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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 AKTIENGESELL-  
 SCHAFT, 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 per-  
 formed, 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 attempt-  
 ing 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 distri-  
 buting 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.

An aim of the present invention is to obvi-  
 ate 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.

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.

According to another aspect of the inven-  
 tion there is provided an apparatus for indi-  
 cating the end of a casting operation  
 when pouring metals from a casting vessel  
 with a bottom outlet, the apparatus compris-  
 ing an immersion outlet arranged to be re-  
 movably 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.

The light sensing element may be an exter-  
 nally cooled phototransistor or photodiode.

An embodiment of the apparatus according  
 to the present invention is shown in a diagram-  
 matic manner in the accompanying drawing.

In this drawing, an immersion outlet 2  
 is removeably 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.

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.

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. 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. 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.

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:

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.

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-

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.

#### 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.

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.

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

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

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

LLOYD WISE, TREGEAR & CO.  
Norman House 105—109 Strand,  
London, WC2R 0AE.

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COMPLETE SPECIFICATION

1 SHEET

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

