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Stellmacher

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[54] **STEAM FLOW CONTROL IN CONTINUOUS CASTING MACHINES WITH DIRECT SPRAY WATER COOLING**

[75] Inventor: **Wilhelm Stellmacher**, Dusseldorf, Germany

[73] Assignee: **Mannesmann Aktiengesellschaft**, Dusseldorf, Germany

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[51] **Int. Cl.** **B22d 11/12**

[58] **Field of Search** .. 164/283, 89; 34/92, 227, 235; 134/104; 98/43 R, 43 PS

[56] **References Cited**

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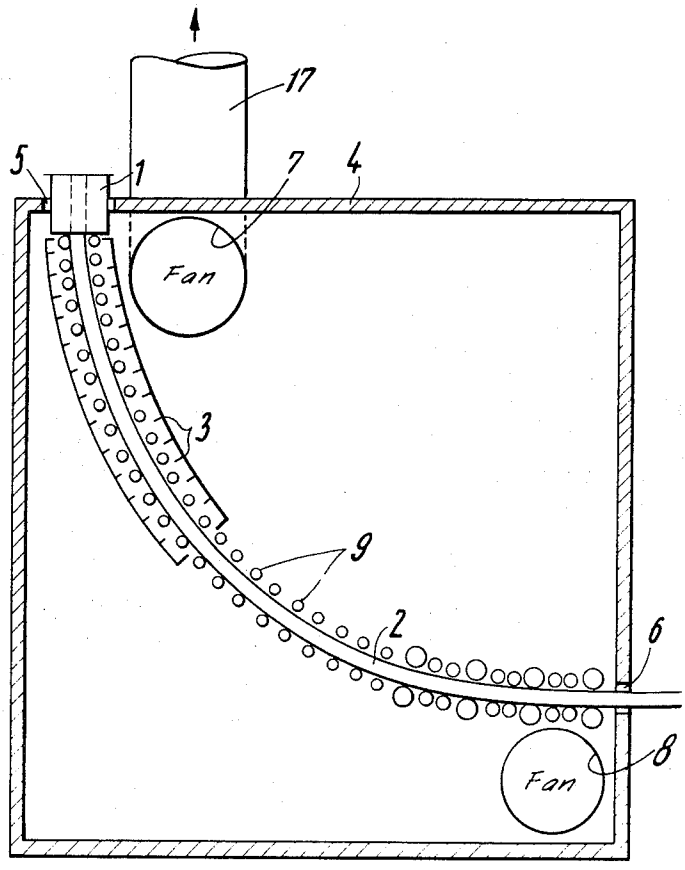
Primary Examiner—Robert D. Baldwin

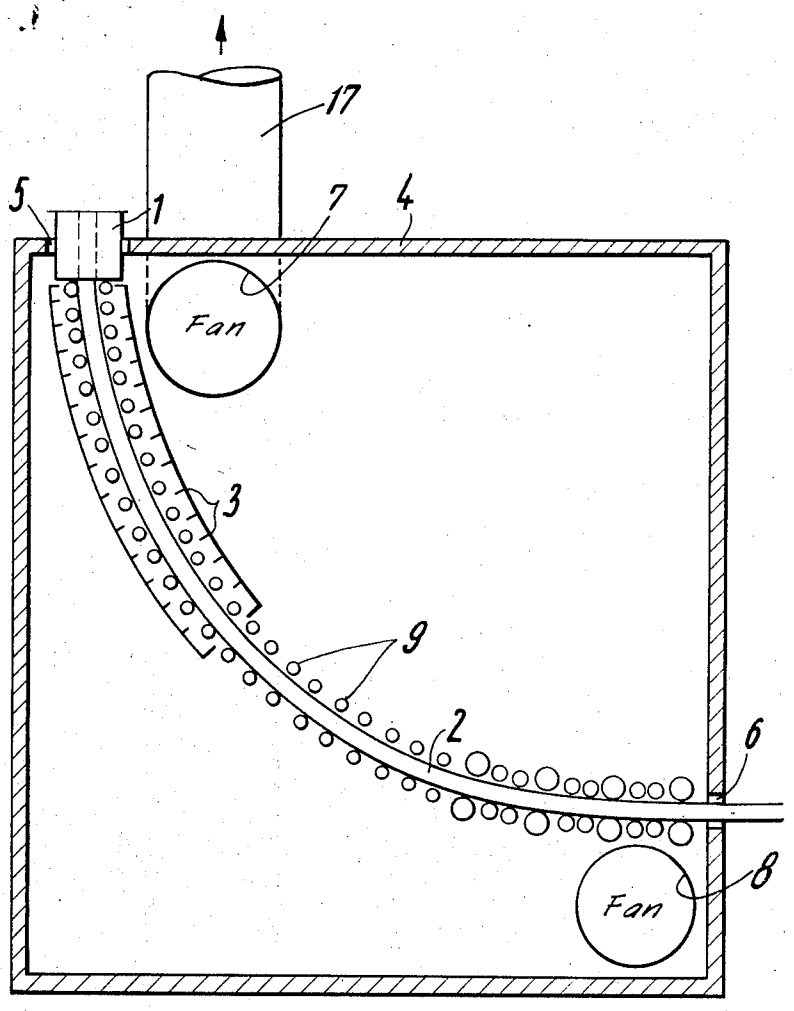
Attorney, Agent, or Firm—Smyth, Roston & Pavitt

[57] **ABSTRACT**

In a machine for continuous casting, which includes a mold, a water spray cooling system for the casting and an enclosure, provided with a suction fan near the location where the casting enters the enclosure, and a second, lower positioned suction fan of lower suction power and disposed preferably below the opening in the enclosure through which the casting leaves.

6 Claims, 1 Drawing Figure




17
5
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Fan

STEAM FLOW CONTROL IN CONTINUOUS CASTING MACHINES WITH DIRECT SPRAY WATER COOLING

BACKGROUND OF THE INVENTION

The present invention relates to apparatus and equipment for preventing escape of steam from a cooling chamber in a machine for continuous casting, using suction for removing the air-water vapor mixture as it forms in zones of direct cooling.

Continuous casting machines operate usually with a mold open at the bottom, and the casting is withdrawn from the bottom opening. The hot strand as withdrawn is cooled directly through spraying of water onto its just solidified outer shell surface. As a consequence, large quantities of water vapor are produced. In order to provide for some control of the steam, it is known to enclose that portion of the casting strand which is sprayed directly with water, and to provide a closed chamber accordingly from which the cooled casting is withdrawn. The water vapor as confined to the chamber, is then extracted by means of a fan and discharged through a chimney or the like.

The enclosure defining such a cooling chamber may have an entrance opening in its upper wall at or near the bottom opening of the mold where the casting is withdrawn, and the casting enters the chamber through that entrance opening. In the alternative, the enclosure may partially envelope the mold, for the mold to be received by the entrance opening to the cooling chamber. This type of construction will be chosen for casting machines in which the mold oscillates. The enclosure is provided with another opening for passage of the casting out of the cooling chamber. Steam escapes through all these openings.

The casting has high temperature throughout its entire extension in the cooling chamber, as the casting solidifies but does not actually cool significantly. Therefor, the passage of such a hot casting into and/or out of the chamber, presents problems of sealing. Also, in case the mold oscillates up and down, the sealing of the chamber presents additional problems. Thus, it appears that some gaps in the enclosure are inevitable and steam escapes through these gaps in the chamber. Other gaps or openings in the enclosure of the cooling chamber are present, for example, where the spray water supply pipes run through and along the walls, and also there are mounting flaps for the mold. As a consequence, water vapor escapes in thick clouds from these gaps, which is a great nuisance and annoyance for operating personal.

In accordance with one known method, it has been attempted to counteract this escape of steam clouds from the cooling chamber through increasing the suction power. Basically, that will solve the problem; however, it was found that suction has to be extremely powerful and, in fact, the pressure distribution in the chamber must be such that a very strong flow of the water vapor develops toward the fan providing the suction, if only very little or no vapor be permitted to escape through the several gaps in the enclosure. In reality, this solution is not satisfactory because the suction power requirements are excessive and, therefor, quite uneconomical.

DESCRIPTION OF THE INVENTION

It is an object of the present invention to provide a more suitable and more economical apparatus for preventing the escape of water vapor and steam clouds from such a cooling chamber so as to improve operating conditions and to reduce danger of accidents. That, in turn, of course, will increase accessability by personnel to the various parts of the machine. It is, therefore, a particular object of the present invention, to provide an improved apparatus for preventing the escape of steam from a cooling chamber of a continuous casting machine, while still using suction for removing the water vapor that has formed in the chamber due to direct cooling of the casting as it is withdrawn from the mold.

In accordance with the improvement, it is suggested to suck the wet air-steam mixture in a relatively high location from the cooling chamber, while relatively dry air is sucked from the chamber at a relatively low point thereof. The upper zone of immediate suction from the chamber should be located near the entrance of the casting to the cooling chamber, as it should be noted that water is sprayed onto the casting right below the bottom of the mold. This upper suction zone includes an opening and a fan leading to a chimney, exhaust pipe or the like terminating outside of the building that houses the casting machine. Proceeding in that manner, it was surprisingly discovered that a fan in the lower opening of the cooling chamber discharges practically dry air which, in fact, could be permitted to flow directly into the machine hall. The lower suction fan does not at all have to have as strong a suction power as the upper one. For example, the lower fan needs to have only thirty percent (30%) or less the suction power of the suction fan as provided near the mold exit. This points to an important aspect of the invention. The invention does not just supplement a steam exhaust system by adding another fan. In other words, the two strategically located suction fans prevent steam discharge from the cooling chamber at a total suction power that is well below the power needed, for example, for a single fan attempting to suck all of the steam out of the cooling chamber. It is believed that the additional suction equipment near the casting exit controls the pressure inside of the chamber so that an overall inwardly pressure gradient is set up even near the entrance of the casting. Due to such inwardly directed pressure gradient, steam does not discharge through any of the gaps in the chamber.

The second fan should be located as close as possible to the opening for the casting where leaving the cooling chamber. Some continuous casting machines provide for a curved path for the casting. Thus, the casting leaves the cooling chamber enclosure through a side wall thereof. For this particular case, it was found to be of advantage to have the lower exhaust fan disposed below the horizontal plane of the opening in the enclosure walls through which the casting leaves the cooling chamber.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, it is believed that the invention, the objects and features of the invention and further objects, features and advantages thereof will be better understood from the following

description taken in connection with the accompanying drawings in which:

The FIGURE illustrates a section view into a cooling chamber of a continuous casting machine incorporating the preferred embodiment of the invention.

DESCRIPTION OF THE DRAWINGS

Proceeding now to the detailed description of the drawings, the FIGURE illustrates a water cooled mold **1** for continuous casting. The charge equipment for the mold is not illustrated and is disposed above the mold as is usual for this kind of machines. A casting **2** is extracted from a bottom opening of the mold. That casting **2** is sprayed with water by means of nozzles **3** covering a span of the casting strand that begins directly below the bottom opening of the mold and extends for some distance therefrom. The casting strand **2** veers by means of guide rollers **9** and into the horizontal direction to facilitate further processing.

The entire arrangement, as far as the casting and its withdrawing and guiding system is concerned, and the nozzle system for direct cooling, is encased or disposed in an enclosure **4** defining a chamber. The enclosure has an upper opening **5** receiving the mold **1.** The mold **1** may be provided for up-and-down oscillation so that the opening **5** must be sufficiently wide for permitting mold **1** to oscillate without binding. The enclosure **4** defining the cooling chamber has another opening **6** in one of its sidewalls, and the casting **2** having horizontal direction of propagation thereat passes through that opening and leaves the cooling chamber accordingly. There are gaps in the enclosure walls adjacent mold **1** as well as between the opening **6** and the casting strand passing through.

Reference numeral **7** refers to a suction outlet provided in one of the sidewalls of the chamber **4** and including a suction fan. The outlet **7** with fan connects the interior of the cooling chamber to a chimney or a venting path and pipe system **17.** The fan sucks air and steam from the interior of enclosure **4** through that pipe and discharge system. The outlet **7** is disposed particularly close to the upper portion of the casting as it is being subjected to direct spray of cooling water; it is this the region of the strongest steam and water vapor development during operation.

A second outlet **8** with fan is provided near the bottom of the cooling chamber, and actually it is provided below the opening **6.** The discharge and suction power of that fan in outlet **8** may be considerably below the suction power of the fan in outlet **7.** The suction power of the fan in outlet **8** may be only about 30 percent or even less than the suction power of the fan in outlet **7.**

It is surprising, but very little or no steam clouds escape through the several gaps adjacent openings **5** and **6.** As stated above, the lower venting outlet **8** should be disposed below the horizontal plane of opening **6.** The air as exhausted through outlet **8** is actually relatively dry so that a pipe exhaust out of the building is not needed. The wet steam-air mixture all discharges through outlet **7** and pipe **17.** The low suction of the fan in outlet **8** just provides pressure gradient control so that practically all of the steam leaves the enclosure through outlet **7.**

It can readily be seen that actually the invention can be practiced in casting machines as they are already existing, particularly in those machines which are provided with a cooling chamber enclosure. These outlets and fans can then be provided in the existing machines for control of the steam flow that results from the water-spraying of the casting. This capability is particularly important as modern continuous casting machines have fairly high extraction speeds, i.e., the withdrawal rates for casting strands is much higher than in machines used earlier. Accordingly, the cooling is more forceful and larger amounts of spray water are used; the steam developed per unit time is higher accordingly. In spite of the increasing amount of developed steam, the rather simple feature of the invention permits complete control of steam flow and discharge process in old and new machines.

The invention is not limited to the embodiments described above but all changes amd modifications thereof not constituting departures from the spirit and scope of the invention are intended to be included.

I claim:

1. In a machine for continuous casting which includes a mold, a water spray cooling system for the casting as extracted from the bottom of the mold, and an enclosure for the cooling system and for a particular length of the casting as extracted, the improvement comprising:

first means effective in the vicinity of spray water cooling of the casting for sucking wet steam and air from the enclosure at a relatively high level therein; and

second means disposed to be effective below the zone of spray water cooling for sucking relatively dry air from the enclosure at a lower level.

2. In a machine as in claim **1,** wherein the first means includes first fan means disposed adjacent the location where the casting enters the enclosure, and the second means includes second fan means adjacent the location where the casting leaves the enclosure.

3. In a machine as in claim **2,** wherein the suction power of the second fan means is significantly below the suction power of the first fan means.

4. In a machine as in claim **3,** wherein the second fan means has 30 percent or less the suction power of the first fan means.

5. In a machine as in claim **2,** wherein the second fan means is disposed below the location where the casting leaves the enclosure.

6. In a machine as in claim **1,** wherein only the first means provide exhaust external to a building housing the machine.

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