

March 31, 1925.

1,531,747

C. W. HAZELETT

SHEET CASTING MACHINE AND METHOD OF COOLING THE SAME

Filed July 11, 1921

3 Sheets-Sheet 1

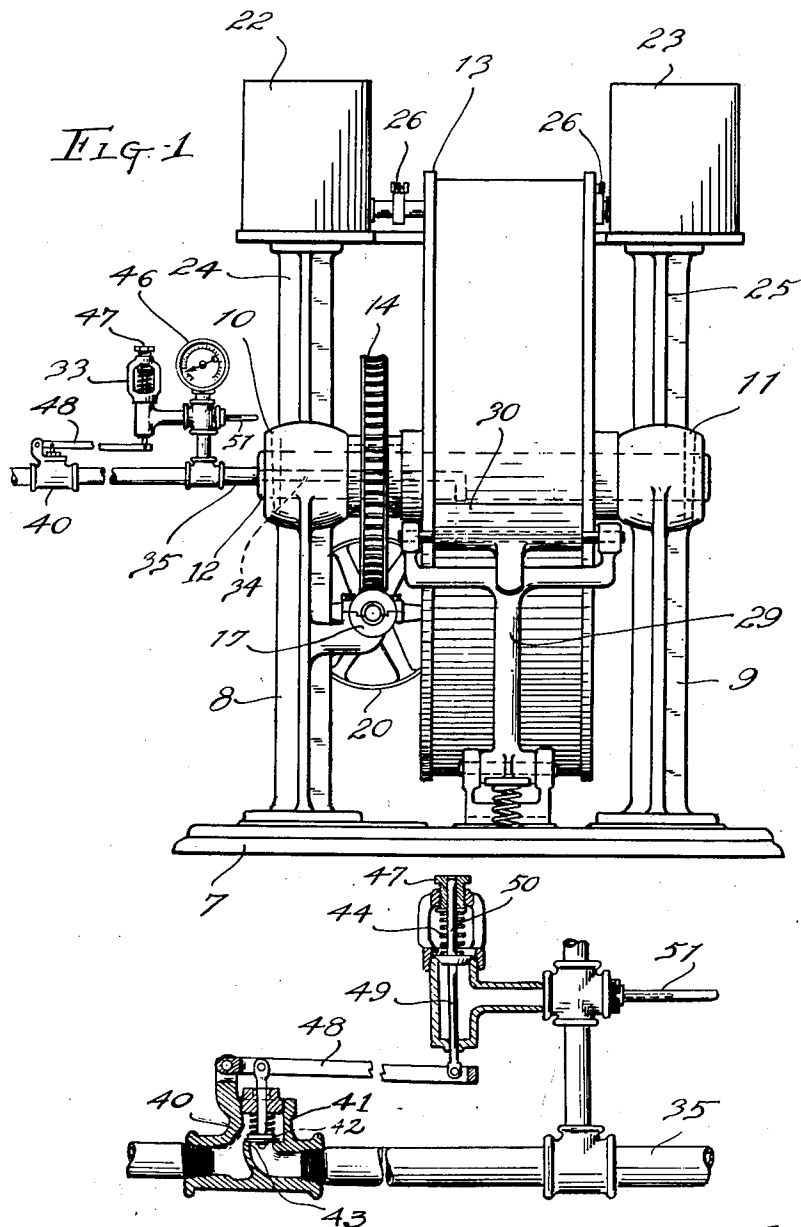


Fig. - 4

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3 Sheets-Sheet 2

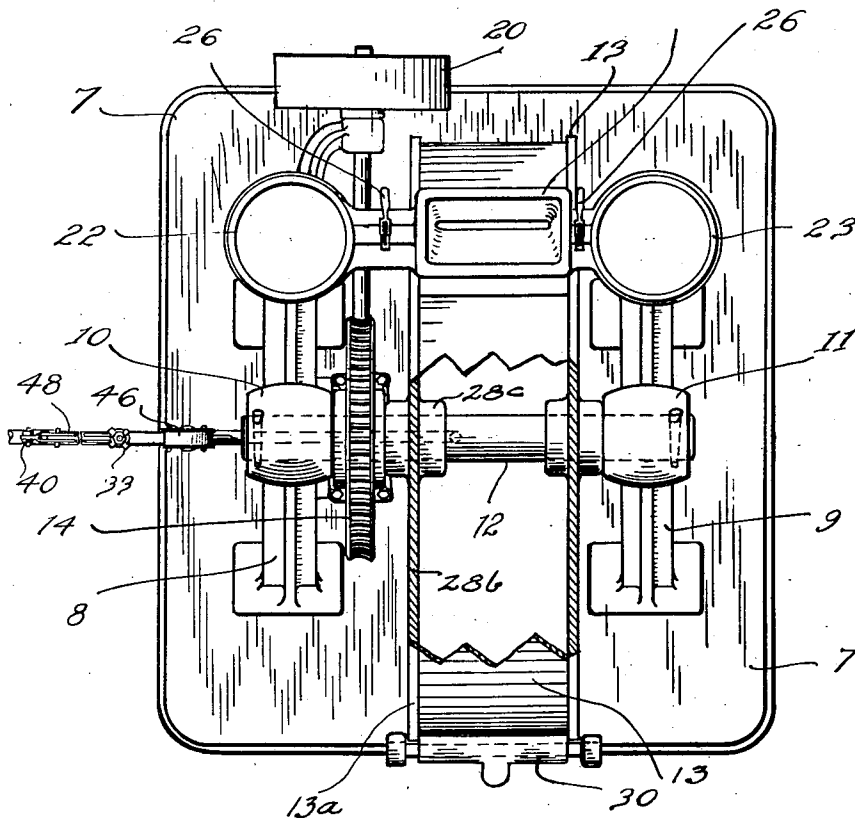


Fig. 2

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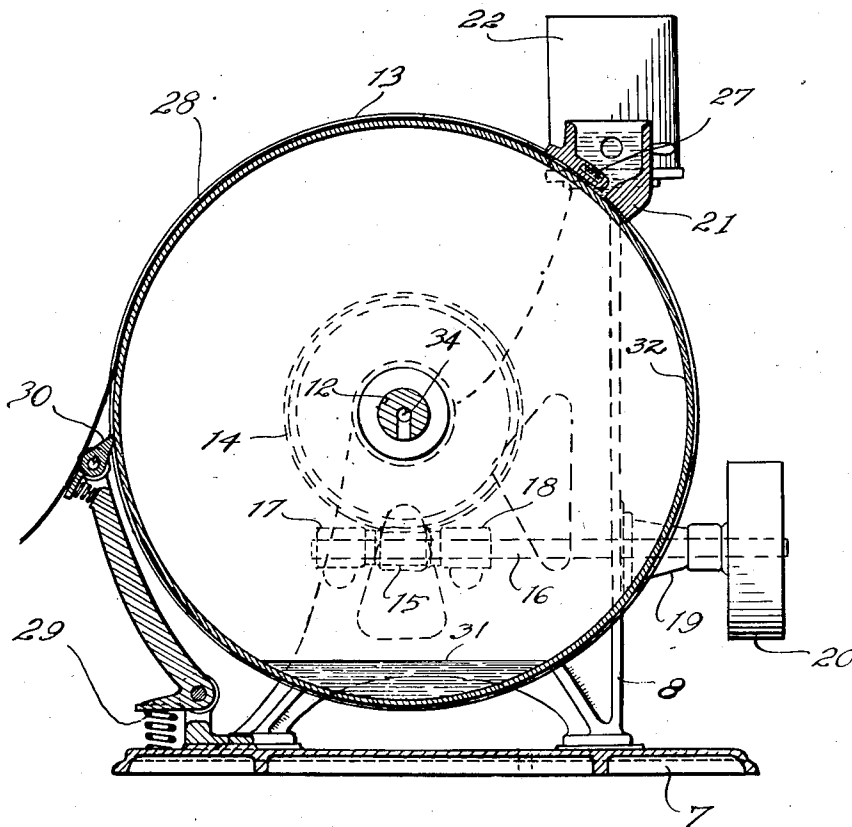


Fig. - 3

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UNITED STATES PATENT OFFICE.

CLARENCE W. HAZELETT, OF LAKEWOOD, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS,
TO THE CLEVELAND TRUST COMPANY, TRUSTEE, OF CLEVELAND, OHIO.

SHEET-CASTING MACHINE AND METHOD OF COOLING THE SAME.

Application filed July 11, 1921. Serial No. 483,710.

To all whom it may concern:

Be it known that I, CLARENCE W. HAZELETT, a citizen of the United States, residing at Lakewood, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Sheet-Casting Machines and Methods of Cooling the Same, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention relates to a rotary machine for casting sheets or strips of metal and is particularly concerned with improvements in a temperature controlling device used in conjunction with such a machine.

The general object of my invention is the provision of a hollow rotary casting drum adapted to receive a cooling medium and means cooperating with the drum whereby the temperature of the cooling medium may be automatically controlled. More specifically, my invention is concerned with means for controlling the flow of fluid to and from the interior of the drum.

Other objects will be hereinafter set forth in the following description in connection with the accompanying drawings which illustrate a convenient embodiment of my invention; the essential characteristics are summarized in the claims.

In the drawings, Fig. 1 represents a front elevation of a rotary casting machine wherein my invention is embodied, while Fig. 2 is a plan view of the same with a portion of the drum shown in section. Fig. 3 is a cross sectional elevation through the center of the machine; Fig. 4 is a cross section of a vapor regulating device hereinafter referred to.

Designating the various parts of the mechanism by reference characters, in Fig. 1, I have illustrated the machine comprised substantially of a base member 7, upon which a pair of frame members 8 and 9 are mounted. These members have suitable bearing portions 10 and 11 suitably bored to receive a non-rotatable drum supporting member 12. A hollow drum 13 may be rotatably mounted upon the member 12. Rigidly secured to the hub of the drum is a worm wheel 14 which may be driven by a suitable worm 15 mounted on a drive shaft 16 and which is supported between the bearing members 17 and 18. These bearing members may be rigid with the side frame

member 8. The outer end of the drive shaft 16 may be supported by a suitable bearing 19 rigidly secured to the frame member 8. This shaft may be driven by any convenient means such as a pulley 20 mounted on the outer end thereof.

The particular purpose of the machine illustrated in the drawings is to cast a continuous metallic web from a pouring gate 21, such as I have illustrated in Fig. 3. A detailed description of the arrangement and cooperation of such a pouring gate with the rotary drum has been set forth in my application filed November 11, 1920, Serial No. 423,309, where the same is claimed.

I prefer to mount suitable reservoirs 22 and 23 upon upwardly extending portions 24 and 25 of the side members 8 and 9 respectively, whereby I obtain a proper hydrostatic pressure in the pouring gate 21. Suitable shut-off valves 26 may be alternately opened and closed as desired, when increasing or restricting the flow of the metal into the pouring gate 21. A suitable heating element 27 disposed within the walls of the casting gate 21 may serve to maintain the under surface thereof at a proper temperature to insure the rapid flow of the molten metal onto the casting surface 28 of the drum 13.

A flexible member 29 suitably mounted on the base 7 is adapted to maintain a scraper member 30 in contact with the casting surface of the drum and may also serve as a stripping means for removing the cast sheet from the drum.

The foregoing description refers to the general arrangement of the machine. This invention is directed to the provision of a method wherein a cooling fluid is conducted to an enclosed cavity formed in the interior of the drum where it may vaporize under low pressure the flow of the cooling fluid being governed by the resulting pressure of the confined vapor.

It is essential that the temperature of the drum be uniformly maintained, irrespective of the speed of the drum or the thickness of the metal being cast thereon. Hence an adequate supply of the cooling fluid must be provided to remove the surplus heat transmitted to the drum from the cast sheet.

I have found that in order to obtain efficient and proper operation of the ma-

chine, the surface of the sheet adjacent the drum surface must be cooled by the drum surface while the upper surface of the sheet is maintained in a molten or semi-plastic condition by the heated under surface of the casting pot. Hence, it is obvious that if the cooling medium within the drum cavity has an overchilling effect upon the sheet being cast, the sheet will solidify rapidly throughout its cross section while still in contact with the under surface of the casting pot and a consequent brake shoe action will take place between the casting pot and the drum.

A very economical construction embodying the foregoing described method of regulating the chilling of the cast sheet may be obtained by providing an annular sealed space within the drum to which a cooling fluid may be conducted intermittently.

To this end, I have provided the drum 13 with solid end walls 28^b corresponding in thickness to the width of the external flanges 13^a. These end walls may terminate in center bearings 28^c. The circumferential wall 32 may be of sufficient thickness to insure rigidity between the end walls of the rotating drum but thin enough to obtain rapid heat conduction from the external to the internal surface thereof.

A supply pipe 35 may be connected to the end of the stationary member 12. A passage 34 formed in the member may serve as a fluid inlet for the cooling liquid 31 which may accumulate therein in contact with the inner surface of the circumferential wall 32. Hence the heat transmitted to the wall may be absorbed by the pool of cooling liquid. By controlling the temperature of this liquid the degree of chilling the drum has on the cast sheet may be definitely regulated.

I have found that the requisite temperature of the cooling liquid is approximately that of boiling water for relatively thin sheets. I have also found that better results may be obtained when casting a very thin sheet by restricting the escape of vapor or steam from the drum interior until the temperature of the boiling water has been raised to about 217° F.

Suitable mechanism for obtaining this result may be comprised of an adjustable low pressure outlet valve 33 associated with the liquid inlet 35, and a water inlet valve 40 controlled by the vapor outlet valve. A suitable pressure gage 46 may be connected with the vapor outlet line and as the valve spring 44 is adjusted by a threaded bushing 47 by the operator the pressure variation due to this adjustment may be read on the gage.

A connecting lever 48 may be attached

to an extension 49 of the vapor valve stem 50 which is adapted to open a water inlet valve 40 when the vapor escapes through the valve 33. As the pressure of the water line is much greater than the vapor pressure within the drum it is obvious that the leverage ratio should correspond with the pressure ratios. The water inlet 43 may be of such size as to permit the replenishing of the cooling water within the drum in proportion to the amount of water escaping therefrom in the form of vapor. It will be noted that vapor may escape from the drum through the line the cooling water enters. A suitable thermometer 51 may be connected with the vapor outlet line upon which the temperature may be read.

From the foregoing description of my invention it is to be seen that I have provided a very simple and economic means for regulating the temperature of the chilling element in a rotary casting machine which may be used for the casting of metal sheets of different thicknesses. While the machine and mechanism herein described is particularly adapted to the casting of lead sheets, it is obvious that sheets cast from other metals may be produced as the range of drum temperatures is dependent upon the control of the vapor pressures within the drum. This is especially so with metals having a higher point of solidification than the boiling point of water.

Having thus described my invention, I claim:

1. In a casting machine, a rotary drum, means causing metal to flow onto the drum, means for bringing a cooling liquid to the interior of the drum, and means for regulating the temperature of the liquid governed by the pressure of vapor formed from the liquid.

2. In a casting machine, a rotary drum, means for causing molten metal to flow onto the drum, means for bringing a cooling liquid into the interior of the drum, and means for regulating the temperature of the liquid governed by the pressure of vapor from the liquid, said means including a liquid inlet and a vapor outlet, a vapor release valve and a liquid inlet valve operated when vapor is escaping through the release valve.

3. In a casting machine, a rotary drum, means causing metal to flow onto the drum, means for bringing a cooling liquid to the interior of the drum, means for regulating the temperature of the liquid governed by the pressure of vapor formed from the liquid, and including a pressure device operated by said vapor pressure for controlling the flow of liquid to the drum.

4. In a casting machine, a rotary drum, means for causing molten metal to flow onto the drum, means for bringing a cooling

liquid into the interior of the drum; and means for regulating the temperature of the liquid governed by the pressure of vapor from the liquid including a liquid inlet and a vapor outlet, and connections therebetween whereby said valves are simultaneously opened and closed by said vapor pressure.

5. The method of cooling the metal expressing element of a continuous sheet casting machine which includes the step of regulating the flow of a cooling liquid into an enclosed cavity of the element so that the flow will be in proportion to the rate of out-flow of the cooling medium when permitted to escape from said cavity only in the form of vapor and whereby the pressure and temperature of the vapor is governed and the amount of liquid retained is controlled to maintain continuous casting conditions.

6. In a sheet casting machine the combination of a rotatable drum, means for spreading molten metal thereon, and automatic means for regulating the flow of a liquid cooling medium to the drum and for controlling the pressure of vapor escaping from the interior of the drum.

7. In a sheet casting machine the combination of a hollow drum adapted to retain water and steam, and pressure regulating means associated with a vapor outlet communicating with the interior of the drum for controlling the pressure of steam formed within the drum consequent to the casting of molten metal upon the outer surface of the drum.

8. In a sheet casting machine the combination of a hollow drum having a water inlet and a vapor outlet, means adapted to cast a molten metallic sheet thereon and automatic means associated with said inlet and outlet ports adapted to regulate the flow of vapor out of the drum and the flow of water into the drum.

9. In a sheet casting machine the combination of a metal casting pot, a rotatable drum adaptable for expressing a cast metallic sheet away from the pot and automatic means for regulating the flow of a liquid cooling medium escaping from the interior of the casting drum in the form of vapor.

10. In a sheet casting machine the combination of a hollow casting drum adapted to retain water and steam within its interior, a metal casting pot adjacent the casting surface of the drum, and pressure regulating means associated with a vapor outlet communicating with the interior of the drum for controlling the pressure of steam

formed within the drum consequent upon the casting of molten metal from said pot upon the exterior surface thereof.

11. In a sheet casting machine the combination of a hollow casting drum having a water inlet and a vapor outlet, a metal pot adapted to cast a molten metallic sheet thereon and means associated with said outlet port for regulating vapor pressure within the drum including a low pressure release valve interposed in the vapor outlet passage.

12. The method of regulating the temperature of an expressing element in a sheet metal casting machine which includes, the trapping of fluid cooling medium within the interior of the element wherein it may be raised to a boiling temperature, retaining the vapor thus formed within the interior of the element under pressure, releasing some of the vapor through a constant pressure valve when the temperature of the element exceeds the temperature desired and permitting an inflow of a volume of cooling liquid corresponding to the volume of liquid escaping in the form of vapor.

13. In a sheet casting machine, a rotary drum having an inner chamber, a metal casting pot associated with the drum having an integral element extending over the drum, means to heat said pot and element, whereby the extending element may maintain the upper surface of a sheet being cast by the pot upon the drum in a semi-plastic condition, and automatic means associated with a liquid inlet and a vapor outlet in the drum for controlling the flow of a liquid cooling medium into the drum chamber and the escape therefrom of the liquid cooling medium when in the form of vapor, whereby the temperature of the casting surface of the drum may be maintained at such a point that the under side of the sheet being cast will solidify while the upper surface is maintained in said semi-plastic condition.

14. In a sheet metal casting machine, the combination of a hollow rotatable drum, means for rotating the drum, means for spreading molten metal over the circumferential surface of the drum, and means for conducting a stream of cooling water into the interior of the drum, said drum having an aperture formed therein whereby steam formed by the transfer of heat from the drum walls to the water may act as a cooling medium on the upper portions of the drum and escape through said aperture under pressure.

In testimony whereof, I hereunto affix my signature.

CLARENCE W. HAZELETT.