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METAL FLOW REGULATION

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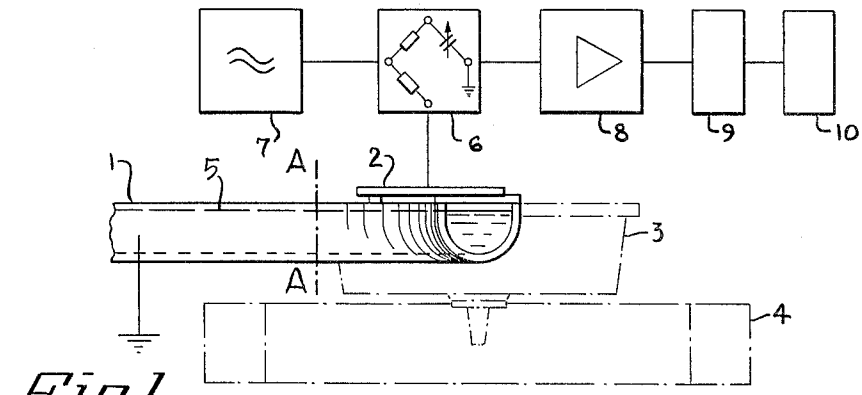

Fig 1

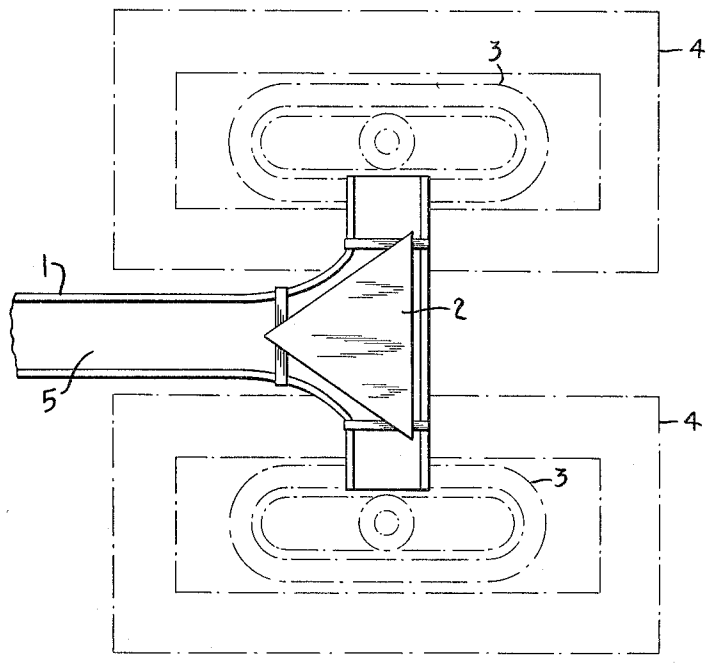

Fig 2

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METAL FLOW REGULATION

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3 Claims. (Cl. 22—79)

In conveying liquid metal from a melting or holding furnace into a tundish or a casting channel leading to a continuous casting apparatus it is very important with respect to the quality of the casting to maintain a constant metal flow and therefore to hold the metal level at a constant height in the tundish or the channel.

There are known different methods for maintaining constant the level of a metal melt in a tundish by means of swimming devices or dipping electrodes controlling the discharge of the metal supply container, for example by tilting. There are also known methods for maintaining constant the level of the molten metal in a continuous casting mold.

The principal object of the present invention is a method for maintaing the level of flowing liquid metal at a constant height, determining the height of the level by means of measuring an electrical capacity and regulating the metal flow as a function of the results of the capacity measurements.

A further object of the invention is an apparatus for carrying out the method of maintaining the level of flowing liquid metal at a constant height by means of measuring an electrical capacity.

According to the invention the electrical capacity is measured between an electrically conducting plate, called measuring plate, arranged in distance above and parallel to the metal level, and the surface of the metal melt. The measuring plate and the metal surface constitute a plate capacitor. The metal flow determining the height of the metal level is regulated in function of the results of the capacity measurements, advantageously by means of an automatic control device. For this purpose the mentioned capacitor is part of an alternating current measuring bridge which is connected to a source of high frequency alternating current and to a control device. The measuring bridge is of the kind of the known Wheatstone bridge. The control device controls the metal flow, preferably the mechanism for tilting the liquid metal supply container.

The method according to the invention is usable for all metals, also for the ferrous metals in spite of their high melting point. But it is especially suitable for melts of non-ferrous metals, especially melts of aluminum and aluminum alloys, magnesium and magnesium alloys.

The invention is further described by means of the accompanying drawing showing a continuous casting equipment for aluminum. The height of the metal level in the channel between a melting-furnace or a holding-furnace and the pouring gate above the continuous casting mold is to be determined and maintained at a constant height by regulating the tilting of the furnace and thus regulating the metal flow.

FIG. 1 is a side view of the equipment, not showing the pouring gate in front, and FIG. 2 is a plan view. FIG. 1 shows also schematically the connection of the measuring device and the control device.

The casting channel **1** consists of cast iron covered with a wash; it has an inside width at A—A of 6.5 cm., a depth of 5 cm. and a wall thickness of 0.8 to 1 cm. In a height of about 1 cm. above the edge of the channel at their bifurcation is placed the measuring plate **2** in form of a triangular iron sheet having a thickness of about 1 mm.

and a one side surface area of 180 cm.^{2}. An intermediate layer of a non-conducting material, for example asbestos, insulates the measuring plate from the channel and from the melt. **3** designates the two pouring gates and **4** the casting molds. The lowering speed of the castings in the molds is regulated to be constant by any known regulating device.

The plate capacitor, constituted by the measuring plate **2** and the metal surface **5** is part of the alternating current measuring bridge **6**, in which the variations of the capacity due to the fluctuations of the metal level are measured. The measuring bridge is energized by a source **7** of high frequency alternating current. The casting equipment and therefore the metal melt on the one hand and the measuring bridge on the other hand are earthed. The current flowing in the measuring bridge and corresponding to the variations of the capacity is magnified in the amplifier **8** and transformed in control pulses in the control device. The control pulses actuate the tilting mechanism of the furnace. The necessary voltage for the capacity measurement amounts to 4 to 6 volts and the current flowing in the measuring bridge is about 2.5 milliamperes.

The measuring plate **2** may consist of any material which is an electrical conductor, it is also possible to use a ceramic plate with a layer of evaporated metal. The width of the plate depends on their distance from the surface of the metal melt. The variations of the capacity due to the fluctuations of the metal level in the channel should amount to 3 to 5 picofarad (3 to 5.10^{-12} Farad). The frequency of the alternating current may lay within the range of 1 to 500 kHz.

What I claim is:

1. The method for maintaining the level of flowing liquid metal at a constant height, determining the height of the level by means of measuring the electrical capacity between an electrically conducting measuring plate arranged in distance above and parallel to the metal level, and the surface of the metal melt, and automatically regulating the metal flow in response to any change in the height of the level determined.

2. The method according to claim **1**, in which method the metal flow is regulated by actuating the tilting mechanism of a liquid metal supply container according to the results of the capacity measurements.

3. An apparatus for maintaining with the aid of a control device, at a constant height the level of liquid metal flowing in a channel structure supplied from a liquid metal supply container, said apparatus comprising an electrically conducting measuring plate arranged at a predetermined distance from said channel structure above and parallel to the upper surface of the liquid metal and forming with said surface an electric plate capacitor, said capacitor being part of an alternating current measuring bridge which is connected to a source of high frequency alternating current and to said control device operable for regulating the metal flow from said supply container to said channel structure.

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