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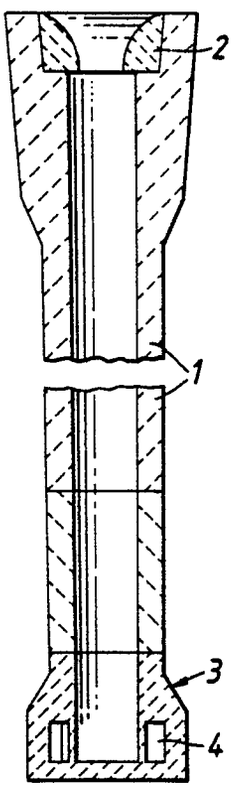
(54) Refractory pouring tube.

(57) A refractory tube (1) through which molten metal is poured into a continuous casting mould, the tube having its lower end sealed and a number of channels (4) extending laterally through the wall adjacent said end, the channels defining arcuate paths wherby to introduce a swirling motion to the metal issuing through the tube. The flow pattern promoted is tangential to the mould walls.

FIG. 3.



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REFRACTORY POURING TUBE

This invention relates to refractory tubes, commonly called pouring tubes or submerged entry nozzles, through which molten metal, e.g. steel, is poured into a continuous casting mould from a tundish or other melt-containing vessel.

In continuous casting moulds of small cross-sectional area e.g. for casting billets or blooms, the submerged entry nozzles employed are often simple plain vertical tubes but, at least in cases where argon injection is not employed, these suffer from the disadvantage of creating a flow pattern which, whilst quiescent near the mould surface, allow inclusions to be carried deep into the molten metal 'sump' where entrapment is likely with the consequent impairment of strand quality.

In order to alter the pattern of flow in the mould it is necessary to direct the flow out through the side walls of the submerged entry nozzle, but in moulds of small cross section this normally results in high velocity jets impinging on the thin solidifying shell of steel, a highly undesirable state of affairs which can lead to surface quality problems or even breakouts.

It is an object of this invention to provide an improved refractory pouring tube.

From one aspect the present invention provides a refractory tube through which molten metal is poured into a continuous casting mould, the tube having its lower end sealed and a plurality of channels extending laterally through the tube adjacent said end, the channels defining arcuate paths whereby to introduce a swirling motion to the metal issuing therefrom.

In accordance with this invention then the flow pattern promoted is tangential to the mould walls. Thus, bearing in mind the common provision of electromagnetic stirring to generate this pattern this technique may be used to reduce or even eliminate the need for electromagnetic stirring systems; this is a major financial saving.

In order that the invention may be fully understood, one embodiment thereof will now be described with reference to the accompanying drawings in which:-

Figure 1 is an axial section of a refractory pouring tube according to this invention;

Figure 2 is a cross-section on A - A in Figure 1;

Figure 3 is a 'segmental' axial section on B - B in Figure 2; and

Figures 4 (a) and 4 (b) illustrate the tangential flow patterns at the channel exits.

Referring now to Figures 1 to 3 the tube comprises an elongated body section 1 having a high integrity insert 2 at its upper end and a nozzle section 3 at its lower end. This nozzle, which in this example is made as a separate part, has a closed bottom but incorporates three channels 4 which extend laterally through the wall of this nozzle and define arcuate paths. This is seen more clearly in Figure 2 which is a section through the nozzle.

Typically, with a tube of say 1000mm length, 100mm diameter, and 55mm bore the nozzle may have an external diameter of 140mm, the channel walls being say 18mm thick, the 'port' or channel height being 35mm and width 15mm.

Figures 4 (a) and 4 (b) show the tangential flow pattern produced.

Typically, with a casting speed of say 0.45m/min, a mould diameter of 400mm and the pouring tube immersed to a depth of 120mm the angular velocity of the molten steel within the mould is of the order of 0.70 rads/sec giving a mean velocity at the wall of about 13 cms/sec. This compares favourably with say, 15 to 30 cms/sec obtained with electromagnetic stirring bearing in mind the potential for increasing the tangential velocity with this development by reducing the port apertures.

Similar velocities may readily be achieved with square moulds.

Although this invention has been described with reference to the particular embodiment illustrated it is to be understood that various modifications may readily be made without departing from the scope of this invention. For example more than three arcuate channels may be provided and they may be at the same or different levels with all or some directed upwardly or downwardly; the shape and dimensions of same may also be modified to secure the most efficient flow patterns.

Claims

1. A refractory tube through which molten metal is poured into a continuous casting mould, the tube having its lower end sealed and a plurality of channels extending laterally through the tube adjacent said end, characterised by the channels (4) defining arcuate paths whereby to induce a swirling motion to the molten metal issuing therefrom.

2. A tube according to claim 1, characterised by three channels adjacent said end, equidistantly spaced circumferentially and lying in a common plane normal to the axis of the tube.

3. A tube according to claim 1 or claim 2, characterised in that the outer side of each channel is defined by a protruding wall (3) such that the plane of the orifice of each channel lies substantially radially of the tube, whereby the molten metal issuing therefrom follows an unobstructed path tangential to said walls.

4. A tube according to any one of claims 1 to 3, characterised in that the channels extend from a circular section bore of substantially constant diameter throughout its length.

5. A tube according to any one of claims 1 to 4, characterised in that at least that part of the tube defining the channels is made as a separate section of said tube.

FIG.1.

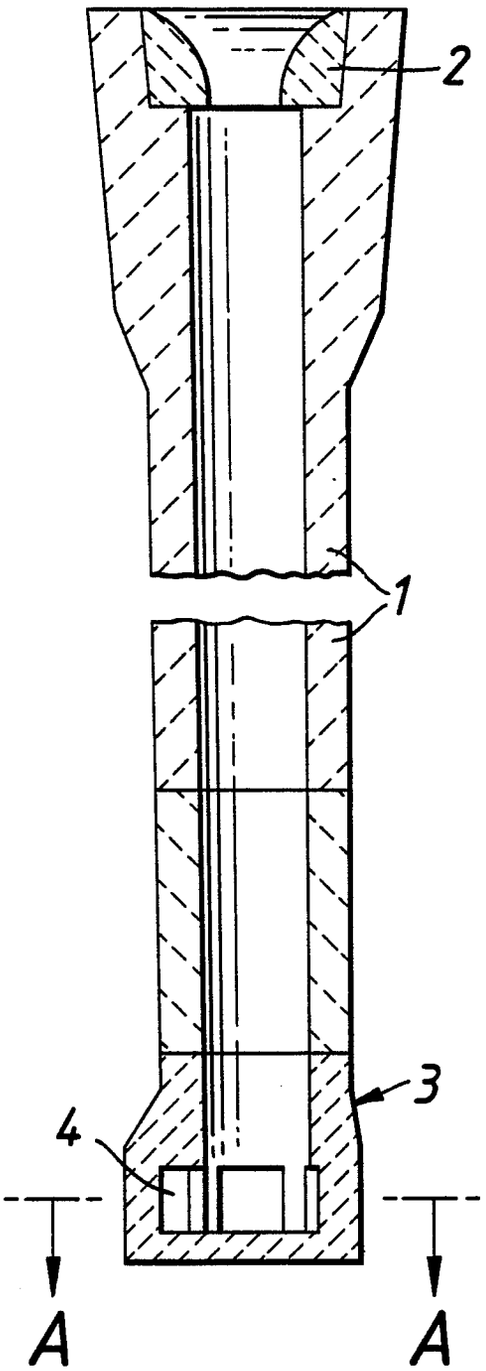

FIG.3.

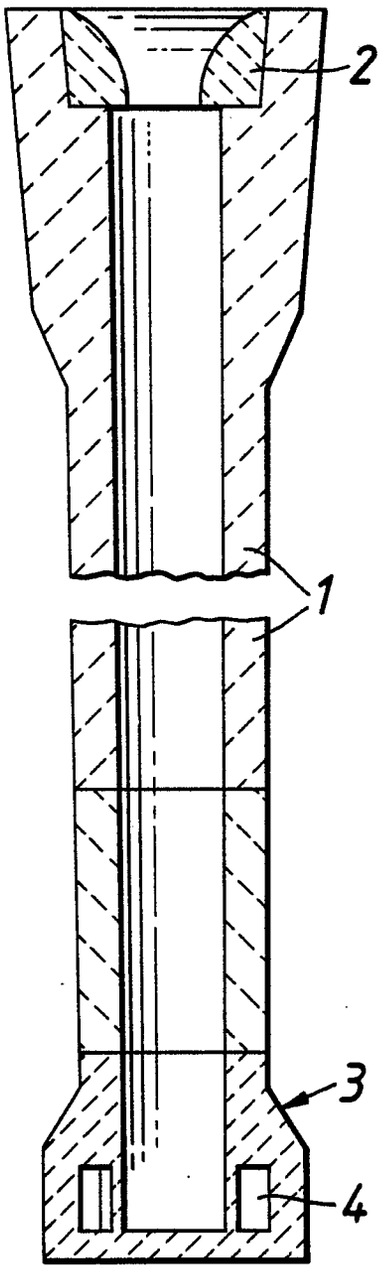

FIG. 2.

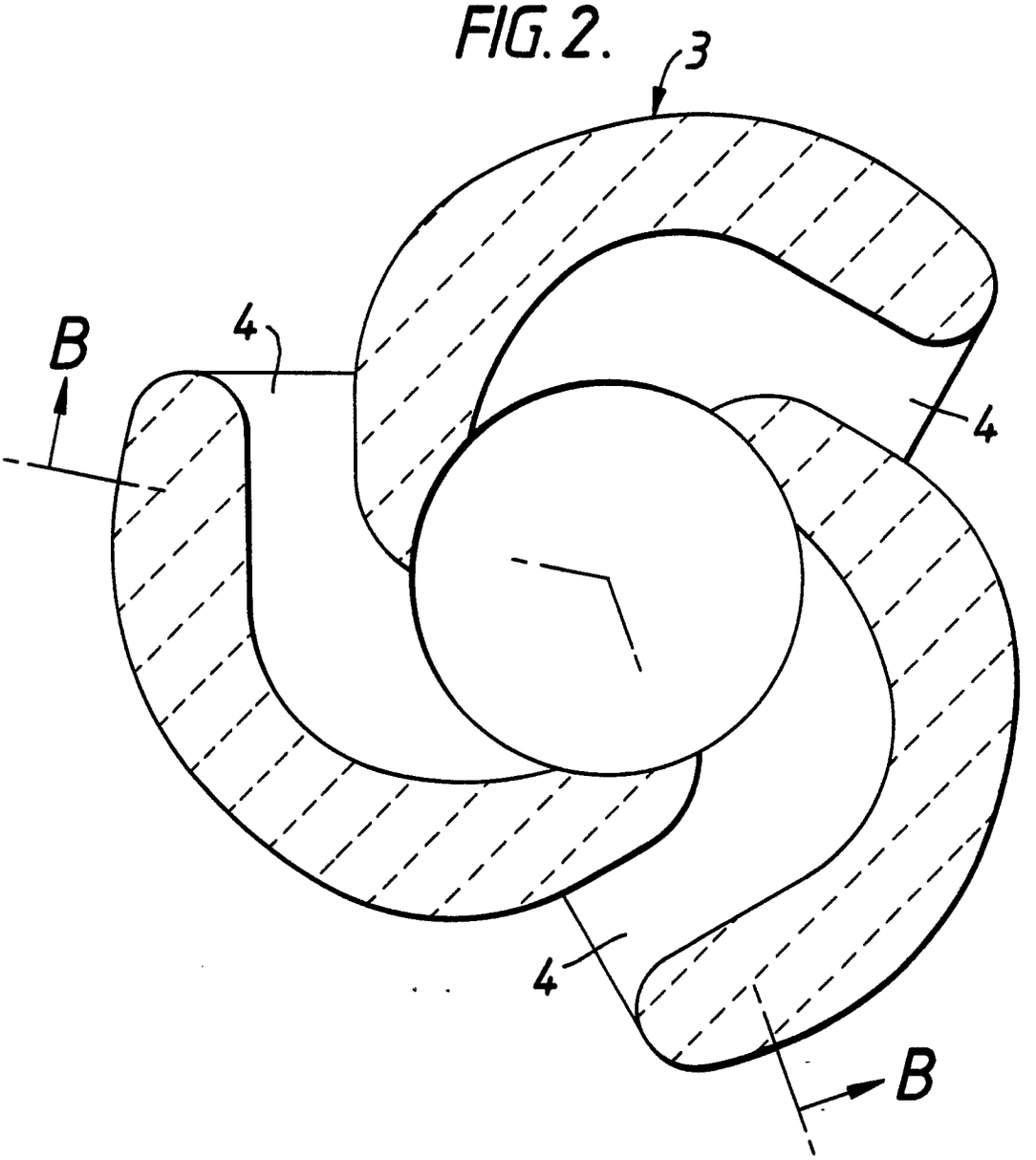

FIG. 4a.

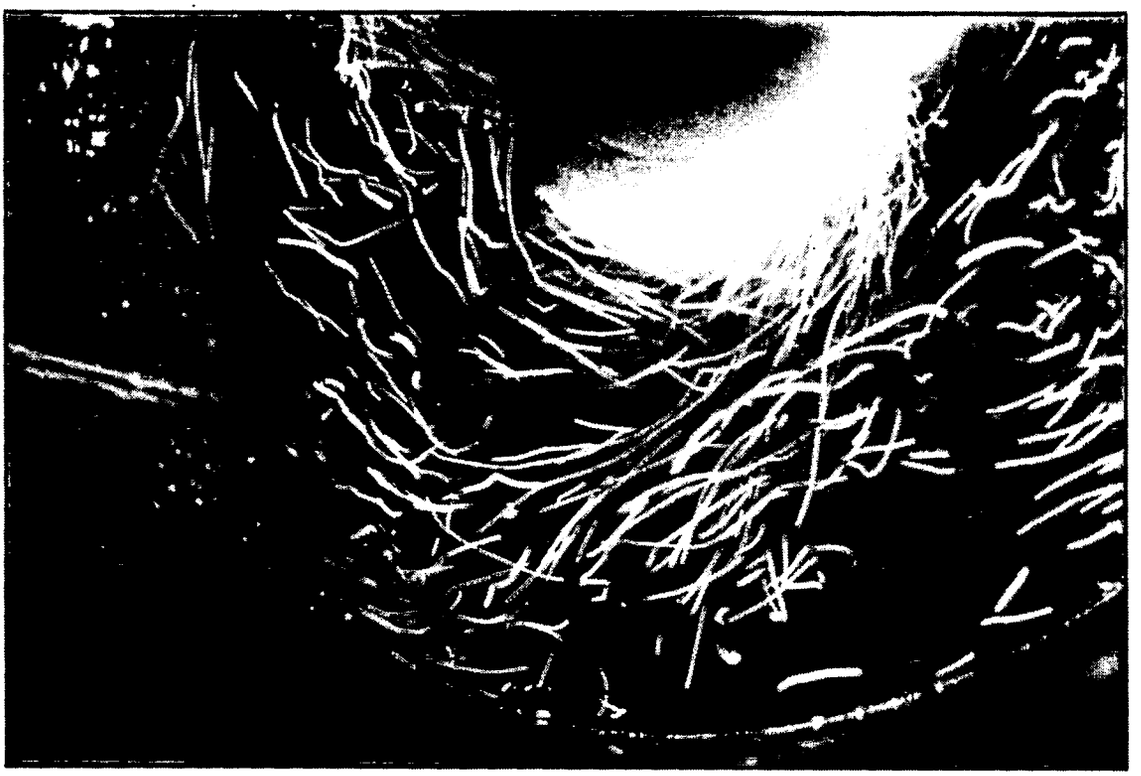

FIG. 4b.

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EUROPEAN SEARCH REPORT

Application Number

EP 87 11 5007

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-B-1 055 186 (VEREINIGTE DEUTSCHE METALLWERKE) * Figures 1,7,8; column 4, lines 8-49 *	1-5	B 22 D 11/10
A	FR-A-2 420 385 (FIVES-CAIL BABCOCK)		
A	DE-A-1 809 934 (DEMAG A.G.)		
A	FR-A-2 099 705 (MANNESMANN AG)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 22 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23-12-1987	MAILLIARD A.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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