

July 21, 1942.

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2,290,286

APPARATUS FOR COOLING METAL MOLDS

Filed May 10, 1940

4 Sheets-Sheet 1

Fig. 1

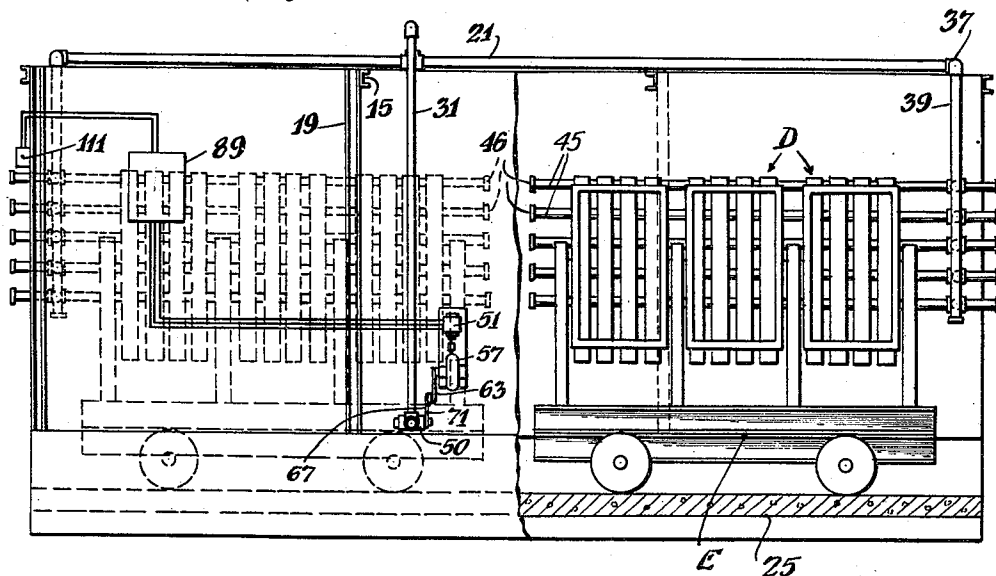
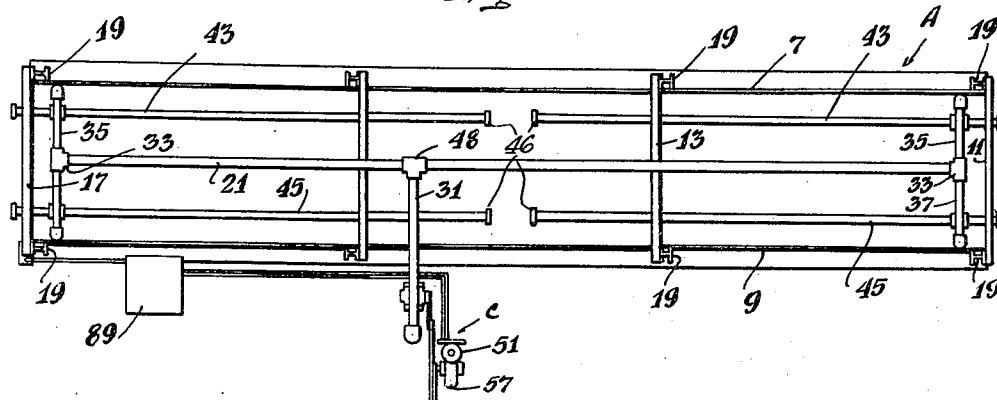


Fig. 3



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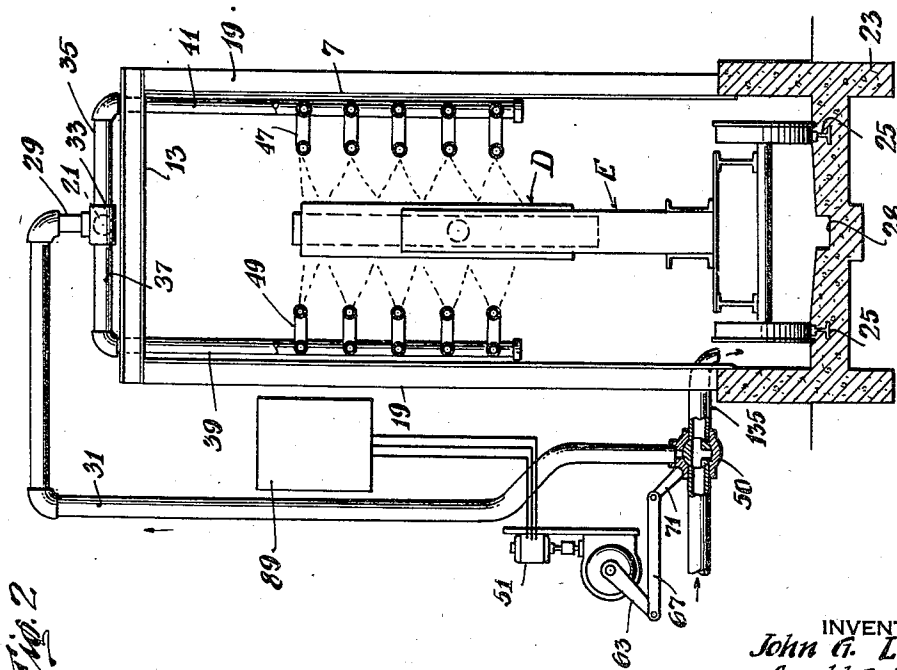
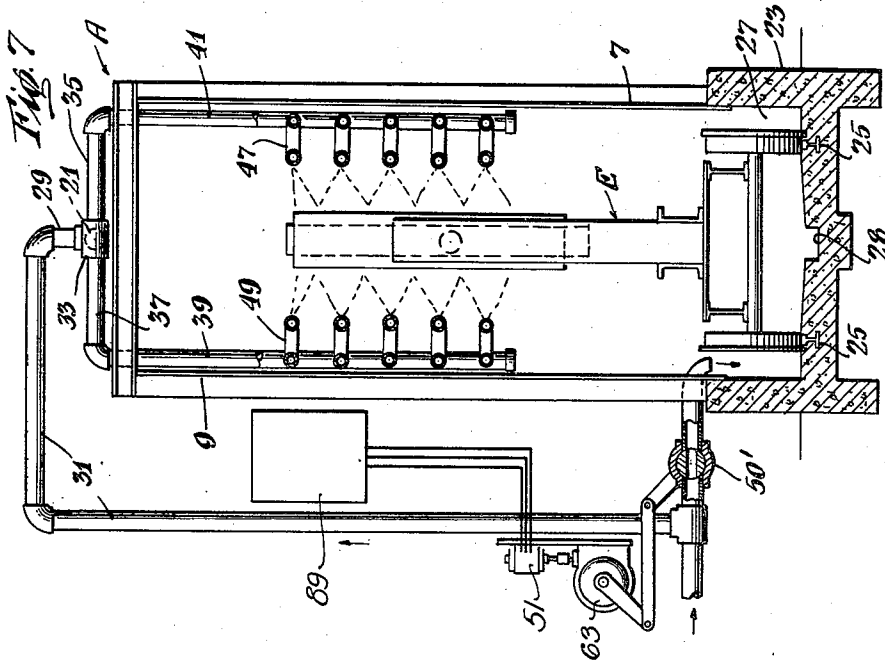
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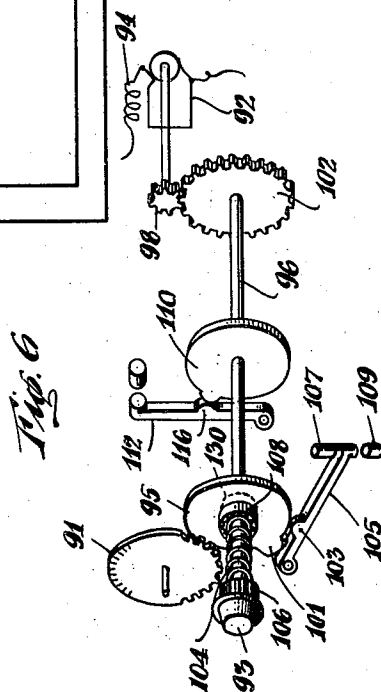
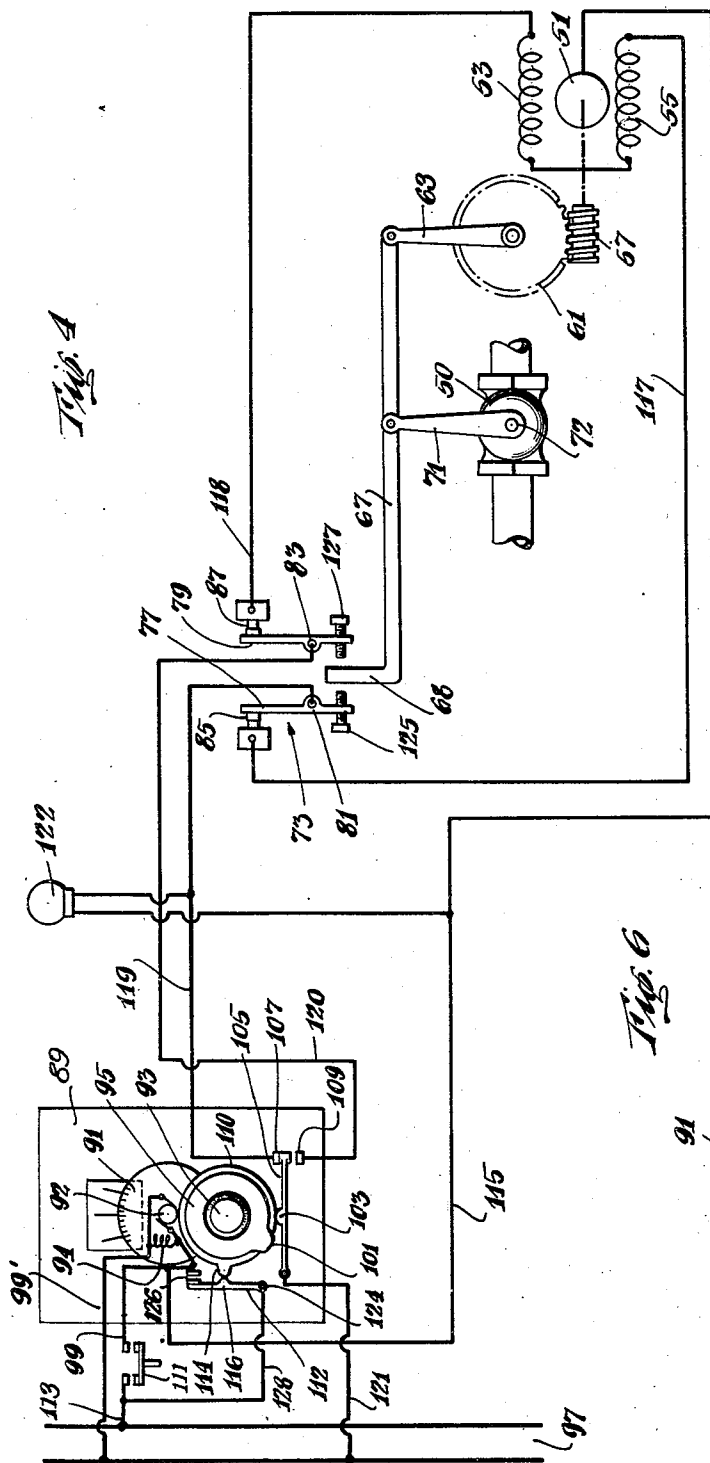
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4 Sheets-Sheet 3



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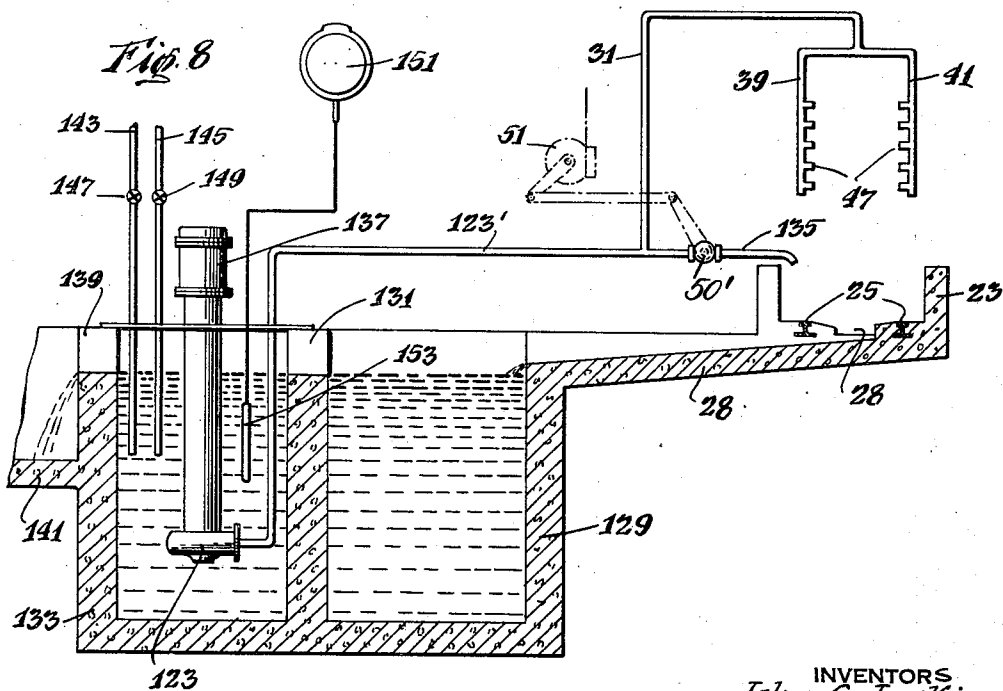
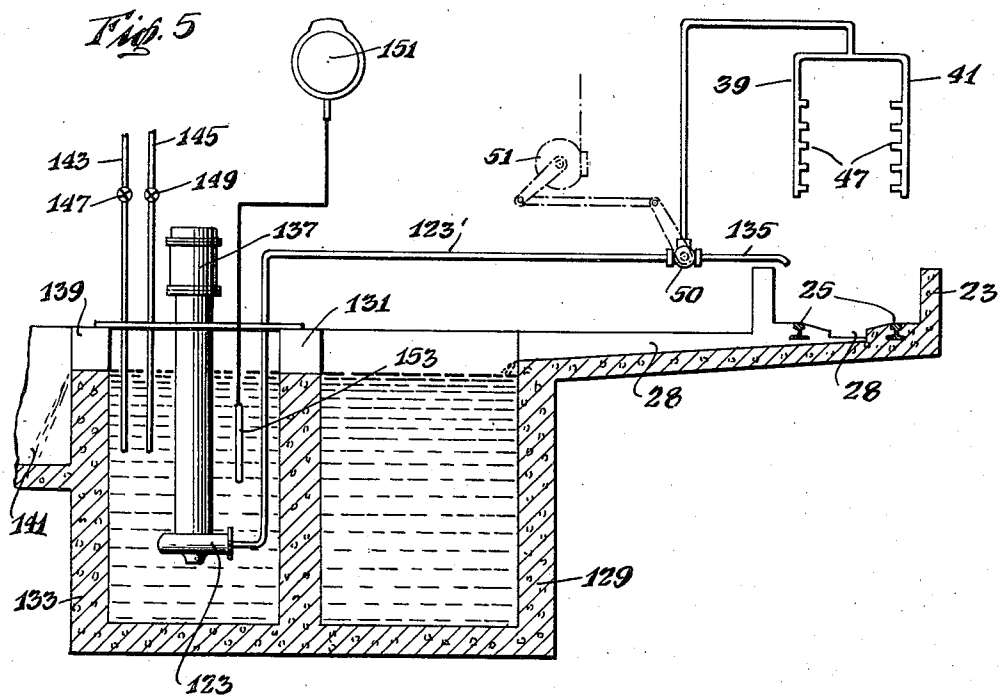
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APPARATUS FOR COOLING METAL MOLDS

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4 Sheets-Sheet 4



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APPARATUS FOR COOLING METAL MOLDS

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5 Claims. (Cl. 22—1)

The present invention relates to improvements in thermal conditioning of molds, and more particularly to an apparatus for applying controlled amounts of a cooling liquid to a heated mold to lower the temperature to a point such that when the mold wash is applied it will readily adhere and form a uniformly continuous coating film thereover.

In casting metals, for example copper, aluminum, etc., molten metal is poured into molds which have been previously coated with a heat resisting coating, and the metal solidified forming billets. These billets are then removed from the molds and the molds recoated and used over again. During the casting process the molds become heated to a high temperature by the molten metal so that it is necessary to cool the molds after each use before applying the mold wash in order to produce sound castings which can be readily removed from the mold.

Various methods and means have been utilized heretofore for attempting to effect rapid cooling of metal casting molds, but no simple, efficient and economical way of accomplishing this has been devised. This is the principal object of the present invention.

A further object is to provide a machine which is operable to effect automatic cooling of the mold to the desired temperature between successive casting operations.

Briefly, the invention consists in providing an adjustable sprayer mechanism which is arranged to spray cooling water onto the hot molds for a predetermined time limit to cool the molds to the optimum temperature required for producing sound castings. Means is provided for varying the duration of the spraying operation in accordance with the amount of heat to be dissipated.

A further object of the invention is to provide equipment of the above-indicated type wherein the spraying period is controlled automatically for a definite period of time, thereby assuring the same spraying time for each mold.

Further objects and advantages of the present invention will become apparent as the description proceeds, and the features of novelty will be pointed out in particularity in the appended claims.

The invention is illustrated by the accompanying drawings which show an adaptation of the invention wherein the molds are illustrated as being mounted on cars for being cooled by equipment embodying the features of the present invention.

Referring more particularly to the drawings:

Fig. 1 represents a side elevational view of a spray chamber equipped with an installation embodying the features of the present invention, the side of the spray chamber being partly broken away to show a mold car therein, with molds in position on the car.

Fig. 2 is an end elevation of the equipment of Fig. 1 showing a mold car with molds mounted in position to receive cooling spray from the spray pipes, the view also showing certain details, partly diagrammatic, of the control mechanism for the spray.

Fig. 3 is a plan view of the spray piping for the installation of Figs. 1 and 2, mold cars being not shown.

Fig. 4 is a wiring diagram for the controls.

Fig. 5 is a diagrammatic representation of the hydraulic circuit for the illustrated equipment.

Fig. 6 is a perspective view of certain details of a timing device which is suitable for use in connection with the present invention.

Fig. 7 is a view similar to Fig. 1 showing a modified form of connection for the pipe which supplies water to the spray chamber, whereby the spray water does not enter the valve.

Figure 8 is a view similar to Figure 5, showing the modified construction of the spray supply line as illustrated in Figure 7.

Referring more particularly to the drawings, the illustrated embodiment of the present invention comprises a spray chamber A, having a plurality of spray-pipes B controlled by mechanism C, for spraying cooling water on molds D mounted on mold car E, and illustrated as billet molds.

The spray chamber illustrated in the drawings includes sides 7 and 9, which are steel plates spaced apart by cross-beams 11, 13, 15, 17 which are welded to the side plates 7 and 9 and to vertical H-beams 19, of which four are shown on each side, these H-beams thereby reinforcing the side plates as well as securing the cross-beams firmly in position. The spray chamber is open at the ends and top, a pipe 21 extending longitudinally of the chamber at the top thereof, and resting on at least some of the cross beams, the beams 13 and 15 being shown on the drawings as supporting the pipe 21 which leads to the spray pipes, which will be referred to hereinafter. The spray chamber A is shown as being erected on a foundation 23, which may be of concrete, the bottom of which forms a bed for rails 25 of the track for the mold car E. The foundation 23 defines a pit 27, the bottom of which slopes downwardly to a

water-return gutter 28, which will be referred to in greater detail hereinafter.

The pipe 29 receives water from a pipe 31 and joins through a T-connection 33 to oppositely extending pipes 35 and 37 which are extended downwardly within the spray-chamber along the side walls thereof, and as is indicated at 39 and 41 in Figures 2 and 7. From these downwardly extending pipes there are extended horizontally similar groups of pipes indicated generally at 43 and 45 which are provided with spray nozzles 47, 49 which direct their spray on the molds. The horizontally extending spray pipes are closed at their ends by suitable cap means 46, as shown in Figures 1 and 3. A T connection 48 is used to join the pipes 31 and 21 together as illustrated in Figure 3.

Any suitable arrangement of the spray pipes and nozzles may be used for directing the cooling water against the molds, one embodiment being illustrated in Figures 1, 2, 3, and 7 of the drawings.

An important feature of the invention resides in the provision of adjustable automatic means for controlling the spraying operation which will now be described. This mechanism controls the flow of water to the spray chamber, for example, through pipe 31 to 21 and comprises a motor actuated valve 50, the operation of which is automatically controlled by an electrically actuated time switch means, such as diagrammatically illustrated in Figure 4.

A reversing motor 51 having field windings 53 and 55 is arranged to operate the valve 50 by means of the worm 57 mounted on the armature shaft of the motor 51. Worm 57 drives the gear 61 in mesh therewith. Gear 61 operates a crank 63 which is connected to the valve operating lever 71 through the rod 67 as shown in Figure 2. When the gear 61 is rotated the valve actuating member 71 is swung to the right or left, depending upon the direction of rotation, about the pivot 72, as viewed in Figure 4, to control the flow of water to the spraying mechanism. The opposite end of the rod 67 is suitably shaped, as at 68 in Figure 4, to form a switch actuating member for the limit switch means 73.

This electrical switch mechanism comprises the contactor arm members 77 and 79 which are pivoted as at 81 and 83. Electrical contact means 85 and 87 coact with the arm members 77 and 79 respectively to form an electrical circuit as illustrated in Figure 4.

For controlling the length of time the spraying means is in operation, a clocklike timing mechanism is utilized as diagrammatically shown in Figure 4. This mechanism is electrically connected to the limit switches 73 for controlling the operation of the motor 51. A dial member 91 has graduated scale markings for indicating the duration of the spraying operation. Associated therewith is a manual adjusting means 93 which is adapted for setting the timing mechanism so that the spraying means will operate for a desired length of time and then be stopped. This adjusting means comprises a cam member 95 which is rotated by the motor 92 having the field windings 94 and connected to the power line 97 through leads 99 and 99'.

The cam 95 is mounted on a suitable shaft 96, see Fig. 6, which extends through the housing 89 and which is rotated by the motor 92 through suitable speed reducing means indicated by pinion 98 on the motor shaft 100 and

gear 102 on the shaft 96. The manual adjustment 93 comprises a knob which is telescopically mounted on the time-adjusting end of the shaft 96. Spring means 104 compressed between the knob 93 and cam 95 normally holds the knob 93 in outward position. The knob 93 is provided with a gear 106 which meshes with dial 91, this latter meshing also with an internal gear 108 on the adjusting cam 95, so that the dial 91 may be set to indicate the duration of the spraying period by pushing in on the knob 93 and turning the dial 91 and adjusting cam 95 to the desired predetermined time interval.

There is provided also on the shaft 96 a cut-off cam 110 for the motor 92, which operates a start-stop switch 112 for starting and stopping the motor 92 as will be described hereinafter in greater detail, a contact lug 114 on the cut-off cam 110 throwing switch 112 by engaging a contact lug 116 on the switch 112.

The cam 95 is provided with a segmental lug 101 which is adapted to engage a contact 103 on a reversing switch 105, the switch 105 being adapted to operate between contacts 107 and 109 for operating the valve-actuating motor 51 in reverse direction. The switch 105 is held by the pressure of a suitable spring (not shown) against contact 107, but when the segmental contact 101 on the cam 95 engages contact 103 on arm 105, the latter is depressed until it engages the contact 109 for reversing the motor 51 and consequently the actuation of valve 50.

A master control switch 111, which conveniently is a push-button switch, is provided between the lead 99 for motor 92 and the line 97; a lead 113 connecting the other side of switch 111 to the line. Since the switch 111 preferably is a push-button switch, it normally is open.

The start-and-stop switch 112 is suitably pivotally mounted as indicated at 124, and is urged normally against contact 126 of the motor 92, by the pressure of a suitable spring, not shown. A lead 128, connected to lead 113 between the switch 111 and line 97 and to the switch 112, supplies sustaining current to the motor 92, the current being returned to the line 97 from motor 92 through lead 99'.

The push-button 111 normally is open, as has been said above, so that when the lug 114 on cam 110 engages contact 116 on switch 112 to break the contact between the switch 112 and motor contact 116, the motor 92 stops.

Now lead 99 is connected also to the motor contact 126, so that when the push-button 111 is closed, current flows through the lead 99, contact 126, motor 92 and back to the line from the motor through lead 99'. This starts the motor and disengages cam contact 114 with switch contact 116, thereby allowing the switch 112 to make contact with the motor contact 126, so that when the push-button 111 is released, the motor 92 still operates by current supplied through lead 128 and switch 112, the motor 92 running until contact is made again between the cam contact 114 and switch contact 116, causing the disengagement of the switch 112 from contact 126, thereby stopping the motor 92, as push-button 111 normally is open, until the push-button 111 is closed again.

It will be understood of course that the time adjusting cam 95 is rotated with the shaft 96, through the medium of friction disc drive 130, see Fig. 6.

Now it will be observed from Fig. 4 that the push-button 111 is connected to the valve motor

51 by way of lead 99 and lead 115 which is connected to the lead 99. The valve motor field 55 is connected to contact 85 for arm 77 of limit switch 73 by a lead 117, another lead 119 connecting the limit switch arm 77, at its pivot point 81, to contact 107 engaged by reversing switch 105, a lead 121 connecting this switch 105 to the other side of the line 97.

This constitutes the spraying circuit at the start of the timing motor 92. When this motor 92 starts and the switch 112 has closed, the motor 51 operates independently of the push-button 111 as does the motor 92, the spraying circuit being then from line 97 through leads 113, 128, switch 112, contact 126, lead 115 and then as described above.

Now the field 53 of the valve motor 51 is connected by lead 118 to the contact 87 for limit switch arm 79, this in turn being connected at its pivot point 83 through lead 120 with contact 109 for the reversing switch 105.

This constitutes the valve-opening circuit, which of course is completed by engagement of the segmented contact 101 on the time-adjusting cam 95 with the contact 103 on the switch 105 to depress the latter into engagement with contact 109.

The length of time of spraying is determined by the position of the segment contact 101 on the cam 95 with respect to the contact 103 on the reversing switch 105. With the cam 95 being turned by its motor 92 in clockwise direction, the more nearly a complete revolution the cam 95 makes before contact 101 depressingly engages contact 103 of switch 105, the longer will be the spraying time. This position of the contact 101 relative to the contact 103 is adjusted by the manipulation of the knob 93.

In order to indicate when the sprays are operating, to an operator who may be at a station remote from the equipment, a signal light 122 is illustrated as being connected in the spraying circuit, the light continuing to glow while the spraying circuit is closed, and being extinguished when switch 105 leaves contact 107.

At the start of operation, with the adjusting cam 95 in proper position and the dial 91 is indicating the desired duration of spraying time, the elements of the mechanism will be in the position shown in Fig. 4.

Push-button 111 is closed momentarily, this momentary closing starting the valve motor 51 and the timing motor 92. The starting of the latter moves the contact 114 out of engagement with contact 116, thereby allowing the switch 112 to close, rendering the push-button 111 inactive and permitting it to open without stopping motor 92 which rotates the cams 110 and 95. Meanwhile the motor 51 operates the worm 57 and gear 61, thereby causing the valve 50 to close, so that water is passed to the spray pipes by the action of pump 123 as will be described hereinafter.

As the valve 50 closes, the switch-actuating member 68 of rod 67 is approaching an abutment screw 125 mounted in the limit switch 73, continued movement of the member 68 towards the left as viewed in Fig. 4 will push against the screw until contact is broken between the switch arm 77 and the contact 85. When this happens the motor 51 stops and the valve 50 is in fully closed position as regards pipe 135, with the spray on.

Now the cams 95 and 110 are rotating continuously, with the segment contact 101 on cam

95 approaching the contact 103 on switch 105, and the spray continues to be on until the segmental contact 101 engages the contact 103 and shifts the switch 105 from contact 107 into engagement with contact 109.

This reverses the valve-motor 51, pulling back the switch actuator 68 and operating the lever 71 to open the valve 50. As the valve 50 is opened, the switch actuator 68 engages an abutment screw 127 mounted in limit switch 75, and presses thereupon until the contact is broken between switch arm 79 and contact 87.

Immediately thereafter the segmental contact has passed off from the contact 103, allowing the reversing switch 105 to snap back against contact 107, and lug 114 of the cam 110 engages contact 116 on switch 112 to open the switch to stop motors 92 and 51 until the button 111 is closed to start the next cycle.

All switches preferably are spring-pressed, to assure positive action, and the abutment screws 125 and 127, being adjustable, assure proper contact of actuator 68 therewith, for assuring proper actuation of the limit switches by the actuator 68.

It has been found in practice that the molds should be cooled uniformly, and that, consequently, it is important to maintain the spraying water at a substantially constant temperature. This will be brought out in greater detail hereinafter.

It has been pointed out above herein that the spray chamber is built on a concrete foundation 23, the bottom of which slopes inwardly to a return gutter 28 which returns the water to a settling sump 129 the top of which is provided with an overflow 131 which leads into a pump sump 133, in which is positioned a pump 123 which continuously operates to circulate water by way of pipe 123' through the valve 50 as illustrated in Figures 5 and 8. Suitable by-pass means 135 is provided for passing the water to the return gutter 28 while the valve 50 is opened. The pump 123 is driven continuously by a motor 137.

The pump sump 133 is provided with an overflow 139 for passing excess water to a cooling pond or other storage 141.

In practice, the water employed for cooling purposes is maintained at a temperature of from approximately 110° F. to approximately 130° F. The temperature of the water-line 21 being held at a definite pre-selected value within this range; but in certain operations the water temperature may be maintained much higher, for instance up to about 200° F.

Consequently, there must be provided temperature control means for the water, which means may conveniently be supplied in the pump sump 133, this being taken as the source of the cooling water.

The temperature control means are illustrated as comprising a steam supply line 143 and a water supply line 145, these being valves 147 and 149 in the respective pipes for controlling admission of steam and water, respectively to the system, the steam being added to heat the water, and water being added for cooling. The pipes 143 and 147 open substantially below the level of the water in the pump sump.

The valves 147 and 149 are operated manually as shown in the drawings. However, thermostatic controls operable by predetermined variations in the water temperature in the sump 133 may be provided readily for automatically main-

taining a constant temperature in the circulating water. By virtue of the steam line 143 and water line 145 the temperature of the circulating water may be maintained closely at any preselected temperature. Of course, suitable heating and cooling coils may be substituted for the pipes shown.

Make-up water may be admitted into the system through pipe 145 for maintaining the requisite volume of water in the system, in addition to providing for the introduction of cooling water into the system if the circulating water becomes too hot for the given operation. The excess water introduced either by the introduction of such water, or by the condensation of steam introduced into the system, overflows through overflow 139 into storage 141.

A temperature indicator 151 is provided to indicate the temperature of the water, the indicator 151 being operated by a suitable gas bulb 153 submerged in the water in the pump sump. Of course, when an automatic thermostatic control is provided for the control of the source of heat and cooling, the indicator 151 serves merely as a check on the proper operation of the thermostatic control. In the illustrated installation, the indicator 151 indicates to an operator whether steam or water is required to be introduced to maintain the desired even water temperature.

While the present invention has been illustrated and described specifically in connection with the cooling by spraying of metal billet molds employed in the casting of copper billets, it will be apparent that the principle of the present invention is not limited necessarily to this particular adaptation of the invention, as this same principle of controlled spraying time in conjunction with the maintenance of an even temperature of the spraying fluid is usable in a wide diversity of applications. For example, it may be applied to molds mounted on a casting wheel, or, in general, to any installation wherein there is needed an automatic timing control for effecting an adjustable predetermined time of contact between the objects and the fluid applied thereto, as well as for maintaining a predetermined constant temperature of the applied fluid, as described above.

It will be understood, of course, that in the embodiment of the invention as illustrated and described herein the valve 50 may be a standard two-way valve operating so that when the valve is open to allow spray water to pass through the pipe 31, the by-pass line 135 is closed; and when the motor 51 reverses at the end of the spraying period the pipe 31 becomes closed and the by-pass line 135 becomes open, for continued circulation of the water. However, it will be understood that details of the system as illustrated may be modified without departing from the scope and spirit of the invention, as shown in Figs. 7 and 8. Thus, the pipe 31 may join the pump line in advance of the valve 50', as illustrated in Figures 7 and 8. Valve 50' may be a simple cut-off valve, to which the by-pass 135 is connected, the operation then being that when the motor 51 operates the valve to close it in the manner as described above, water will pass through pipe 31 to the spray chamber, and when the motor 51 reverses at its end of the spray period as described above to open the valve, the water is prevented from flowing through pipe 31, which is a vertical pipe, and passes through the relatively short by-pass 135 and thence back to the pump sump 133. In this arrangement of the

equipment the water will not pass into the valve 50' on its way to the spray chamber, but otherwise the actuation of the various elements of the system will be the same as has been described above in detail.

What is claimed is:

1. An apparatus for cooling molds to a predetermined temperature comprising the combination with a cooling liquid circulating system provided with a liquid reservoir, pump, and mold spraying station, of a conduit means connected to the discharge side of said pump for conducting the cooling liquid to said station and in contact with said molds to cool the same, a valve in said conduit for controlling the passage of cooling liquid therethrough, means comprising a pivoted lever for opening and closing said valve, a motor for actuating said lever, said motor being reversible to move said lever in either direction to operate said valve, adjustable timing mechanism operatively connected to said motor for operating said valve so as to apply cooling liquid directly onto said molds for a predetermined length of time, and then automatically bring about the actuation of said valve to cut off the application of cooling liquid to the molds.

2. Apparatus for cooling metal casting molds which comprises the combination with a spray chamber having means for positioning the molds to be cooled therein, of a conduit for passing cooling fluid into said chamber and directing it in the form of a spray onto said molds to cool the same, valve means in said conduit, means for controlling the operation of said valve to allow cooling fluid to pass to said spray chamber for a predetermined time, and means automatically operable after the expiration of said predetermined period of time to cut off the flow of liquid to the spray chamber, and means for maintaining the cooling fluid at a substantially constant predetermined temperature to effect uniform cooling of the molds.

3. Apparatus for cooling metal casting molds which comprises in combination with a spray chamber and means for moving mold means to be sprayed therethrough, of a conduit for passing cooling liquid from a source of supply to said spray chamber, valve means positioned in said conduit for controlling the flow of liquid to the spray chamber, means comprising a reciprocable lever for operating said valve to control the flow of cooling liquid, time-setting switch mechanism for operating said valve to effect spraying of said mold means for a predetermined period of time and then cut off the spray by diverting the flow of liquid from the spray chamber back to the source of supply, means for continuously circulating the cooling liquid from the source through said conduit, said means including a by-pass controlled by said valve operable to allow said cooling liquid to pass back to said source of supply without passing through said spray chamber, means for returning the water from said spray chamber to the source, and means for adjusting the temperature of the water to maintain it substantially constant.

4. An apparatus for cooling molds to a predetermined temperature comprising a spray chamber, means for positioning the molds to be sprayed in said chamber, a source of water supply and pipe connections to said chamber for conducting cooling water thereto, valve means in said pipe for controlling the flow of water to said spray chamber, mechanism comprising a

reciprocable means for operating said control valve, prime mover means operatively connected to said reciprocable means for intermittently moving it from one position to another, adjustable time switch means associated therewith for starting said prime mover to bring about the shifting of said reciprocable means to operate said valve and cause water to pass to said spray chamber and be sprayed on the molds positioned therein, said reciprocable means being actuated by said prime mover after a predetermined time interval corresponding to the setting of said time switch to stop passage of cooling water to said spray chamber and onto said molds.

5. An apparatus for cooling molds comprising a sprayer mechanism, a source of water supply, conduit means connecting said water supply and sprayer mechanism through which cooling wa-

ter is conducted and sprayed onto said molds, valve means in said conduit, means operatively connected with said valve for moving the same between a spraying and non-spraying position, time switch mechanism associated with said valve operating means for bringing about the actuation of said valve to return it to its normal non-spraying position at the end of a predetermined time interval during which said valve has been set in the spraying position, means for adjusting said time switch mechanism to vary the duration of the spraying operation, and means for maintaining said water supply at a substantially constant temperature to effect uniform cooling of the molds.

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