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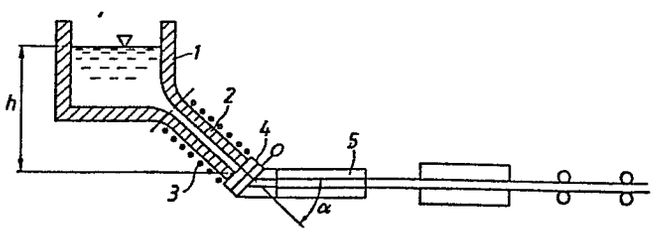
(54) **Metallurgical container.**

(57) Metallurgical container, such as a ladle, tundish, casting box or furnace, provided with a heating device comprising an inductive heating means. According to the invention said heating device (2) consists of a tube-like portion connected or connectable to the bottom or the lower portion of the side walls of the container. At least one valve (4), such as a sliding valve, is connected to the tube-like portion, and by means of an inductive heating coil (3) and/or an electromagnetic stirrer arranged in or around said tube-like portion the melt in the heating device can be subjected to stirring. The tube-like portion is preferably formed as an outlet part (2) of the container.

FIG. 1



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Metallurgical container

The invention relates to a metallurgical container according to the precharacterising part of claim 1. Such a container can be a ladle, tundish, casting box or furnace.

In horizontal continuous casting machines and also in other types of continuous casting machines, the mould is arranged so as to be connected to one side of the casting box. In order to be able rapidly to exchange moulds in the event of a disturbance, a sliding valve is mounted between the mould and the casting box and is normally fixed to the casting box. One problem in this connection is that upon start-up and in the case of long shutdown periods, the steel or other metal solidifies in front of the sliding valve, among other things because of heavy heat losses to the lining, which makes it impossible to start up or restart the casting process.

The casting box may sometimes be formed as a crucible furnace with the lowermost coil turns located below the outlet. However, also in such a design there is a risk of freezing at the end of the outlet.

The invention aims to provide a solution to the above-mentioned problems and other problems associated therewith and consists in a container according to the introductory part

of Claim 1, which is characterized by the features of the characterizing part of Claim 1.

Further developments of the invention are characterized by the features of the additional claims.

In other words, the heating device is extended to such an extent that an induction coil with the necessary power is able to surround the molten metal part, the so-called "tail", thus arising. Thus, the molten metal can be heated, and usually stirred, in the outlet part to prevent freezing therein.

In a preferred embodiment the heating device is positioned between the container and a valve, such as a sliding valve, and is formed as a tubular outlet part.

In a further embodiment, the valve is positioned between the heating device and the container.

The outlet part is suitably reinforced tangentially and/or radially, which is important, among other things, because of the great hydrostatic pressure which often prevails in the outlet part of the container.

The outlet part may be vertical, extending from the bottom of the container, or horizontal, or inclined, extending from the lower part of the ladle.

The advantages of the subject-matter of the invention can be summarized as follows:

1) The molten metal in the outlet part and near the sliding valve is prevented from solidifying (freezing) in the case of a shutdown of the casting operation, for example in the case of a mould replacement.

2) The possibility of self-circulation up to and into the container prevents local overheating.

3) It compensates for temperature drops in the case of long casting times.

4) The bottom portion of the container can be formed so as to be completely emptied after completed casting; no valuable residues will remain.

5) The level of the bath surface can be lowered, for example by reducing the volume (height) of the casing box, while maintaining the ferrostatic pressure in the mould (see in Figure 1 where h represents the ferrostatic pressure).

6) The proposed heater, as well as the lined cylinder, is easy to dismantle and replace, which means short breakdowns.

The inclination of the outlet part defined by the angle alpha in Figure 1 may vary. A desirable location is at the bottom of conventional casting ladles in order to obtain, in combination with a sliding valve, a reliable opening mechanism.

The invention will now be described in greater detail with reference to the accompanying drawings showing - by way of example - in

Figure 1 an embodiment of a container according to the invention with an inclined outlet part,

Figure 2 an embodiment of a container according to the invention with a horizontal outlet part,

Figure 3 a further embodiment of the invention.

Figure 1 shows a casting container in the form of a ladle, tundish or furnace 1 for continuous casting which is provided with an inclined outlet part 2 connected to the bottom of the container. The angle of inclination, alpha, may be set optionally at different values; h represents the ferrostatic pressure.

Around the outlet part 2, which is tubular, made of a refractory compound, and suitably reinforced tangentially and/or radially, there is arranged an induction coil 3. The induction coil 3 may also be made integral with the tubular outlet part 2. The reinforcement of the outlet part 2 may be made in accordance with EP-A-85 10 1148.6. This reinforcement is important in view of the considerable ferrostatic pressure.

The inclination of the channel with the heater, i.e. the outlet part 2, may vary. It is combined with a valve, for example a sliding valve 4. The outlet part 2 and the sliding valve 4 are connected to a device according to the SE-A-8505505-1 (EP-A-86 11 5969.7), comprising a horizontal casting mould 5. Around this mould 5 there is arranged at least one electromagnetic stirrer (not shown) developing at least one component of force in the casting direction in order to improve the casting structure.

Figure 2 shows a casting ladle 6 having a vertical outlet part 7. Also in this case the ladle may be designed in the same way as above (see Figure 1). The outlet part is formed with a surrounding or integral induction coil 8 around the tubular body 7 of a refractory material. The induction heater should not be mounted on the ladle 6 but at the casting station and in such a way that the "casting tail" of the ladle 6, when brought in proper position in relation to the induction heater, adopts a casting position. However, the

heater can also be made movable and be located around the "casting tail" afterwards.

Figure 3 shows a further embodiment of the invention, in which the sliding valve 9 is positioned between the heating device 10 and the ladle or tundish 11. The heating device comprises an inductive heating coil 12 and an electromagnetic stirrer 13 or a combined heating and stirring coil 12, fed from a single-phase and/or a multiphase current source. The device 10,12 is thus an inductive heater. The sliding valve 9 is connected to the ladle or tundish 11.

During heating the sliding valve 9 is opened and the melt in the ladle is communicating with the melt in the inductive heater 10. The stirring of the melt in the heating device, either from the stirrer 13 or from the combined coil 12, stirs the melt with such a strength and direction that metal flows via the sliding valve 9 into the ladle and vice versa.

The heater is connected to the bottom 14 or to the side wall of the ladle 11. At the other end of the heater there is a bottom 16 or a second slide valve 16. This valve can be opened for emptying the heater after a heating step or for emptying the whole ladle. The heater 10 may be made with one inductive heating coil 12 and a loose tube located therein. This tube may be laminated for obtaining strength and satisfactory electrical properties.

The lamination may be formed with an inner layer, which withstands the temperature of the melt and chemical actions, and with one or more intermediate layers for good thermal insulation, and an outer layer consisting of tangentially wound fibres, such as glass fibre, SIC fibre, or another fibre having low electrical conductivity.

The heating device 10,12 of Figure 3 is removable.

The afore-described embodiments of the invention may be varied in many ways within the scope of the claims.

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C L A I M S

1. Metallurgical container, such as a ladle, tundish, casting box or furnace, provided with a heating device comprising an inductive heating means, c h a r a c t e r i z e d in that said heating device (2) consists of a tube-like portion connected or connectable to the bottom or the lower portion of the side walls of the container, that at least one valve (4,9,16), such as a sliding valve, is connected to the tube-like portion, and that by means of an inductive heating coil (3,12) and/or at least one electromagnetic stirrer (13) arranged in or around said tube-like portion the melt in the heating device, at least close to the valve, can be subjected to stirring.

2. Metallurgical container according to claim 1, c h a r a c t e r i z e d in that said tube-like portion is formed as an outlet part (2,7) of the container.

3. Metallurgical container according to claim 1 or 2, c h a r a c t e r i z e d in that the of the heating device is positioned between the container and the valve (4,16).

4. Metallurgical container according to any of the preceding claims, c h a r a c t e r i z e d in that the tube-like portion consists of a tubular, refractory portion with an integral coil.

5. Metallurgical container according to any of the preceding claims, c h a r a c t e r i z e d in that the tube-like portion consists of a tubular, reinforced portion which is reinforced tangentially and/or axially.

6. Metallurgical container according to any of the preceding claims, c h a r a c t e r i z e d in that the tube-like portion is connected with its one end to the bottom or to

the lower part of one of the side walls of the container vertically, inclined or horizontally and with its other end to a casting machine.

7. Metallurgical container according to any of the preceding claims, c h a r a c t e r i z e d in that a valve (9) is positioned between the heating device and the container.

8. Metallurgical container according to claim 7, c h a r a c t e r i z e d in that the heating device is removable from the container (11) and the valve (9).

9. Metallurgical container according to claim 7 or 8, c h a r a c t e r i z e d in that at the outer end (16) of the heating device there is arranged a second valve (16), such as a sliding valve.

10. Metallurgical container according to any of the preceding claims, c h a r a c t e r i z e d in that the heating device is provided with a combined inductive heating and stirring coil (12), fed from a single-phase or multiphase current source.

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FIG. 1

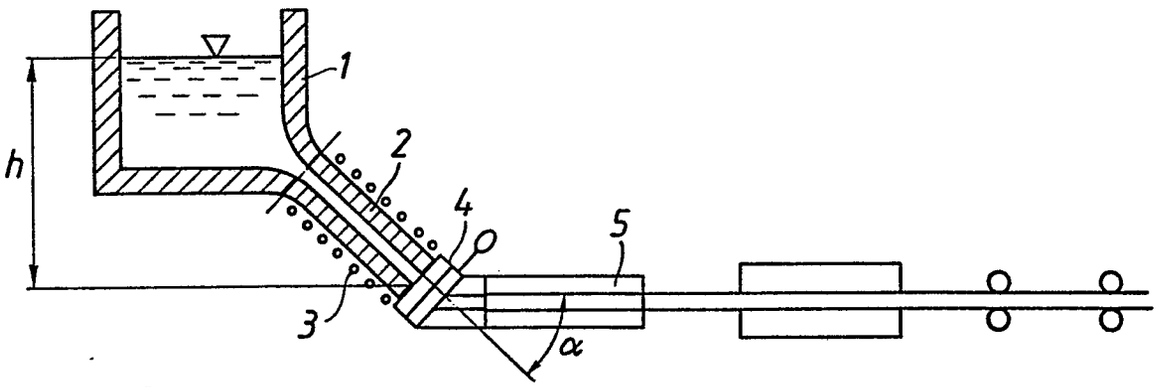

FIG. 2

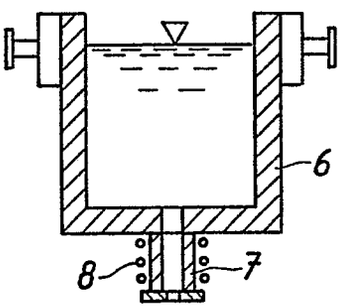

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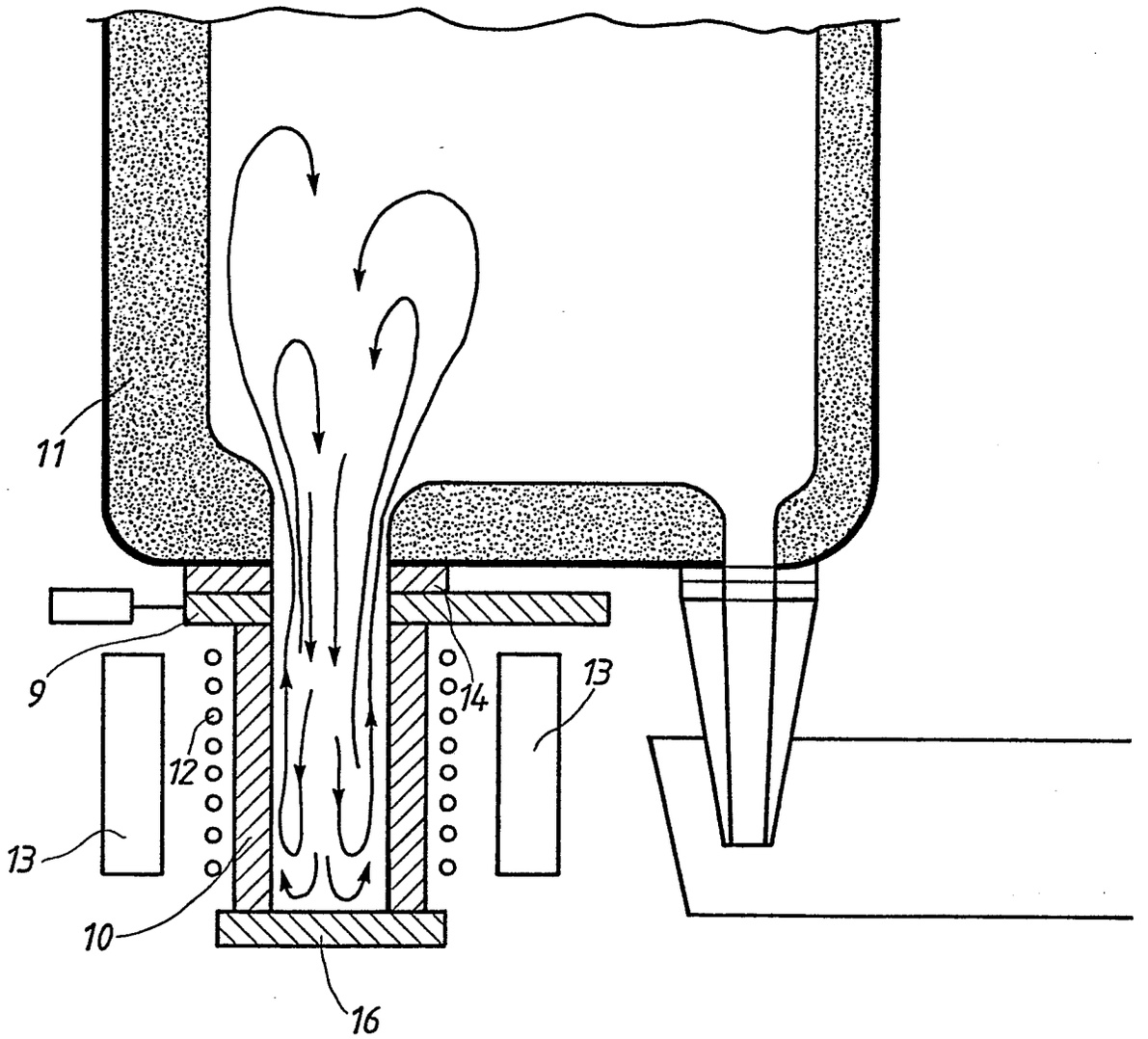
FIG. 3



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EUROPEAN SEARCH REPORT

Application number
EP 87 10 2704.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-A-1 049 547 (BOCHUMER VEREIN FÜR GUSSTAHL-FABRIKATION AG) *Column 1, line 49-column 2, line 39, figure*	1-3 10	B 22 D 11/10 B 22 D 41/00 F 27 D 11/06
X	CH-A-444 390 (INTERSTOP AG) *Figure 2, column 2, line 40-column 3, line 2*	1-4	
X	US-A-2 225 373 (N.P. COSS) *Figure 1, page 2, right column, lines 52-60*	1, 2, 6, 7	
X	US-A-4 243 092 (ASEA AB) *Figure, column 2, lines 63-68*	1-3, 7, 9	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
X	PATENT ABSTRACTS OF JAPAN; vol 5, no 10 (M-51); & JP-A-55-141 366 (SUMITOMO KINZOKU KOGYO K.K.) 05.11.1980	1, 2, 7	B 22 D F 27 B F 27 D H 05 B
X	PATENT ABSTRACTS OF JAPAN, vol 8, no 128 (M-302); & JP-A-59-30 468 (NIPPON KOKAN K.K.) 18.02.1984	1-3	
A	EP-A3-0 152 849 (ASEA AB) *Claims, figures 3, 4*	5	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
STOCKHOLM	14-05-1987	NYSTRÖM U.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
A	AT-A-246 441 (ASEA AB) *Whole Document* ------	8
A	PATENT ABSTRACTS OF JAPAN, vol 9, no 98 (M-375); & JP-A-59-223 149 (SHIN NIPPON SEITETSU K.K.) 14.12.1984	8

CLASSIFICATION OF THE APPLICATION (Int. Cl.4)

B 22 D 11/10
B 22 D 41/00
F 27 D 11/06

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 22 D
F 27 B
F 27 D
H 05 B