in FIGURE 6, outside the water bath.

As a modification of the construction illustrated, the pressure-water pipes may be located inside the water bath, in the neighborhood of its bottom.

We claim:

1. Apparatus for cooling metal articles such as slabs, plates and thick sheets by immersion in a substantially vertical position in a cooling liquid bath, said apparatus comprising a relatively long and narrow cooling bath tank, a slide pivotally mounted adjacent one end of said tank for movement about a horizontal axis substantially parallel to the longitudinal axis of said tank from a horizontal position to a substantially vertical position, a plurality of arms supported for longitudinal sliding movement on said slide, means for delivering said articles in a horizontal position and depositing the same on said arms, said horizontal pivotal axis being so located that the weight of said article on said arms tends to cause pivotal movement of said slide, arms and articles from a horizontal to a substantially vertical position, a power cylinder mounted on said tank, a piston in said cylinder and a piston rod connected to said slide for assisting in the pivotal movement thereof, means for lowering said arms and said articles vertically into said tank, and means for moving said articles from said arms and for conveying said articles to the opposite end of said tank.

2. Apparatus as defined in claim **1** in which said means for removing said articles from said arms and for conveying said articles to the opposite end of said tank comprises a roller table disposed in the lower portion of said tank and extending longitudinally thereof, said arms serving to deposit said articles in edgewise vertical position on said roller table, tappet means for engaging and moving said articles supported by said roller table from said one end of said tank to the opposite end, and means at said opposite end for lifting said articles out of said tank.

3. Apparatus for cooling metal articles, such as slabs, plates and thick sheets by immersion in a substantially vertical position in a cooling liquid bath, said apparatus comprising a relatively long and narrow cooling bath tank, means at one end of said tank for lowering said articles into said tank in a vertical position, means in the lower portion of said tank and extending longitudinally thereof for supporting said articles in a vertical position, means for moving said articles on said supporting means from said one end of said tank to the opposite end, means at said opposite end for lifting said articles out of said tank, inlets for cooling liquid at said opposite end of said tank, outlets for cooling liquid at said one end of said tank, pressure liquid nozzles in the lower portion of said tank for scavenging away any scale detached from said articles, and a scale outlet in said tank at said one end disposed below said liquid outlets.

4. Apparatus as defined in claim **3** in which said nozzles are disposed below said article supporting means.

5. Apparatus as defined in claim **3** in which the bottom of said tank is inclined downwardly toward said scale outlet.

References Cited by the Examiner

UNITED STATES PATENTS

87,507	12/1869	Paige	148—143
367,961	8/1887	Coffin	148—153
496,208	4/1893	Procuiner	148—156 X
1,919,136	7/1933	Smith	148—143 X
2,062,769	12/1936	Sprink	148—153 X
2,347,608	4/1944	Owen	134—134 X
2,542,940	2/1951	Pioch	148—156 X
2,609,826	9/1952	Marvin et al.	134—60
2,619,098	11/1952	Walters	134—64
2,928,401	3/1960	Finston	134—83 X

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