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PATENTANWALTE

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MANDATAIRES EN BREVETS EUROPÉENS

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Casting system

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The present invention concerns a casting system for continuous strip casting of metals and more specifically a nozzle package in this system which comprises an extruded nozzle holder and a precast nozzle in refractory material.

Today the casting of wide strips of different aluminium alloys on such casting machines as described e.g. in U.S. Patent No. 3.405.757 is limited due to the difficulties in achieving appropriate product quality with regard to surface quality and internal structure.

Several factors influence the strip quality. The most important ones include uniform, controlled feed of metal to the cylinders, casting temperature control, material and pressure distribution across the casting nozzles and nozzle quality. The final result depends on optimization and interaction at all stages of the total casting system, but nozzle design and quality seem to be crucial.

As regards nozzle materials, there are a number of requirements that must be fulfilled. They must be thermostable, homogeneous and free from stress after machining, heat insulating (low thermal conductivity), hard-wearing and at the same time machinable to exact dimensional tolerances, inert to the cast metal, they must not contain any components that are dangerous to health, they must be reasonably priced, they must have low weight and low hygroscopicity, etc.

A well-known and hitherto widely used fireproof, ceramics-like material sold under the name Marinite, in the form of compressed sheets with a hard surface, has now been abandoned for many applications because of its asbestos content and its relatively high hygroscopicity.

A common feature of the new replacement materials that have gradually appeared is their relatively poor mechanical strength. This results in heavy wear and, consequently, short nozzle life, and further problems of maintaining a uniform strip quality.

A material that is gaining more and more popularity within casting technology is based on aluminium-silicates (45-50%  $\text{Al}_2\text{O}_3$ ) and 45-55%  $\text{Si O}_2$ ) and marketed under various names, e.g. under the name Triton Kaowool from the firm Morganite Ceramic Fibres Ltd. Here, too, the drawback is poorer mechanical strength than marinite, which results in the above problems regarding quality and short nozzle life.

Another problem in connection with strip casting is that the known strip casting machines represent a high degree of complexity, heavy, complicated designs requiring a lot of time in connection with replacement of nozzles and starting up the strip casting process. In strip casting the economy of the process depends on a minimum of down time periods and quick achievement of uniform product quality after starting up the process. Heavy nozzle holders comprising welded steel plates amounting to several hundred kilograms in weight also requires a larger operating crew on the strip cast machines, as well as capital investment in and maintenance of special equipment needed for assembling/disassembling of nozzles.

The object of the present invention is to provide a flexible, simple and easy casting system which minimalizes the disassembling and replacement time, reduces the required number

of operators on the strip cast machines and at the same time increases the stand time of the nozzles. A further object of the invention is to provide a casting system which results in a low-energy and high performance casting process at a lower rejection grade.

These and other objects and advantages are achieved by means of a device according to the invention, the new and unique features of which will be described in more detail in the following specification and patent claims.

The invention will now be described in detail assisted by drawings, Figs. 1-2, where

Fig. 1 shows a perspective view of a horizontal strip casting machine with auxiliary equipment for feeding molten metal, and

Fig. 2 shows in more detail the nozzle with nozzle holder in a vertical cross-section.

The continuous casting unit, as shown in Fig. 1, comprises a transfer gutter (1) between a holding furnace (not shown in the figure) and a buffer crucible (2), a fireproof, lined gutter (3) that leads the molten metal to a metal levelling box (4), and further a distributor box (5) and feed channel (6) connected to the nozzle (7) that discharges into the cavity formed between the two rotating cylinders (8). Solidified metal is shown behind the cylinders as a (pre)rolled strip.

The metal from the holding furnace, e.g. aluminium or its alloys, is fed through a fireproof, lined gutter (1) to the crucible (2), shown in the cross-section in the figure as resistance heated, two-chamber crucible, that represents a metal buffer in the casting system. This function is often

combined with refining/purification and/or degassing of the metal at this stage. The crucible is further provided with a temperature regulator (not shown in the figure) which is coupled to a heating device in order to ensure exact cast metal temperature control. A combination of fine temperature adjustment at this stage and extra-insulated metal gutters results in a low-energy casting process.

The treated metal is supplied in desired volume and at adjusted temperature to the levelling box (4) where the fine adjustment of the further metal flow takes place (adjustment equipment not shown in the figure). The casting equipment itself includes the distributor box (5), the feed channel (6) and the nozzle (7) which is designed and dimensioned to achieve utmost uniformity in filling of the mould cavity between the cylinders (8) with uniform pressure and temperature distribution across the full width of the nozzle.

The nozzle (7) as shown in Fig. 2 comprises two symmetric exterior walls (71,72) with narrowed/inclined contour facing the cylinders (8) which is in conformity with the contour of the cylinders. The exterior walls have been precast with all essential details, such as integrated spacer and deflector plate for uniform distribution of metal along the nozzle, in "Triton Kaowool" and with the surfaces of the inclined sections finely machined to exact tolerances. This special design of the nozzle is disclosed in a co-pending patent application claiming priority from Norwegian Patent Application No. 83.3086

In all essential aspects except for mechanical strength the material employed is superior to the Marinite hitherto used. "Triton Kaowool" is first and foremost less hygroscopic than Marinite, which eliminates special nozzle drying and storage in cabinet drier prior to installation and all special

measures that had previously to be taken during start-up of the casting process. Furthermore, this material has better insulating characteristics, i.e. reduces thermal loss, and this further adds to the low-energy profile of the casting process. In addition, "Triton Kaowool" contains absolutely no asbestos fibre, and consequently it satisfies the heavy demands for occupational hygiene.

As regards poorer resistance to wear from the cylinders, which has so far been an effective obstacle to widespread use of this material in nozzles for continuous strip casting, it has been found that an appropriate surface treatment of the conical nozzle sections provides effective protection and increases nozzle life considerably.

Fig. 2 shows a vertical cross-section through the nozzle (7) placed in a nozzle holder (12). The nozzle holder is extruded with all the essential construction details and standard tolerances in hardened aluminium alloy and cut down in suitable lengths. The surface of the extruded nozzle holder exhibits such a quality that all machining and/or surface treatment is redundant. In order to complete the nozzle holder holes are merely bored and threaded to house the screws (13) which are applied to clamp (fasthold) the casting nozzle in the holder by means of a complementarily designed fastening wedge (15). The fastening wedge is also extruded in hardened aluminium alloy and both these low-weight components, 11.6 and 2.7 kg per m of extruded length, respectively, represent a weight reduction of 80% compared to the known steel-based equipments. Furthermore, providing the nozzle holder in aluminium alloy offers an advantage. The broken/used holders are directly returned to the casting shop for remelting, and in this way the price of the nozzle holder is further reduced.

Application of the "ready to use" extruded nozzle holder in hardened aluminium alloy according to the present invention represents the following advantages with regard to the known prior art:

- a) Considerably lower price per nozzle holder makes it possible to keep several already assembled nozzles with holders in different required sizes (widths) in the casting shop so that the nozzle exchange time is minimalized.
- b) There is no need for special accessory equipment like cranes, lifting tables etc. to assist with the nozzle exchange, which means lower capital, operational and maintenance costs.
- c) Because of the weight reduction the whole assembly nozzle/nozzle holder can easily be handled by a single man - possible reduction of required number of operators.
- d) Providing an adequately strong nozzle holder in aluminium results besides in a weight reduction also in space (volume) savings compared to the known overdimensioned steel nozzle holders in a very important and crucial part of the casting system - between the feed channel (6) and discharge of metal from the nozzle (7) into the cavity between the casting cylinders. Shorter distance between the feed channel and the nozzle achieved in this way results in lower heat losses. This means further heat savings in a low-energy casting process and furthermore, in combination with the special configuration of deflector plates in the nozzle, also an improved temperature control across the nozzle tip, which together with material and pressure distribution is of crucial importance to the strip quality.

Claims

1. Casting system for continuous strip casting of metals comprising a holding furnace (1), transfer gutter (2), buffer crucible (3) with temperature control, metal gutter (4) with metal levelling box (5), distributor box (5), feeding channel (7) attached to nozzle (7) which discharges into the cavity formed between two rotating cylinders (8), characterized in that the nozzle (7) is securely clamped in a nozzle holder (12) which is ready to use extruded with all its essential functional features, tolerances and surface condition.
2. Casting system according to claim 1, characterized in that the extruded nozzle holder (12) is provided with a complementary fastening wedge (15) which locks the casting nozzle (7) in the holder by means of screws (13).
3. Casting system according to claim 2, characterized in that the nozzle holder (12) and the fastening wedge (15) are carried out in hardened aluminium alloy.

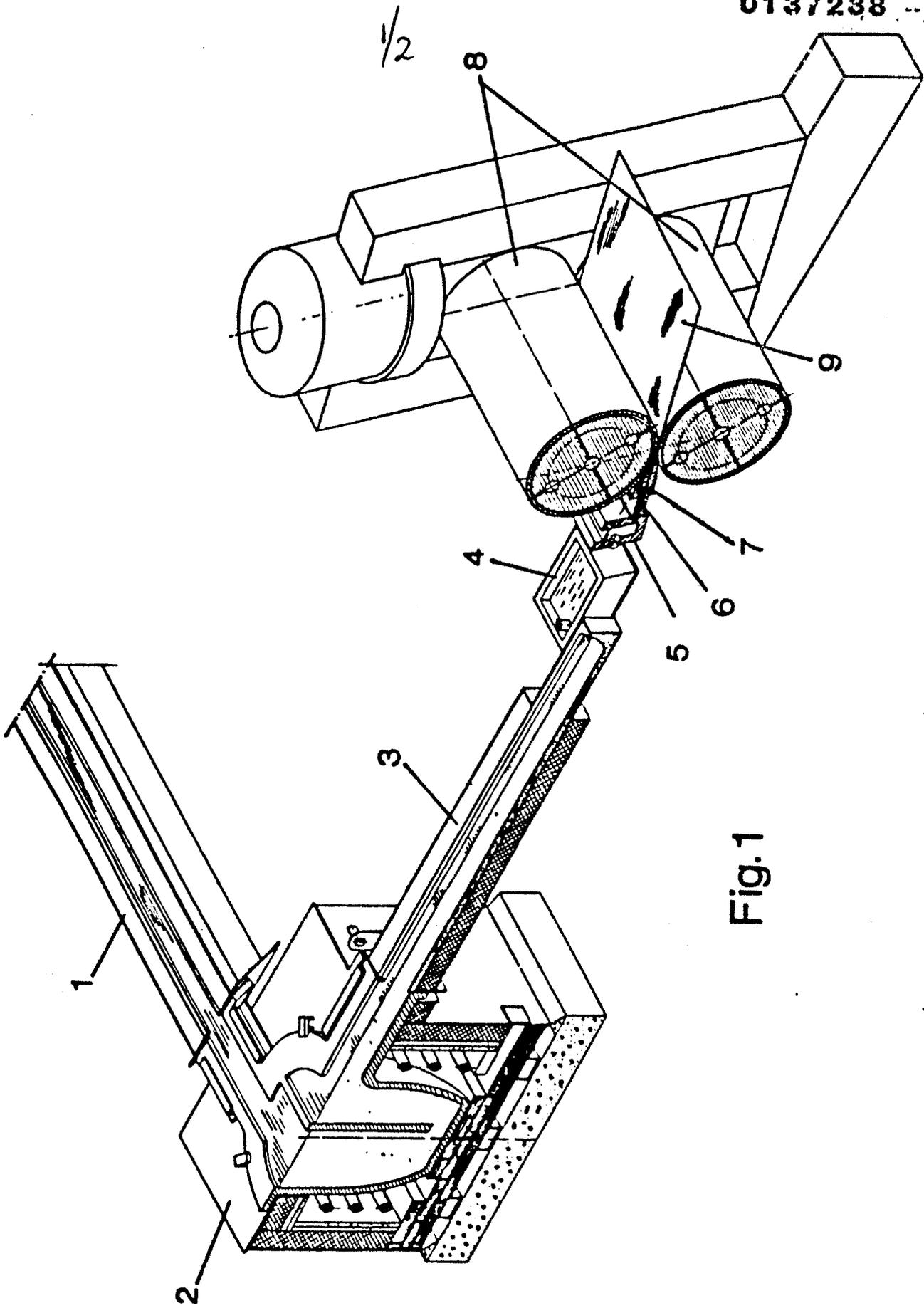


Fig. 1

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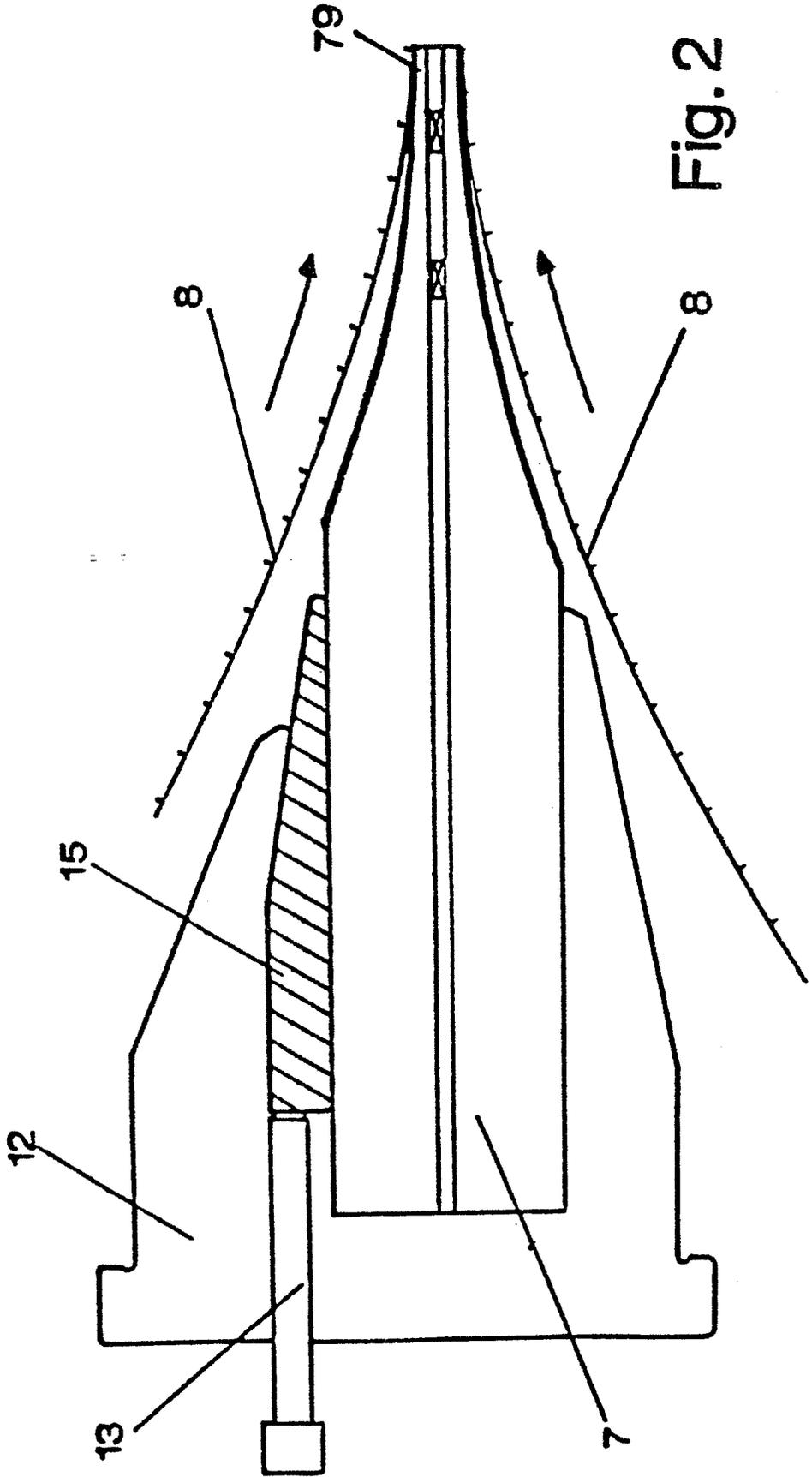


Fig. 2



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	EP-A-0 072 041 (ESTEL HOOVOGENS BV) * Abstract *	1,2	B 22 D 11/06 B 22 D 11/10 B 22 D 41/08
A	--- EP-A-0 081 303 (AIR PRODUCTS) * Abstract, figure *	1	
A	--- EP-A-0 040 072 (BATTELLE DEVELOPMENT)		
D,A	--- US-A-3 405 757 (L.M. HARVEY et al.) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			B 22 D 11/00 B 22 D 41/00
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 20-11-1984	Examiner GOLDSCHMIDT G
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone		T : theory or principle underlying the invention	
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A : technological background		D : document cited in the application	
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P : intermediate document		& : member of the same patent family, corresponding document	