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(56) Related Art  
**US 4799533**

## Abstract

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### Chill Tube and Process for Resizing a Chill Tube

An outer circumferential groove (9) is provided spaced from the upper front side (3) of the tube wall (4) of the chill tube (1). U-shaped  
10 flanges (10) with inner locking ledges (11) engage the same [circumferential groove] from the opposite sides. The radial extent of the locking ledges (11) is smaller than the depth of the circumferential groove (9). Close to the upper front side (7) there is provided a  
15 circumferential shoulder (5) at which a reinforcing frame (6), which is adapted to be connected by screws with the flanges (10) and is supported at the flange (18) of the water tank (2), can be fixed in form-fitting and sealing fashion. When the chill tube (1) is resized, particularly by  
20 explosive forming, the wall thickness decreases so that thereafter the shoulder (5) must be touched up and only a new reinforcing frame (6) need be applied and joined with the flanges (20).

(Figure 3)

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**COMPLETE SPECIFICATION**

FOR A STANDARD PATENT

**ORIGINAL**

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Invention Title:	Chill Tube and Process for Resizing a Chill Tube

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

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## TUBULAR MOULD

### Background of the Invention

The present invention is directed to a tubular mould, which can be positionally fixed at a top end in a water tight manner within a water tank, as well as a method for recalibrating a tubular mould that has already been in use.

It is generally known that tubular moulds used for continuous casting are positionally fixed in an impervious manner in water tanks used for cooling. To withstand the high cooling-water pressures, the tubular moulds are reinforced at their upper ends, to enable them to retain their inherent stability. In this connection, it is generally known, especially when working with "beam-blank" or "dog-bone" moulds having a double T-shaped cross-section, to weld wedges (i.e., splines) into the mutually opposing outer channels at the upper ends, to provide tubular moulds of this kind with a substantially rectangular cross-section (as seen via a frontal view).

In recalibrating these types of tubular moulds, using the explosive reforming method (Accumould method), the use of welded-in wedges has proven, however, to be a hindrance during the reforming process. In addition, the welded seams sometimes tear apart, resulting in an imperfect seal. Furthermore, it became apparent that it was impossible or very difficult to recalibrate the original form at the upper end of the tubular moulds.

It is the object of the present invention to substantially overcome or at least ameliorate one or more of the disadvantages of the prior art.

### Summary of the Invention

Accordingly, the present invention provides a tubular mould having a top end that is positionally fixed in a water-tight manner within a watertank, comprising:

a tube wall having a top front end, the tube wall having a circumferential recess adjacent the top front end, and an outer peripheral groove having a depth, the groove being located at a distance from the top front end and circumferential recess of the tube wall;

a plurality of U-shaped flanges, the flanges having inner latching segments configured for gripping insertion into the peripheral groove, each of the inner latching segments having a radial extension smaller than the depth of the peripheral groove; and

a reinforcement frame at least partly located in the circumferential recess, the frame being screw-couplable and adjacent to the U-shaped flanges and bracing against

flanges of the water tank, the frame being locatable in position with an exact fit, while being sealed off from the tube wall, as well as from the flange of the water tank,

wherein the tube wall is thereby stabilized against pressures exerted by cooling water.

5 In the preferred embodiment, the outer peripheral groove has, a rectangular cross-section and is provided at a distance from the top front end of the tube wall of a tubular mould. Furthermore, a circumferential recess is formed adjacently to the top front end of the tubular mould. This recess is used to ensure that the reinforcement frame, which supports itself on the flange of the water tank as well, is sealingly located in  
10 position with an exact fit. The reinforcement frame is also sealed off from the water tank. Disposed underneath the reinforcement frame are two U-shaped flanges having inner latching segments, which grip from opposing sides into the peripheral groove on the tube wall.

The radial extension of the latching segments is smaller than the depth of the peripheral  
15 groove. Once the U-shaped flanges are positionally oriented with the aid of the latching segments in the peripheral groove, the reinforcement frame is slid onto the recess and then securely fastened by screws to the two U-shaped flanges. In this way, the top end of the tubular mould is provided with sufficient dimensional shape stability with respect to cooling-water pressures. This obviates the need for welding, thereby eliminating the  
20 danger of damage to the mould material.

If a tubular mould that has already been in use requires recalibration, one merely needs to remove the reinforcement frame and the U-shaped flanges. This makes it possible to restore the inner mould cavity, so that it meets the continuous casting requirements. Once the mould cavity has been restored, which, as a rule, is associated  
25 with a reduction in wall thickness at the top end of the tubular mould, the recess is merely reworked in conformance with the reduced wall thickness. A new reinforcement frame, adapted thereto, is then put in place and screwed to the remaining U-shaped flanges. These flanges can remain because the radial extent of the latching segments is smaller than the depth of the peripheral groove.

30 The fact that this calibration process can be repeated numerous times and that merely the appropriate reinforcement frames need to be provided is quite beneficial.

In accordance with a preferred specific embodiment, the inner rim of the reinforcement frame facing the deepest part of the recess is provided with a hollow recess to accommodate a sealing ring. This sealing ring is pressed into the corner region of the

recess when the reinforcement frame is screw-mounted on the U-shaped flanges, thereby ensuring the sealing action.

In another embodiment, the features of the invention may be applied to a tubular mould configured with a double-T shape, as is generally known, for example, in the form of a "beam-blank" or a "dog-bone" mould. It is also within the scope of this invention that it be applied with billet and bloom shapes.

All known methods can be used to restore the inner mould cavity of a tubular mould. Particularly preferable, however, is the explosive reforming method, in which a mandrel is introduced into the tubular mould. Once the inner mould cavity is restored, the recess at the top end of the tubular mould is advantageously reworked in a milling operation.

### Brief Description of the Drawings

A preferred form of the present invention will now be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a perspective view of the top end of a "beam-blank" tubular mould;

FIG. 2 is a perspective, exploded view of the top end of the tubular mould of FIG. 1 in an exploded view; and

FIG. 3 is an enlarged, vertically cross-sectioned view of the top end of the tubular mould of FIG. 1 shown in an installed state.

### Detailed Description of the Invention

In FIGS. 1 through 3, numeral 1 denotes a tubular mould made of copper and having a double T-shaped cross section. A tubular mould 1 of this kind is also referred to as a "beam-blank" mould.

To positionally fix (FIG. 3) a tubular mould 1 of this kind in an impervious and dimensionally stable manner in a water tank 2 (not shown in greater detail), a peripheral-side recess 5 having a rectangular cross-section is provided adjacent to the top front end 3 of tube wall 4. This recess 5 accommodates a reinforcement frame 6, whose top side 7 runs coplanar with the front end 3 of the tube wall 4. Reinforcement frame 6 has an essentially rectangular outer contour, with rounded corner regions 8. FIG. 2 shows reinforcement frame 6, flipped over by 180.degree.

Below recess 5, at a distance roughly corresponding to the vertical extension of recess 5, an outer peripheral groove 9 having a rectangular cross-section is provided in tube wall 4. Peripheral groove 9 accommodates inner latching segments 11 formed on

two U-shaped flanges 10. The radial extension of latching segments 11 is smaller than the depth of peripheral groove 9. Corner regions 12 of flanges 10 are also rounded.

Once latching segments 11 have been pushed into peripheral groove 9, reinforcement frame 6, together with sealing ring 15 embedded in groove 13 in the region of inner rim 14, is placed upon recess 5 and subsequently set tightly with flanges 10 by a plurality of screw bolts 16, extending along the contour of tubular mould 1.

Reinforcement frame 6 is underpinned by retaining plates 17, which are screw-coupled to water tank 2. A seal 21 at the flange 18 between reinforcement frame 6 and water tank 2 is used to seal off above-lying flange 18 of water tank 2.

10 In the embodiment shown in FIG. 3, a water cooling jacket 19 is employed.

Recalibrating a tubular mould 1 requires disassembling it, and then removing reinforcement frame 6, as well as flanges 10. Tubular mould 1 is then calibrated using the explosive reforming method by introducing a mandrel (not shown in greater detail) into mould cavity 20. This explosive reforming process reduces the thickness of tube wall 4 in the upper region. On the basis of this reduction, recess 5 is subsequently reworked accordingly, in particular, re-cut (i.e., re-milled). Peripheral groove 9 does not need to be reworked, since its depth is greater than the radial extension of latching segments 11. Once recess 5 is reworked, a new reinforcement frame 6, adapted thereto, is mounted and set tightly with flanges 10.

20 Given a roughly 0.7 mm reduction in wall thickness per calibration, a tubular mould 1 can be recalibrated about three times.

**The claims defining the invention are as follows:**

1. A tubular mould having a top end that is positionally fixed in a water-tight manner within a watertank, comprising:

5 a tube wall having a top front end, the tube wall having a circumferential recess adjacent the top front end, and an outer peripheral groove having a depth, the groove being located at a distance from the top front end and circumferential recess of the tube wall;

10 a plurality of U-shaped flanges, the flanges having inner latching segments configured for gripping insertion into the peripheral groove, each of the inner latching segments having a radial extension smaller than the depth of the peripheral groove; and

a reinforcement frame at least partly located in the circumferential recess, the frame being screw-couplable and adjacent to the U-shaped flanges and bracing against flanges of the water tank, the frame being locatable in position with an exact fit, while being sealed off from the tube wall, as well as from the flange of the water tank,

15 wherein the tube wall is thereby stabilized against pressures exerted by cooling water.

2. The tubular mould as recited in claim 1, wherein the reinforcement frame has an inner rim, part of which faces the groove and which is provided with a hollow recess to accommodate a sealing ring.

20 3. The tubular mould as recited in claim 1, wherein the mould has a double-T shape.

4. The tubular mould as recited in claim 2, wherein the mould has a double-T shape.

25 5. A tubular mould substantially as hereinbefore described with reference to the accompanying drawings.

**Dated 4 April, 2003**

**KM Europa Metal Aktiengesellschaft**

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**SPRUSON & FERGUSON**



Fig. 1

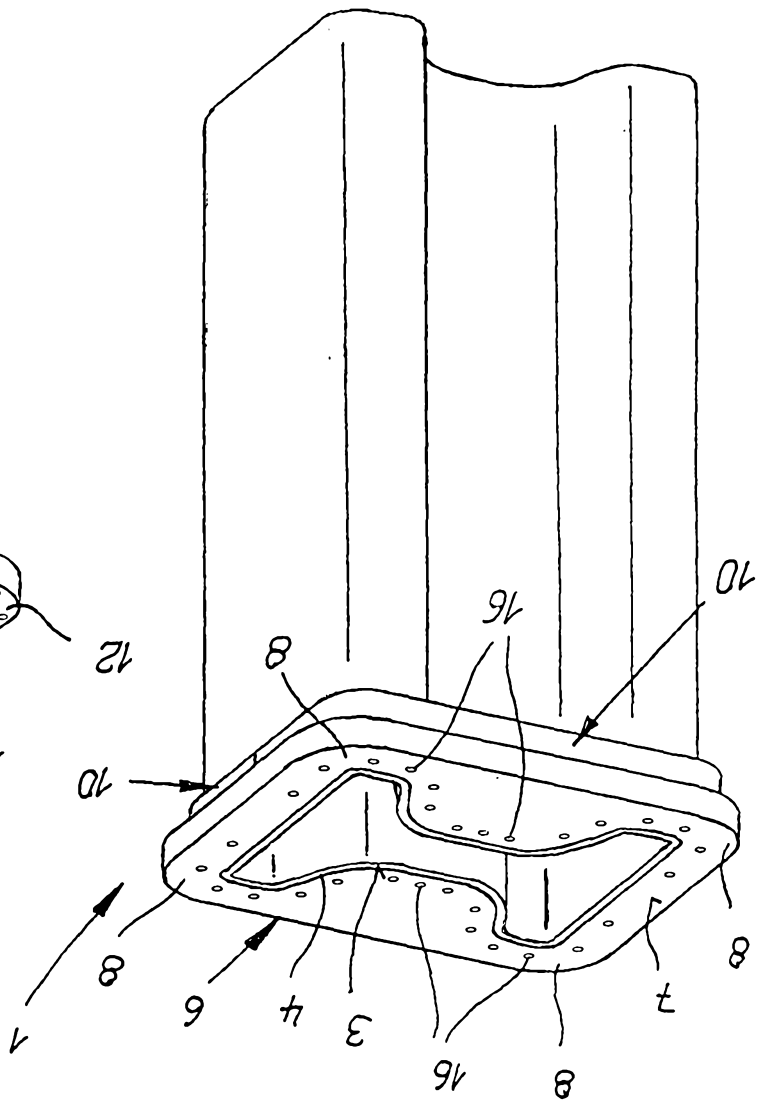


Fig. 2

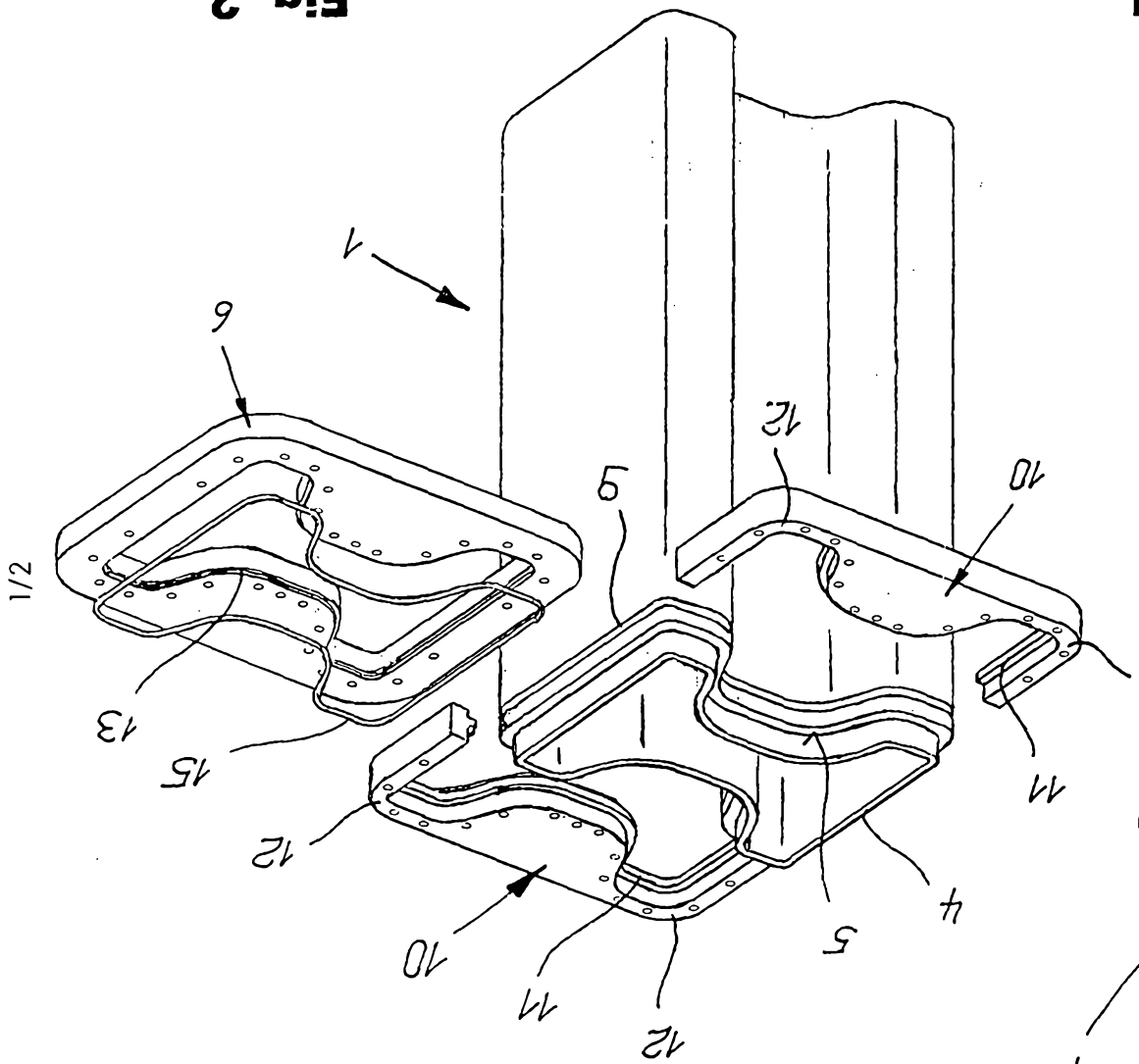


Fig. 3

