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(54) METHOD OF AND APPARATUS FOR INDICATING THE END OF THE  
 CASTING OPERATION WHEN POURING METALS FROM CASTING VESSELS

(71) We, MANNESMANN AKTIENGESELLSHAFT, a German body corporate, of 4 Dusseldorf 1, Mannesmannufer 2, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of indicating the end of a casting operation when pouring metals, particularly when using an enclosed casting stream, from casting vessels having an outlet arranged at the bottom of the vessel, and an apparatus for carrying out this method.

When pouring metals from casting vessels having an outlet arranged in the bottom, without enclosure of the casting stream, it is possible for skilled operators to detect, by observing the colour of the casting stream, when the outlet of the ladle has to be closed at the transition from metal to slag, so that the slag is prevented from running out.

This is not always possible when attempting to protect the casting stream from reoxidation by the air oxygen by means of a refractory tube between the ladle outlet and the surface of the metal. When carrying out continuous casting using a sequence pouring process, that is to say when pouring a plurality of ladles in succession by means of the same distributing device, it is absolutely necessary to ensure that no slag or hardly any slag passes out of a ladle into the distributing vessel, since it particularly attacks the refractory materials in the distributing vessel and thus may disturb the further casting operation to a noticeable extent. Therefore it has been necessary when casting with an invisible casting stream to judge by the indications of weight given by the ladle balance of the casting crane. However, this indication is insufficiently precise. In order to ensure clean outflow, that is to say to prevent slag from passing from the ladle into the distributing vessel, it is necessary in every case to close the casting ladle prematurely. This results in a residue of metal remaining each time in the ladle

and being tipped along with the slag into the slag skip. 50

An aim of the present invention is to obviate the aforesaid disadvantages and to provide a method and an apparatus making it possible to carryout precise and objective monitoring of a casting operation using an enclosed or sheathed casting stream. 55

According to one aspect of the present invention, there is provided a method of indicating the end of a casting operation when pouring metals from a casting vessel with a bottom outlet, in which the intensity of the light radiation of the casting stream is detected immediately after issuing from the outlet by means of a light sensing element which is located at one end of a tube, the other end of the tube being situated in an immersion outlet at the level of the outflow of the casting stream, the variation in the intensity of the light radiation on transition from metal to slag indicating the end of the casting operation. 60

According to another aspect of the invention there is provided an apparatus for indicating the end of a casting operation when pouring metals from a casting vessel with a bottom outlet, the apparatus comprising an immersion outlet arranged to be removably attached to the bottom outlet and a tube, one end of which is located adjacent the immersion outlet at the level at which the casting stream issues from the bottom outlet and in the other end of which is located a light sensing element which is connected to a measuring apparatus and a signal transmitter. 65

The light sensing element may be an externally cooled phototransistor or photodiode. 70

An embodiment of the apparatus according to the present invention is shown in a diagrammatic manner in the accompanying drawing. 75

In this drawing, an immersion outlet 2 is removably attached by way of a seal to the bottom outlet of a ladle 1. A straight open end tube 3 is situated at right angles to the casting stream entering the immersion outlet 2 approximately at the level at which the casting stream issues from the ladle 1. 80

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The opening of the straight tube 3 remote from the immersion outlet 2 is closed with a plug 6 in which there is mounted a light sensing element 4 which responds to variations in the radiation intensity of the casting stream at the transition between metal and slag. 5

Because of the high standard of light sensitivity required it is advantageous to use a photodiode or a photo-transistor as the light sensing element. A photo-transistor is preferably connected in a collector-emitter circuit arrangement U including a differentiating amplifier 5. The action of light from the casting stream on the PN junction of a semiconductor in the transistor in the circuit produces pairs of charge carriers which represent a measure of the intensity of the casting stream and can be measured directly as a photoelectric voltage. 10 At the transition from metal to slag in the casting stream, the intensity of the casting stream is modified and therefore there is also a variation in the photoelectric voltage which is used as a signal for closing the ladle. 15 The semiconductor is cooled for example externally by compressed air, or by blowing an inert gas through the tube. The cooling operation can be controlled with suitable control elements. 20

Two examples will now be given of particularly clear indications of the variation in intensity of the casting stream at the transition between steel and slag: 25

1. The voltage obtained from the semiconductor is connected up to a differentiating amplifier. When the voltage is constant, which happens as long as the casting stream consists exclusively of steel, there is no voltage at the output of the differentiating amplifier. At the instant when the voltage at the amplifier input changes, because of a change in intensity in the casting stream at the transition between steel and slag, the speed of change of the input signal produces a voltage at the amplifier output which is used for controlling a "close ladle" signal. 30

2. A particularly simple method of obtaining a signal indicating that the casting operation should be ended is to connect the photoelectric voltage from the semi- 35 conductor, not to an amplifier, but to a suitable measuring recorder which is provided with adjustable measurement value limiting contacts. The measurement value range for the casting stream when composed of steel is limited by the adjustable contacts. At the transition from steel to slag the indication moves out of the preset measuring range and triggers a signal for the end of the casting operation. 40

WHAT WE CLAIM IS:—

1. A method of indicating the end of a casting operation when pouring metals from a casting vessel with a bottom outlet, in which the intensity of the light radiation of the casting stream is detected immediately after issuing from the outlet by means of a light sensing element which is located at one end of a tube, the other end of the tube being situated in an immersion outlet at the level of the outflow of the casting stream, the variation in the intensity of the light radiation on transition from metal to slag indicating the end of the casting operation. 45

2. An apparatus for indicating the end of a casting operation when pouring metals from a casting vessel with a bottom outlet, the apparatus comprising an immersion outlet arranged to be removably attached to the bottom outlet and a tube, one end of which is located adjacent the immersion outlet at the level at which the casting stream issues from the bottom outlet and in the other end of which is located a light sensing element which is connected to a measuring apparatus and a signal transmitter. 50

3. An apparatus as claimed in claim 2, wherein the light sensing element is an externally cooled phototransistor or photodiode. 55

4. A method of indicating the end of a casting operation when pouring metals, substantially as herein described with reference to the accompanying drawings. 60

5. An apparatus according to Claim 2, substantially as herein described with reference to the accompanying drawings. 65

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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of  
the Original on a reduced scale*

