

Sept. 25, 1928.

1,685,546

H. S. LEE

PROCESS FOR CONTROLLING METAL CASTINGS

Filed March 8, 1926

3 Sheets-Sheet 1

Fig. 1

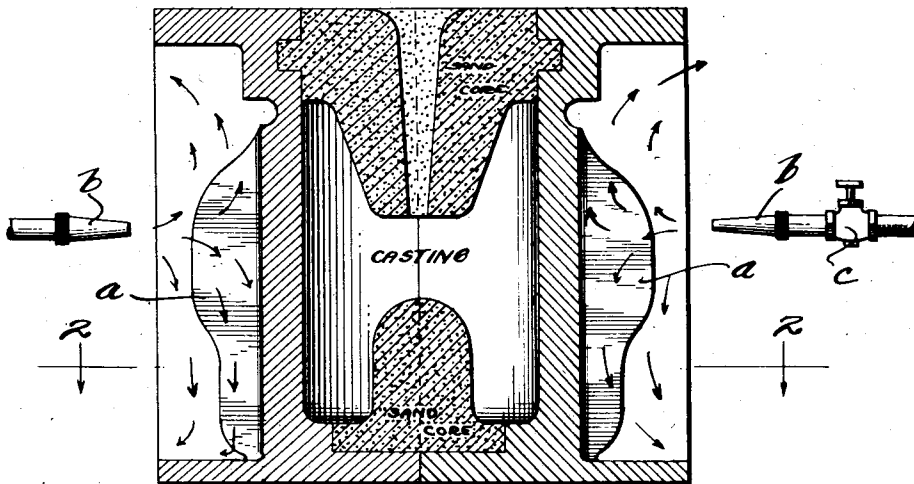
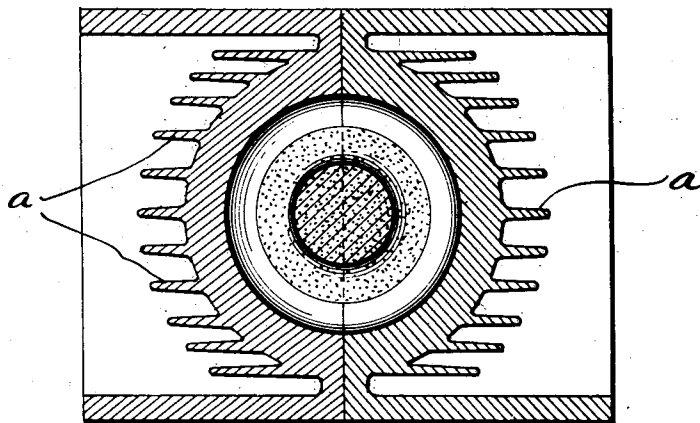


Fig. 2

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3 Sheets-Sheet 2

Fig. 3

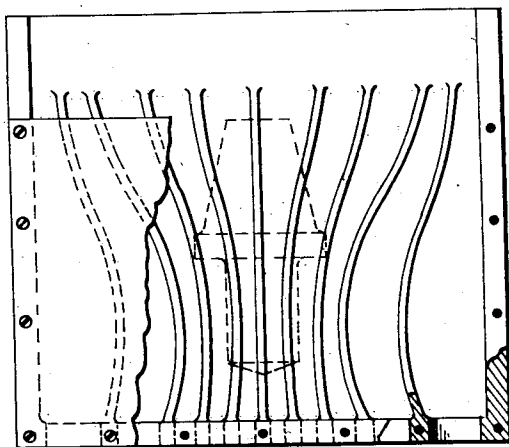
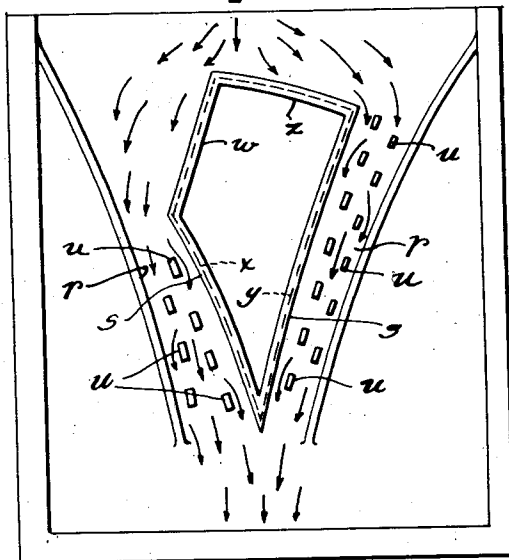


Fig. 4

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3 Sheets-Sheet 3

Fig. 5

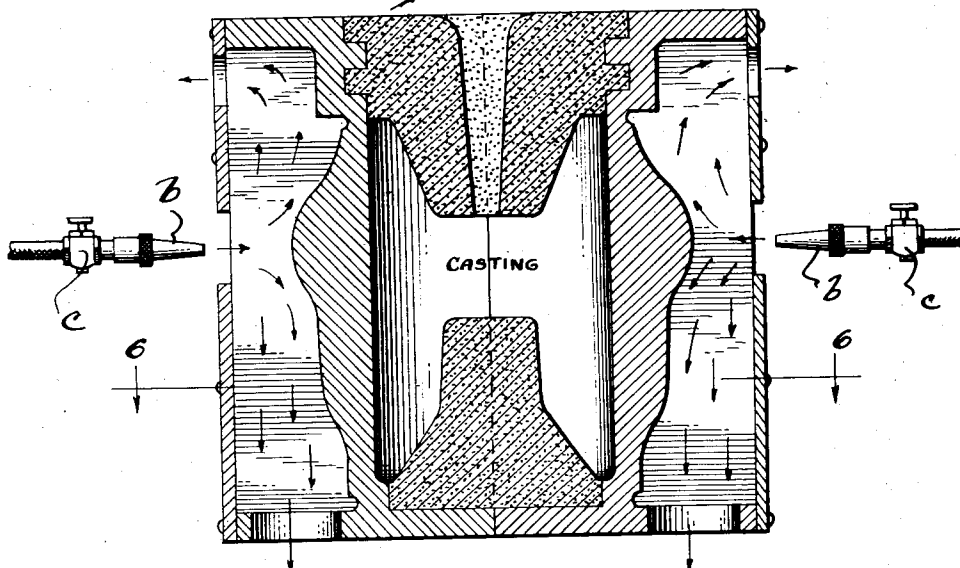
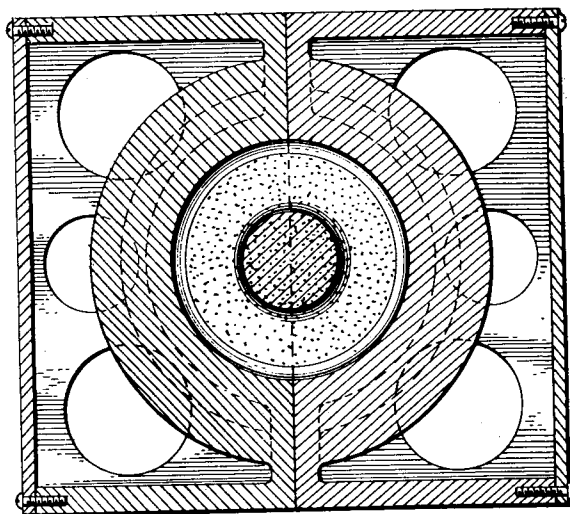


Fig. 6

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PROCESS FOR CONTROLLING METAL CASTINGS.

Application filed March 8, 1926. Serial No. 93,056.

This invention relates to the heat control of castings and permanent moulds. It is the object of the invention to afford a process for properly controlling the character of the finished casting by means of a suitable regulation of the heat conditions.

It is the further object of the invention to provide an apparatus to carry out this process. This will be more fully described hereinafter.

In the drawings:

Fig. 1 is a vertical section of a permanent mould showing means for regulating the character of the casting.

Fig. 2 is a cross section on the line 2—2 of Fig. 1.

Figs. 3 and 4 are elevations showing means for chilling a portion of the casting.

Figs. 5 and 6 are sectional views showing means for controlling the casting by the thickness of the mould as distinguished from the fin structure shown in Figs. 1 and 2.

I have found that in the producing, commercially, of permanent mould castings, in order to get castings that have predetermined properties at certain points, it is necessary to nicely control the heat dissipation in the mould. For instance, it is desirable in getting a casting of uniform properties throughout that the cooling of the casting progress be substantially uniform throughout regardless of the section of the casting. Again, in other castings it is desirable to chill a portion of the casting to harden the surface. It is the object of the present invention and discovery to afford an apparatus and method to understandingly accomplish these purposes with fair precision.

In carrying out my improved process I find that the most significant thing is to regulate within given limits the abstraction of heat from the mould at any particular location. When this is understandingly and carefully done, the character of the finished casting can be controlled within rather small limits so as to accomplish the best results in the work produced. I have devised several methods and several apparatuses for accomplishing this general heat control.

Referring to Fig. 1, a casting is shown which has a sort of I-beam section. It, of course, has greater bulk at the center than elsewhere. Now, if an ordinary permanent mould is used and ordinary moulding methods, it will be obvious that the center

will be the last place to cool, and consequently the rapid cooling of the corners, or thin portions of the casting will result in different properties in the finished casting at different parts. This is especially true where the casting has to be rapidly cooled, as is the case in permanent moulds which are operated on a semi-automatic machine which goes through a cycle of timed operations. In such a machine the castings have to be rapidly cooled in order to clear the moulds for the next batch of castings as the machine proceeds on its way. If artificial cooling means are introduced then it will be obvious that portions of the casting may be actually chilled in cooling other portions of the casting within the desired time limit. This, of course, is highly undesirable in a casting that is to be machined all over or for castings that are to be used for many purposes. It will be understood that this I-beam casting is simply an illustration of one form of casting which presents the problem which I have sought to meet with my improved methods and apparatus.

Continuing the description of the process and referring to Figs. 1 and 2, one method of carrying out this regulated heat abstraction is illustrated. Here the mould is provided with air cooling fins. These fins are wider adjacent the heavy portions of the casting than at the ends. This, of course, will tend to conduct the heat away faster at the center as they have a greater capacity than the end portions of the fins. Thus abstraction of the heat away faster at the center is effected as the fins have a greater capacity near the center than at the end portions. This abstraction of the heat may be done wholly without any artificial agitation of the air surrounding the fins, provided the fins are constructed large enough and the excess heat at the center of the casting to be conducted away is not too great, and provided further that the time element permitted in cooling is large enough. However, I find it usually desirable, especially when using a semi-automatic machine in which the time element for cooling is rather short, to introduce a further step and means in this heat abstraction. For instance, in Fig. 1, an air blast is furnished by the nozzle *b* and this may be nicely controlled by means of the hand valve *c*. The air blast, as will be seen, is arranged to strike the side of the mould at the center adjacent the

heavy portion of the casting. Now it will be obvious that measurably good results could be obtained by having a large air blast strike the mould on plain walls at the point where the greatest rapidity of heat abstraction is desirable. However, I find it more advantageous to combine the two methods and the two devices and use both a larger surface area for heat dissipation and also a greater amount of air at the points on the mould where the fastest heat dissipation is desirable. Hence at the center and thickest portion of the casting we here have both a greater surface area of the metal of the mould and also the cold air strikes directly at this point. These two factors cooperate together in supplementing each other in the action so that too much bulk will not be required in the excess portions of the mould used for cooling and also too much air will not be required. The two also working conjointly enables the greatest possible rapidity of the cooling action. Consequently they are very desirable in permanent moulds where the time unit is an important factor in a continuous cycle of operations.

Figs. 3 and 4 show still a different variation of the cooling devices. In Fig. 3 the ribs are so formed as to bring a greater number into proximity to a given area of the casting than in other portions of the casting. In the type shown in Fig. 3 this is calculated to chill a portion of the casting for the greater rib density is at one of the small portion of the casting, and consequently it will be obvious that if the heavy portion of the casting be rapidly cooled the smaller part of the casting is bound to be chilled. This, of course, may be worked with or without air agitation in the neighborhood of the ribs.

In Fig. 4 a point of a plow is shown in which the point is chilled. Here still another way of controlling the heat abstraction is illustrated. Here ribs *r* and *s* are employed to direct the air blast along the sides *x*, *y*, which are the parts of the plow point to be chilled. The ribs *w*, *z*, direct the air blast from the portion of the casting not to be chilled. The teeth *u* help dissipate the heat at the surfaces to be chilled.

In Figs. 5 and 6, still another modification of the method and a different device is shown. Here the conduction of the heat from the heavy portion of the casting is controlled by varying the thickness of the mold walls, for the thicker the section of the mold wall the greater its capacity for heat conduction, and somewhat similar an effect is secured as with the use of fins.

Considering my invention from a broad standpoint, it must be understood that the artificial aid to heat dissipation may be accomplished in a variety of ways. I have here shown the air blast. Obviously suction

could be employed and the fluid need not necessarily be air. As I have already explained, the heat control and dissipation of the abstraction of the heat may be made effective by either conduction alone (varying the section or fin construction of the mould) or by convection—that is, bringing a fluid in contact with the particular portions of the casting to be more rapidly cooled, or the two may be united together to employ both conduction and convection.

It will be apparent that the exact construction of the section of the mould will have to be nicely worked out in accordance with the time factor, the character of the casting desired, the amount of cooling fluid, etc. These will all vary of course, and no positive directions can be given. The illustrations in the drawings are simply rough examples of my improved process and apparatus and will serve to readily apprise one skilled in foundry practice how to proceed to carry out the invention.

This application is related to application Serial No. 61,673, in which I have shown and described the control of a casting by means of thickening the walls of the casting and also by reducing the walls to choke back the conduction at different points. The present application is intended to cover both the process and the apparatus while application Serial No. 61,673 is intended to contain the claims to one specific way of controlling the temperature—by varying the mass of metal. In so far as that application contains a complete disclosure of any of the broad subject matter claimed in this application, this application may be considered a continuation in part thereof.

In my application Serial No. 51,973, I have disclosed broadly the use of the cooling fins by air agitation produced by suction. However, I have not described and claimed the controlling of the different portions of a casting by a variant fin construction or a variant fluid application. This application may to a limited extent be considered a continuation in part of such prior application in so far as the present application makes any broad claims to the subject matter disclosed in such prior application, especially to heat dissipation generally by increasing the conductivity capacity of the mould, or by convection due to fluid application, or by both.

Still another application, Serial No. 51,723, discloses the control of the character of the casting by heat conduction regulation due to the use of metals of varying co-efficients of conductivity at determined portions of the mould. This aforesaid application may be considered as limited to a modification of the generic invention here claimed, namely the species of both the method and the apparatus controlling the heat abstraction.

tion by conduction by varying the coefficient of the conductor.

What I claim is:

1. In the art of casting ferrous metals in permanent molds, the method of obtaining predetermined varied characteristics in the metal of a cast article, which consists in the controlling of the dissipation of the heat from the cast metal by the application of a regulable cooling fluid to local portions of the mold walls so that such heat is dissipated from various portions of the cast metal in such degrees of rapidity as will effect the varied characteristics in the cast metal.
2. In the art of casting ferrous metals in permanent molds, the method of obtaining

predetermined varied characteristics in the metal of a cast article, which consists in the calculatingly controlling the dissipation of the heat from the cast metal in accordance with the predetermined characteristics to be obtained by regulating the conductive capacity of the mold walls and by the application of a cooling fluid to such mold walls so that such heat is dissipated from various portions of the cast metal in such degrees of rapidity as will effect the varied characteristics in the cast metal.

In testimony whereof he affixes his signature.

HARRY S. LEE.