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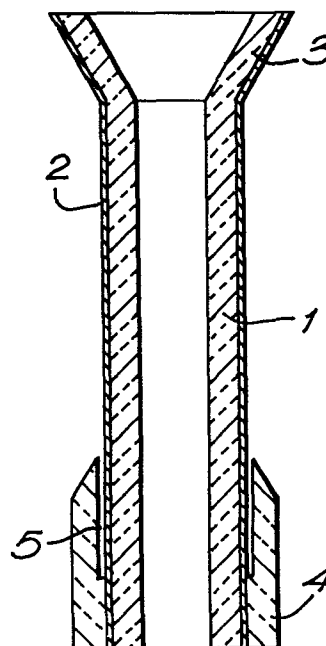
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⑤④ **Pouring tubes.**

⑤⑦ The pouring tube comprises a tubular structure (1, 6) formed from refractory, heat-insulating material encased by a sheet metal casing (2, 7). The metal casing (2, 7) is protected from attack by molten metal and/or accompanying slag by a protective sleeve (4, 9). The sleeve (4, 9) and the casing (2, 7) are located in a spaced apart relationship over at least a part of the length of the sleeve to allow for expansion of the tube without fracture of the sleeve.



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POURING TUBES

This invention relates to pouring tubes for use in the casting of molten metal.

The invention is particularly suited to the continuous casting of metals, particularly in the case of tubes for use between a ladle and a tundish, for which the invention is now more specifically described below. However, it should be appreciated that the invention is not confined to use in continuous casting as it may be used in other enclosed molten metal pouring systems.

In continuous casting, molten metal e.g. steel is passed from a ladle into a tundish which serves to maintain a constant head of molten metal. The metal flows out from the base of the tundish through one or more nozzles into one or more continuous casting moulds. The quality of the cast metal, withdrawn from the base of the mould as a strand for subsequent use as billets, blooms or slabs, can be adversely affected by oxide and other non-metallic inclusions which may be entrained if the molten metal stream is not

protected adequately as it flows between the ladle and the mould or moulds.

A number of proposals have been suggested in which the stream of molten metal flowing from the base of a ladle is surrounded by a ladle stream protection tube i.e. a pouring tube. Use of the tube minimises the deleterious oxidation effects of atmospheric oxygen on the molten metal, serves as a heat shield, thereby protecting operatives working near the stream of molten metal from radiant heat, noxious fumes and any sparks or stray molten metal droplets that may arise from unshielded streams.

Moreover, inert gas e.g. argon can be passed through the tube around the molten metal stream thereby enhancing the minimisation of access by atmospheric oxygen and nitrogen to the stream.

Pouring tubes may be formed from highly refractory materials such as graphitised alumina, fused silica, or zirconia but these are very

costly to produce and consequently for economic reasons their use cannot always be justified.

Alternatively, pouring tubes have been proposed which comprise a tubular structure
5 formed of refractory, heat-insulating material in the form of a tube encased by thin sheet metal e.g. steel. These pouring tubes, albeit expendable i.e. they have a limited useful service life expectancy, still possess several advantages
10 not least their initial low cost, ease of manufacture and low-density which contributes to easier handling during installation and removal after casting. The outer casing may be provided with a close fitting protective sleeve of heat-
15 insulating material located over that portion of the tube which in use is contacted by the molten metal and/or slag held in a tundish.

The improved heat-insulating properties and low density of the expendable tubes compared
20 with the highly refractory tubes considerably reduces the amount of heat radiated to the surroundings and, accordingly, the degree of super-heat applied to the molten metal in the ladle

may be reduced.

The outer protective sleeve is generally located at the lower end of a pouring tube and extends upwards for a sufficient length so as to project at least 50 mm above the anticipated level of the upper surface of the molten metal held in a tundish.

This sleeve protects the pouring tube from slag attack and the metal casing from premature melting. Without the protective sleeve the metal casing will melt not only below the surface of the molten metal in the tundish but also for a distance of say about 15 to 30 mm above the slag/metal surface. Furthermore the metal casing may melt before sufficient sintering of the refractory, heat-insulating material of the pouring tube has occurred to strengthen it, with the result that the tube will be weak and exhibit a tendency to fracture. If fortuitously the tube remains intact, the absence of the casing above the molten metal will permit the ingress of air due to the porous nature of the refractory, heat-insulating tube portion which

completely negates a most important function of the pouring tube i.e. to protect the molten metal stream from atmospheric oxidation.

However, it has been observed that the protective sleeve may fail in service due to premature cracking. The cracking generally extends substantially along the length of the sleeve and tends to occur within 30 to 40 minutes of commencement of casting e.g. during the time taken to cast one ladle of molten steel. Once the sleeve has cracked the molten metal/slag attacks the metal casing and may cause the entire pouring tube to fail.

According to the present invention there is provided a pouring tube assembly for use in the casting of molten metal which comprises a refractory, heat-insulating tube portion encased by a sheet metal casing, the casing having over at least part of its length a protective heat-insulating sleeve thereon, the protective sleeve and the metal casing being spaced apart over at least a part of the length of the sleeve.

The space between the sleeve and the metal casing is preferably upto 2 mm, and is preferably within that part of the sleeve which is uppermost in use. The protective sleeve may
5 be in contact with the metal casing for at least a part of the length of the casing.

The protective sleeve may be formed by the well-known slurry methods from a mixture of refractory filler material, fibrous material and
10 binders. The preferred refractory filler material may be selected from one or more of alumina, calcined magnesite, silica, chamotte, olivine, zircon, chromite, calcined bauxite or other oxides and silicates. The fibrous material
15 is preferably one or more of calcium silicate fibre, aluminosilicate fibre, rockwool or slag wool. The binder is preferably an organic binder e.g. a synthetic resin binder such as phenol-formaldehyde resin, urea-formaldehyde
20 resin or mixtures of these. The sleeve may be formed such that it is more refractory at the zone where it is contacted by molten slag in use in a tundish.

The protective sleeve may have a dressing of refractory paint or like coating to resist the erosive and/or chemical attack from the molten metal and accompanying slag held in the tundish.

5 The space between the protective sleeve and the metal casing may be filled with a preformed compressible gasket or sleeve formed of e.g. a highly fibrous very low density material such as calcium silicate fibre, aluminosilicate fibre,
10 rockwool, slag wool or glass fibre. Optionally, one or more low density fillers such as expanded perlite, expanded vermiculite, or calcined rice husks may be used with or without a binding agent.

 Alternatively, the protective sleeve may
15 be formed at least in part as a duplex structure so as to include the compressible gasket or sleeve as the innermost layer of the structure. Other variants include wrapping at least part of the metal casing with heat-insulating tape or blanket
20 prior to the addition of the sleeve or loosely tamping a fibre filler into the space between the sleeve and the casing after the protective sleeve has been located on the pouring tube.

The invention is further described with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a section through a
5 parallel sided, pouring tube (having a flared top portion) of the invention and

Figure 2 is a section through a tapered pouring tube of the invention in which the protective sleeve has a duplex construction.

10 Referring to Figure 1 a pouring tube comprises a refractory, heat-insulating material tube 1 encased over its length by a mild steel casing 2. The pouring tube has a flared upper end 3, to mate with the outlet from a metallurgical
15 vessel (not shown). A heat-insulating protective sleeve 4 is located around the metal casing in a spaced apart relationship over part 5 of the length of the sleeve.

Referring to Figure 2, a tapered pouring
20 tube comprises a refractory, heat-insulating material tube 6 encased over its length by a

mild steel casing 7. The tube has a plain upper
end 8 to locate with the outlet from a ladle
(not shown). A heat-insulating protective sleeve
9 is located around the metal casing in a spaced
5 apart relationship over the length of the sleeve
by means of the inner compressible alumino-
silicate fibre layer 10.

A pouring tube according to the present
invention was used to continuously cast a low-
10 carbon fully aluminium-killed steel at a temperature
of 1550°C for a duration of 4 hours. At the end
of the casting sequence no significant deterioration
of the pouring tube was evident and the outside
surface of the immersed portion of the tube
15 exhibited minimum erosion indicating that the tube
of the present invention would have been capable
of withstanding an even longer duration continuous
casting sequence.

CLAIMS

1. A pouring tube for use in the casting of molten metal consists of a refractory, heat-insulating tube portion (1, 6) encased by a sheet metal casing (2, 7), the casing having over at least part of its length a protective heat-insulating sleeve (4, 9) characterised in that the protective sleeve (4, 9) and the metal casing (2, 7) are spaced apart over at least a part of the length of the sleeve.

2. A pouring tube according to claim 1 characterised in that over at least a part of its length the protective sleeve (4) is in contact with the metal casing (2).

3. A pouring tube according to either of claim 1 or claim 2 characterised in that the protective sleeve (4, 9) is slurry-formed from a mixture comprising refractory filler material, fibrous material and binder.

4. A pouring tube according to any preceding claim characterised in that the protective sleeve (4, 9) has a zone which in use is to be contacted by

molten slag and which is more refractory than the remainder of the protective sleeve (4, 9).

5. A pouring tube according to any preceding claim characterised in that the protective sleeve (4, 9) has a coating of refractory paint.

6. A pouring tube according to any preceding claim characterised in that the space between the protective sleeve (4, 9) and metal casing (2, 7) is filled with a preformed compressible gasket or sleeve.

7. A pouring tube according to claim 6 characterised in that the compressible gasket or sleeve is formed from one or more of calcium silicate fibre, aluminosilicate fibre, rockwool, slag wool or glass fibre.

8. A pouring tube according to either claim 6 or claim 7 characterised in that the compressible gasket or sleeve contains a proportion of low density filler selected from one or more of expanded perlite, expanded vermiculite or calcined rice husks.

9. A pouring tube according to any of claims 6 to 8 characterised in that the protective sleeve (4, 9) and the compressible gasket or sleeve are integral.

10. A pouring tube according to any of claims 1 to 5 characterised in that the space between the protective sleeve (4, 9) and metal casing (2, 7) is filled with a heat-insulating tape or blanket wrapped around the metal casing.

11. A pouring tube according to claim 2 characterised in that the space between the protective sleeve (4) and metal casing (2) is filled with loosely tamped fibres.

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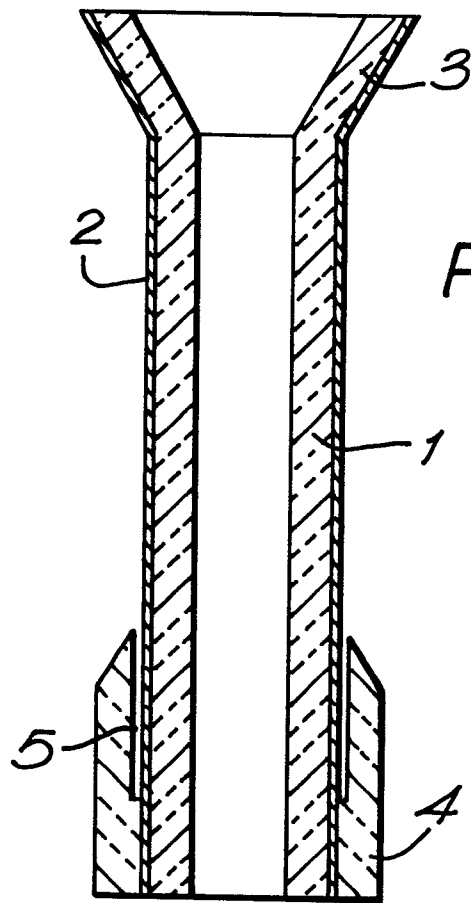


FIG. 1.

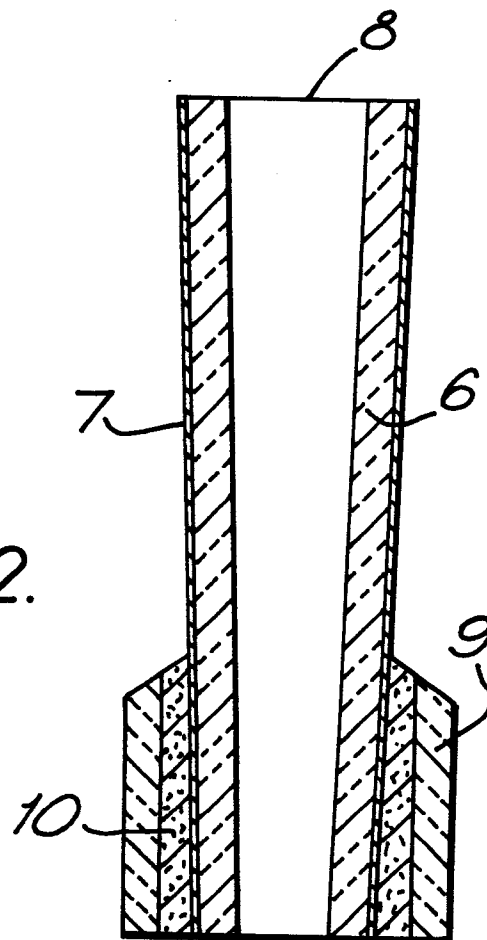


FIG. 2.



European Patent
Office

EUROPEAN SEARCH REPORT

0178053

Application number

EP 85 30 5872

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)
A	FR-A-1 493 389 (V.S. STEEL CORP.)		B 22 D 11/10

A	WO-A-8 201 836 (DAUSSAN)		

A	BE-A- 679 008 (U.S. STEEL)		

A	EP-A-0 102 292 (DAUSSAN)		

A	FR-A-2 285 946 (DIDIER-WERKE)		

			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			B 22 D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 13-12-1985	Examiner MAILLIARD A.M.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			