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 [31] **12506/67**

[50] Field of Search..... 164/60, 61,  
 87, 253, 279, 283

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[54] **METHOD FOR COOLING THE MOLD BLOCKS OF A CASTING MACHINE WITH CATERPILLAR MOLD**  
**8 Claims, 6 Drawing Figs.**  
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 164/283  
 [51] Int. Cl..... B22d 11/06,

**ABSTRACT:** A method for cooling casting caterpillar mold blocks provides for a coolant spray case that has a rarefied atmosphere to prevent the escape of coolant. The apparatus to carry out the method has a casing, spray nozzles and connecting pipes and is connected to a source of rarefied pressure.

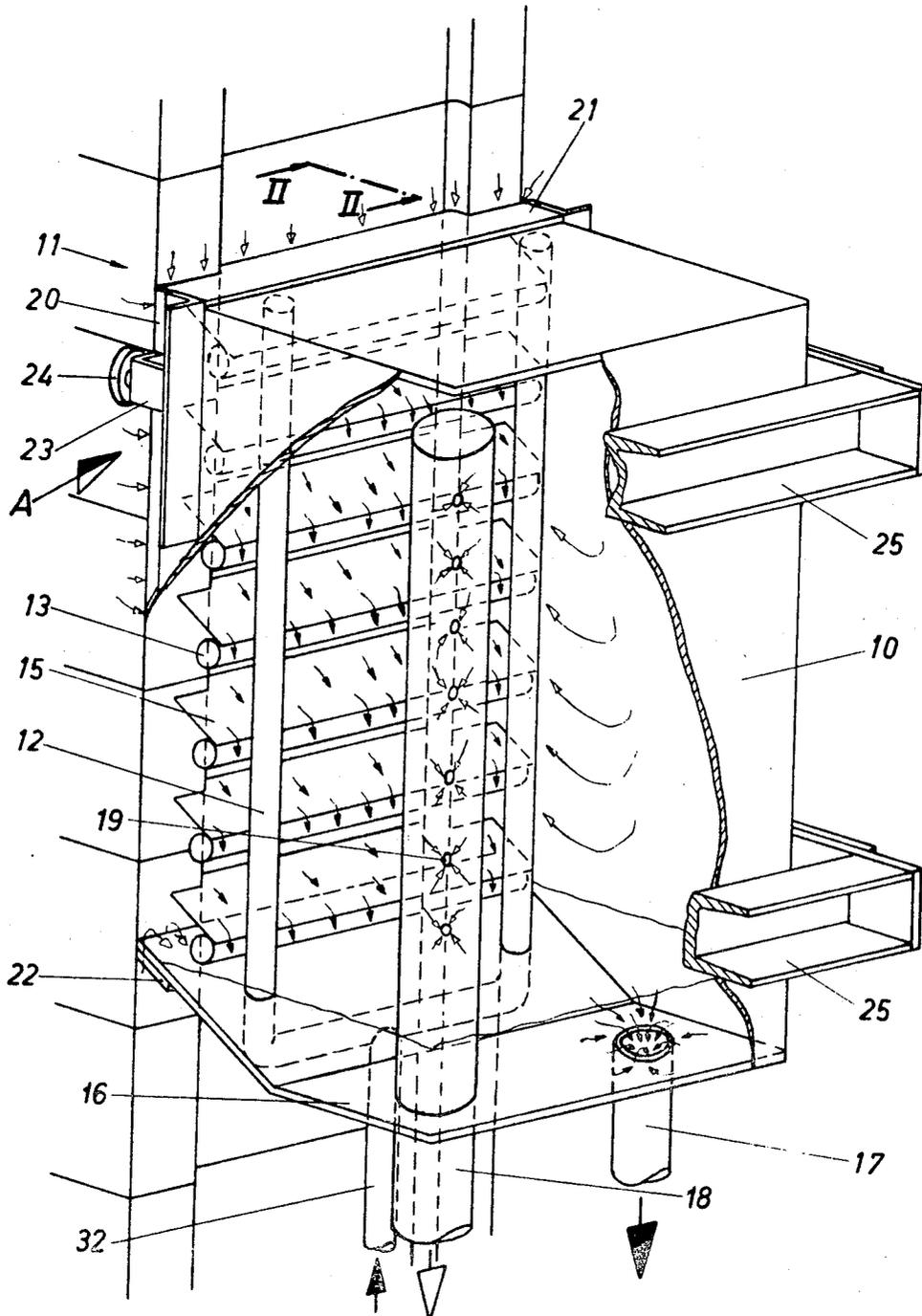


Fig. 1

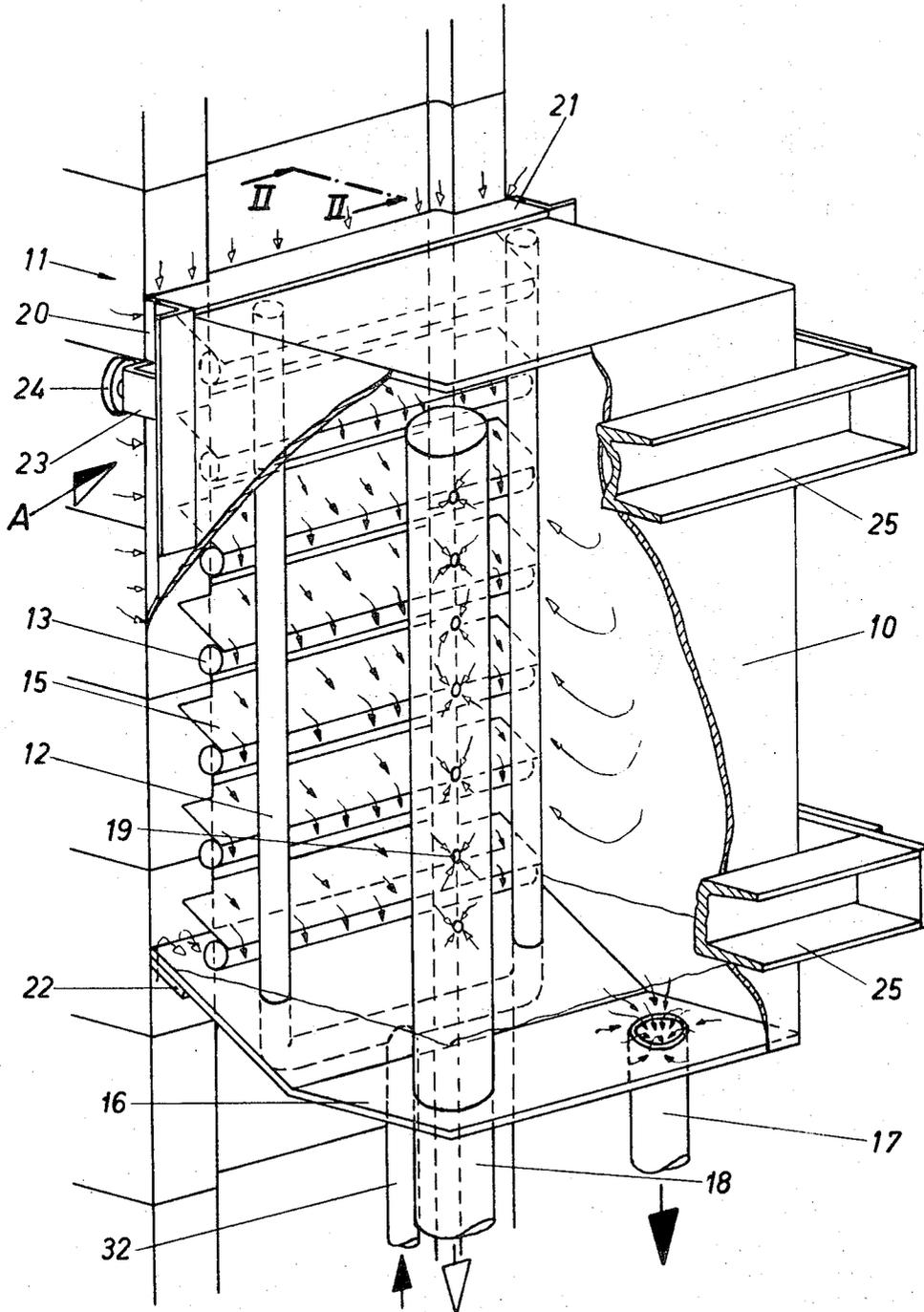


Fig. 2

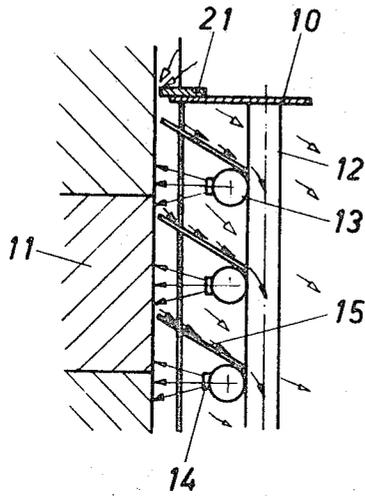


Fig. 3

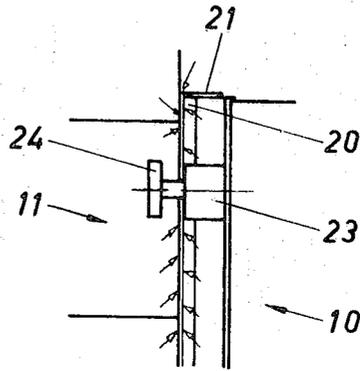


Fig. 4

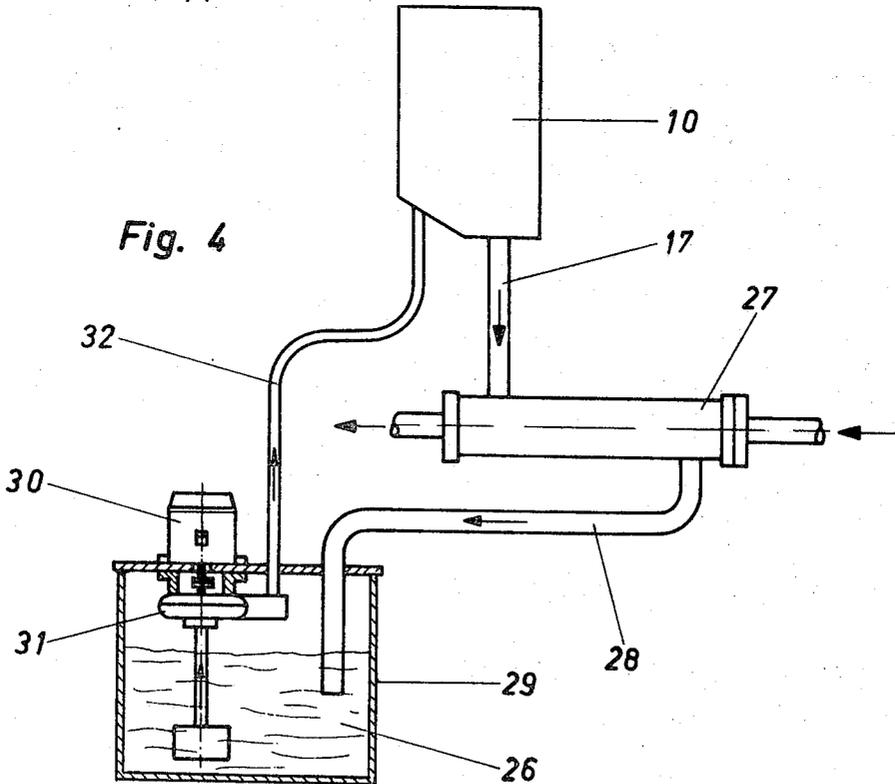


Fig. 5

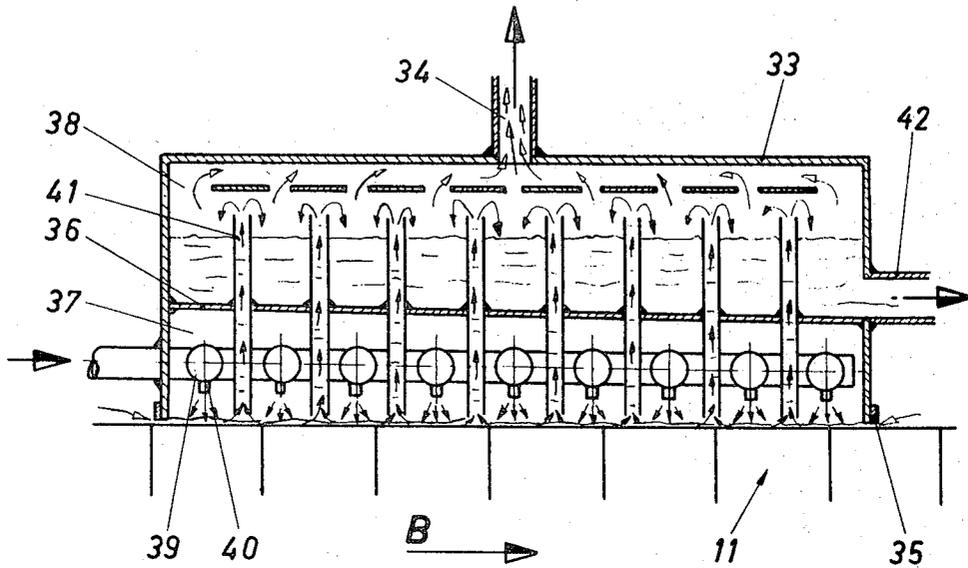
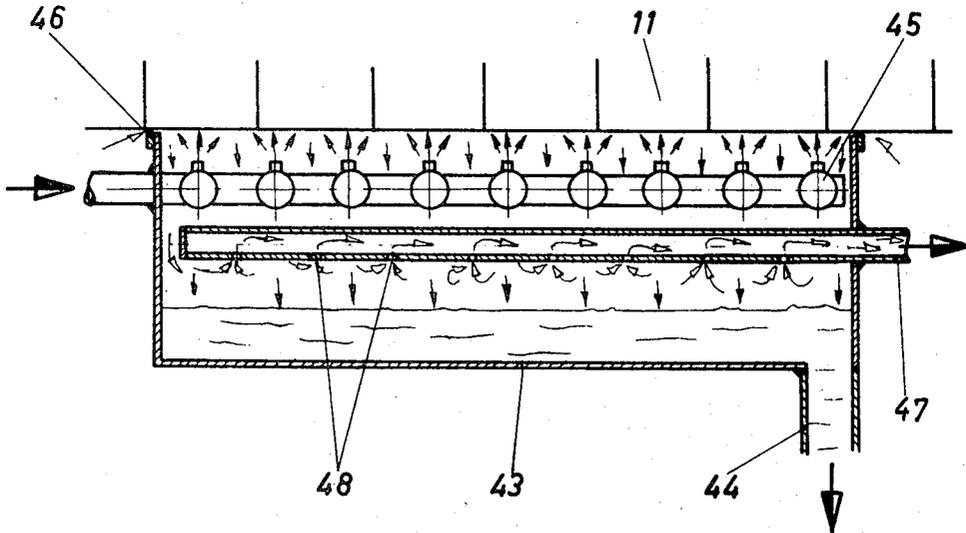


Fig. 6



## METHOD FOR COOLING THE MOLD BLOCKS OF A CASTING MACHINE WITH CATERPILLAR MOLD

The invention relates to a method and to a device for cooling the mold blocks of a casting machine with a caterpillar mold, especially of a machine for the casting of strips of non-ferrous metals, chiefly of aluminum and aluminum alloys.

Reference is had to my copending application Ser. No 753,270, filed on the same day as the instant application.

Several machines have been developed for the continuous casting of strips. In one machine the mold cavity is defined by a cooperating pair of endless chains of articulated mold blocks, and means are provided for revolving each of said chains about its own center. The chains are mounted so that over a portion of their lengths they are in engagement one with the other and define between them a mold cavity having walls which move continuously as the respective chains are revolved together at the same linear speed. Machines of this kind have been named "machines with caterpillar molds." In one of the said machines the mold blocks of one row are not tied together; they are moved separately in a guide system and maintained in circuit in such a way that they meet ever again at the pouring end of the mold cavity to form with the blocks of the other row a closed mold.

In the book "Handbuch des Stranggiessens" of E. Herrmann, published 1958 by the Aluminium-Verlag GmbH in Dusseldorf (Western Germany), the casting in caterpillar molds is described on pages 51 to 63.

Among the great number of proposed constructions only the machine of the Hunter-Douglas Corporation used for the casting of strips from aluminum and aluminum alloys (Handbuch des Stranggiessens, pages 536/37 and 540/41) has been successful. Hunter-Douglas machines are in operation in the United States of America and in the Netherlands.

The Hunter-Douglas machine is characterized chiefly by the fact that each mold block is cooled separately by water circulation. The coolant is supplied thereto and withdrawn therefrom through rotatable coolant distributors connected to the moving coolant passageways in the blocks by lengths of flexible hose. This cooling system is intricate and the Hunter-Douglas machine is inaccessible on the side of the rotating hoses.

It is also well known to eliminate the heat taken up by the mold blocks by dipping them into a cooling liquid or by sprinkling them after they passed through the mold. This system of cooling has the advantage that a regulation of the temperature of the mold blocks is possible; that is to say that these blocks can be brought by suitable cooling to the most favorable temperature for casting respectively for solidification of the melt, whereas mold blocks with constant inner cooling meet relatively cold at the entrance of the mold.

It is accordingly among the principal objects of the invention to provide methods and means for the cooling of such molds without the disadvantages of the prior art.

It is a further object of the invention to provide for the coolant spraying of the mold blocks in a rarefied air to restrain the accidental escape of coolant.

Further objects and advantages of the invention will be set forth in part in the following specification and in part will be obvious therefrom without being specifically referred to, the same being realized and attained as pointed out in the claims hereof.

According to the method of the invention the mold blocks of a casting machine with caterpillar mold are cooled by spraying a coolant liquid against the mold blocks where their molding face is turned away from the casting. The cooling liquid (generally water) is sprayed against the blocks in a case in which a reduced air pressure is maintained. Because of the air underpressure in the case respectively because of the inflow of air into the case caused by the underpressure, and an outflow of cooling liquid out of the case between the same and the blocks and the penetration of the liquid between the contact surface of the blocks is prevented. For instance, with vertical casting downwards the mold blocks are cooled by sprin-

gling during their upward travel; they leave the zone of the cooling case quite dry, so that no disturbance can happen due to any residual coolant.

It has proved advantageous to add to the cooling liquid an emulsion of oil in water or a lubricant suspension; the oil or other lubricant remaining in the mold blocks after evaporation of the coolant may be sufficient for their lubrication.

The invention relates also to a device for carrying out the method according to the invention. The device comprises substantially a case, preferably made of sheet metal, which is open towards the mold blocks and encloses a great number of spray nozzles for the coolant, for instance several rows of spraying pipes, and is connected to a device producing reduced pressure. The said device has to maintain the necessary underpressure during cooling.

In the accompanying drawings;

FIG. 1 is a fragmentary perspective view, partly in section, of a preferred embodiment of the cooling case in cooperation with a vertically disposed caterpillar mold;

FIG. 2 is a fragmentary sectional view taken along the line II-II of FIG. 1;

FIG. 3 is a fragmentary elevational view seen in the direction of the arrow A of FIG. 1;

FIG. 4 is a schematic elevational view, partly in section, of an auxiliary unit for the operation of the cooling device according to FIG. 1;

FIG. 5 is a fragmentary vertical sectional view of a modified upper cooling case of a caterpillar mold disposed horizontally; and

FIG. 6 is a fragmentary vertical sectional view of the lower cooling case of the modification of FIG. 5.

In FIG. 1, a steel-sheet case 10 is open towards the blocks 11, which move upward in the present example, and reaches to the latter with a clearance as small as possible. Two vertical water supplying tubes 12 are provided, the lower extremity of each of which is connected to a pressure water-conduit 32. The water which rises in the tubes 12 flows into the horizontal spraying pipes 13 which are provided with nozzles 14 through which water is sprayed against the molding face of the blocks 11. A deflector 15 is disposed over each spray tube; the purpose of the said deflector is to prevent the pouring of a substantial amount of water down the walls of the mold blocks 11 and its interference with the cooling by spraying. The bottom 16 of the case 10 acts as a collecting vessel and is provided with an outlet tube 17.

By means of the tube 18 that is connected to a source of rarefied pressure, such as an exhaustor or a vacuum pump (not shown), a rarefied pressure is produced in the case 10. The said tube is closed on its upper end and is provided with boreholes 19 along its wall 9, and on the side away from the blocks, in order to avoid the entry of spray water, its bottom is connected to the source.

The air sucked out of the case enters the tube 18 through the lateral openings 19; the lowest of them must, of course, be at such a level over the bottom of the collecting vessel 16 that it cannot suck in water. Lateral sealing ledges 20 are provided, and a transversal sealing ledge 21 at the upper part of the case; the latter reaches into the cavity of the mold blocks; a similar transversal sealing ledge 22 is fixed on the lower part of the case 10. The clearance between the surfaces of the blocks 11 and the sealing ledges 20, 21 and 22 amounts to several tenths of a millimeter, for example to about 0.5 to 1 mm. This clearance depends on the power of the device producing the rarefied pressure. A rarefied pressure of 200 to 300 millimeters water column produced by a fan is quite sufficient under the above-mentioned conditions. In any event the pressure in the case 10 must be so low and the airflow through the clearance (indicated by arrows with white head in FIGS. 1 to 3) so powerful that no water can escape through the clearance between the sealing ledges and the surface of the blocks. Moreover the outlet tube 17 must be disposed in such a manner that it prevents the air from entering the case 10.

An atmospheric excess pressure of 2 to 10 in the ascending pipes 12 for the cooling water is generally sufficient. The most favorable pressure may be found most simply in each case by casting trials.

Angle irons 23 support the guide rolls 24, which touch laterally the mold blocks 11. Two adjustable mounting frames 25 made from channel irons are connected to the structure which supports the casting machine.

The number of the spraying pipes 13 depends on their cooling effect and the extent of the sprayed surface, on the available volume of cooling liquid and on the amount of heat which needs to be dissipated. In FIG. 1 there are disposed about two spraying pipes for each mold block. The sprayed surface is advantageously at least as large as the working surface (inner wall) of the mold which is in contact with the casting metal prior to the separation of the solidifying casting from the mold wall. One needs at least dissipate approximately the whole heat taken up by the mold blocks during solidification.

FIG. 4 shows schematically an auxiliary unit utilizable for operating the cooling case according to FIG. 1. The said unit is in this view an integral component of the cooling device, but this is not absolutely necessary for carrying out the method of the invention. Nevertheless it offers several advantages, for instance better starting conditions and the possibility to add to the cooling water a die lubricant, for instance an emulsion of oil in water, or a suspension of graphite. The cooling water 26 flowing out from the cooling case flows through a cooler 27 and a discharge pipe 28 into the coolant reservoir 29. From the latter the coolant is supplied by means of a pump 30 driven by a motor 31 to the pressure water pipe 32, from which it flows through the spraying pipes 13; thereafter it is sprayed by the nozzles 14 against the working surfaces of the mold blocks 11 and collected on the bottom of the case 10; finally it flows again through the outlet tube 17 and the discharge pipe into the coolant reservoir 29. The cooling water remains in circulation; therefore, substantially only water lost by evaporation and, if a lubricant is used in the cooling water, only little lubricant need to be replenished.

#### EXAMPLE

1000 mm. wide and 20 mm. thick bands of pure aluminum are cast vertically downward in a machine with a caterpillar mold at a speed of 2.5 meters per minute. The mold blocks made from forged steel have a thickness of 250 mm. at the wide mold wall. The metal poured into the mold has a temperature of 680 to 700° C., the emerging casting a surface temperature of 540 to 450° C. The cooling water is supplied with a pressure of 6 kg. per square centimeter and sprayed on the mold blocks through ten spraying pipes. The speed of the circulating cooling water amounts to 800 liters per minute; soon after the beginning of the casting operation, the cooling water for the mold blocks has a temperature of about 30° C. at the inlet of the mold and of about 55° C. when flowing out through the outlet tube 17. Directly under the cooling case the mold blocks have at their mold face a temperature of 170 to 200° C. and when leaving the case a temperature of 60 to 70° C.

In the machine shown in FIGS. 1—4, the casting metal flows vertically downward. The method and the device according to the invention, however, may instead be used also with casting upward as well as with casting in any other position.

When casting horizontally as well as in most positions of inclined casting, the cooling device must have, of course, a shape that differs from that of FIGS. 1—3. FIGS. 5 and 6 serve as examples. FIG. 5 shows schematically the upper and FIG. 6 the lower cooling device of a caterpillar casting machine disposed horizontally.

In FIG. 5, a case 33 is provided, made of sheet steel (corresponding to the case 10 of FIG. 1); and has on its interior a rarefied pressure. This case 33 is connected through the tube 34 to an exhauster. It is provided at its whole periphery with sealing ledges 35 and reaches to the mold blocks 11 within 0.5

to 1 mm. The arrow B shows the travel direction of the mold blocks 11 and therefore the casting direction. The case 33 is divided in two chambers 37 and 38 by a partition (intermediate bottom) 36. Spraying pipes 39 are disposed in the chamber 37; they spray cooling water through nozzles 40 against the mold blocks 11. Tubes 41 disposed through the partition 36 are welded to the latter; they connect the chamber 37 to the chamber 38. They are intended to remove by suction the cooling water accumulating on the die halves or blocks and to conduct it into the upper chamber 38, from which it flows out through the pipe 42. For this purpose the tubes 41 reach down nearly to the surface of the mold blocks and surmount the partition 36 up to the edge of the discharge pipe 42.

The tubes 41 have the further purpose of preventing the escape of water between the mold blocks and the sealing ledges as well as through the joint abutment between the mold blocks, by means of an intensive air flow.

The lower cooling device, which is represented in FIG. 6, does not need any partition. It comprises substantially a sheet case 43 with outlet tube 44 for the water. The cooling water is sprayed by spraying pipes 45 against the mold blocks 11 and flows at the bottom of the case into the outlet pipe 44. For the purpose of generating the air flow, which in this device also has to prevent the escape of cooling water between the mold blocks and the sealing ledges 46, a suction pipe 47 with apertures 48 is disposed in the case 43 and is connected to a device (not shown) producing rarefied pressure.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

Having thus described the invention, what I claim as new and desire to be secured by Letters Patent, is as follows.

I claim:

1. In a method for cooling, with the aid of a casing open at one side, the molding faces of mold blocks of a casting machine with a caterpillar mold, the steps comprising positioning the casing with the open side closely adjacent the molding faces where the molding faces are turned away from the casting, spraying through the open side a coolant against the molding faces while maintaining in the casing a rarefied air pressure such that due to the entry of air into the casing the coolant is restrained from escaping through any space between the casing and the mold blocks.

2. A method according to claim 1, the coolant containing an emulsion of oil in water.

3. A device, for use in spray cooling the molding faces of a caterpillar mold having mold blocks, comprising a casing connected to a source of rarefied air pressure and open towards the mold blocks and defining therewith a clearance of several tenths of a millimeter, a conduit for supplying a coolant, said casing containing several spraying nozzles fed from said conduit and directed against the molding faces.

4. A device according to claim 3 for the vertical continuous casting, comprising horizontal spraying pipes connected to said conduit and disposed one above the other and having each several of said spraying nozzles, a deflector disposed over each spraying pipe for drawing off the water pouring down the wall of the mold blocks to the inside of the casing over the spraying pipes.

5. A device according to claim 3 for the horizontal or nearly horizontal casting, comprising a discharge pipe fed from said conduit, said casing including an upper cooling case divided into two chambers, a partition between said chambers; spraying pipes in one of the chambers connected to said discharge pipe; tubes welded to the partition and connecting said one chamber to the other chamber reaching down nearly to the surface of the mold blocks and rising above the partition up to above the top edge of said discharge pipe, and a pipe connecting said other chamber to said source.

6. A device according to claim 3, comprising a tube disposed in the casing and connecting said casing to said source, and through which tube air and vapor are sucked off due to the rarefied pressure.

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7. A device as claimed in claim 3, a coolant reservoir, a cooler connected to said reservoir, a pump and said conduit supplying coolant to said spraying nozzles.

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8. A device as claimed in claim 7, said conduit supplying coolant first to said cooler and thence to said spraying nozzles.

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