Dec. 17, 1940. S. JUNGHANS 2,225,415

PROCESS FOR THE CONTINUOUS CASTING OF CASTINGS WITH CONTINUOUS LONGITUDINAL HOLLOW SPACES

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Fig. 1.

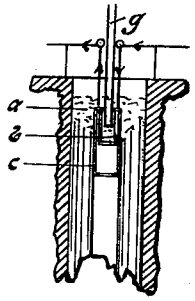


Fig. 2.

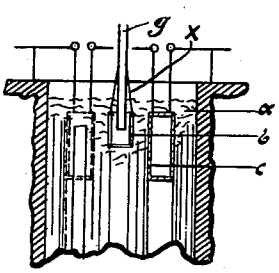


Fig. 3.

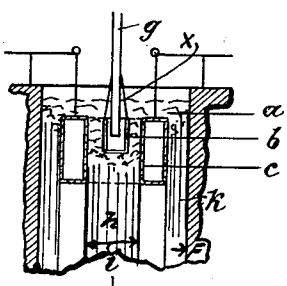


Fig. 1a.

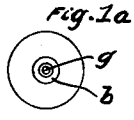


Fig. 2a.

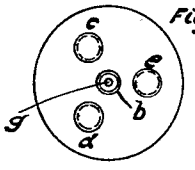


Fig. 3a.

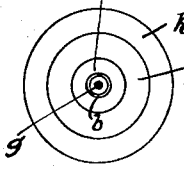


Fig. 4.

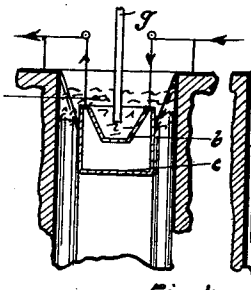


Fig. 5.

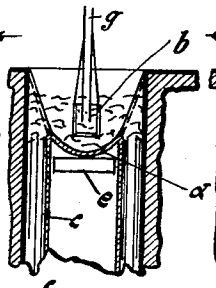


Fig. 6.

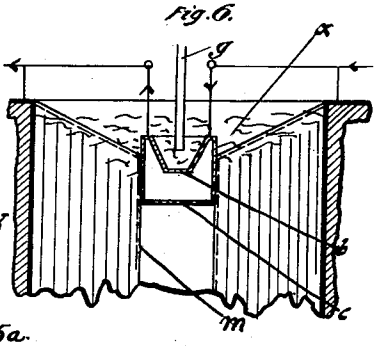


Fig. 4a.

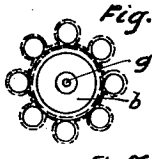


Fig. 5a.

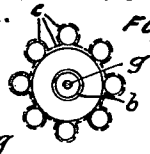


Fig. 8.

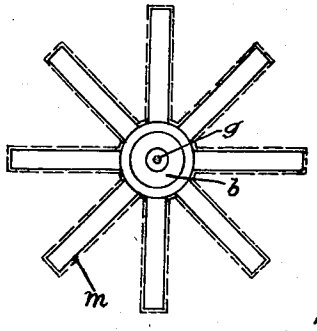
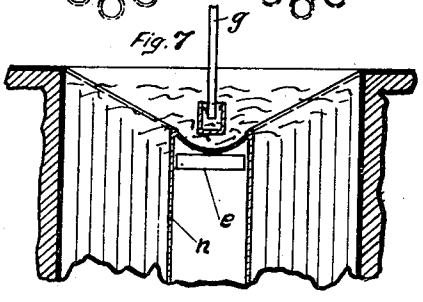


Fig. 7



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Fig. 9.

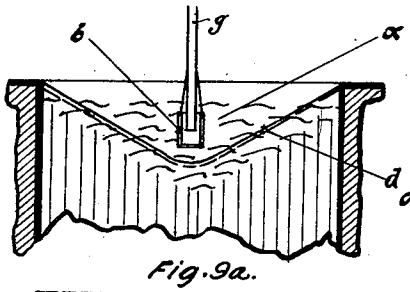


Fig. 9a.

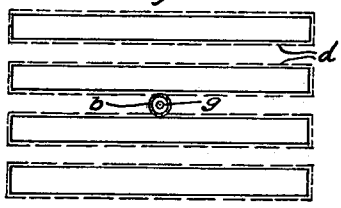


Fig. 10.

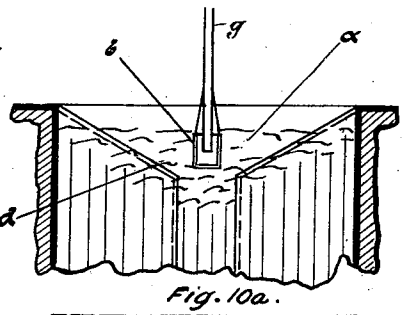


Fig. 10a.

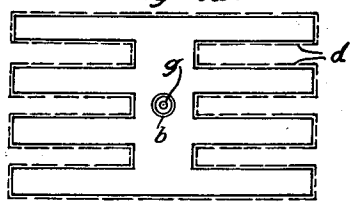


Fig. 11.

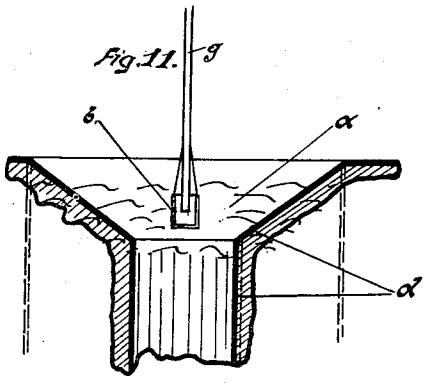
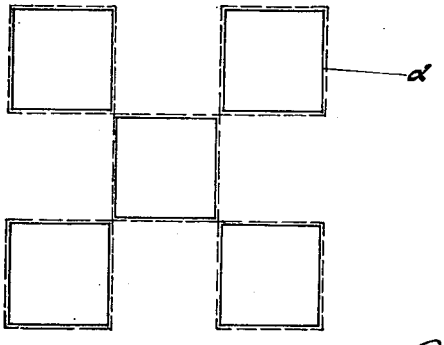


Fig. 11a.



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UNITED STATES PATENT OFFICE

2,225,415

PROCESS FOR THE CONTINUOUS CASTING OF CASTINGS WITH CONTINUOUS LONGITUDINAL HOLLOW SPACES

Siegfried Junghans, Stuttgart, Wurttemberg, Germany

Application May 6, 1938, Serial No. 206,366
In Germany May 8, 1937

1 Claim. (Cl. 22—200.1)

It has been already proposed to cast continuously castings with hollow spaces, in which case a mandrel or core is introduced from above into the centre of the chill mould and during the casting produces in the cross-section enclosed by the chill mould a hole which appears in the finished casting as a longitudinal hollow. This casting is therefore a pipe.

It has however been found that this method has the drawback that as the supply of the liquid metal has to take place laterally of the centre of the chill mould, the temperature distribution in the liquid casting head or ingate is an irregular one, for the supply side must always contain a hotter metal than the opposite side. This results in an irregular congealing or solidification which leads in turn to irregularities in the structure of the cast metal. Another drawback is that this process can be applied only in the case of relatively large casting cross-sections, as between the core and the wall of the chill mould there must be always so much liquid metal as to make impossible solidification between the metal supply pipe and the core or the mould wall, as otherwise the work would be interrupted on account of such freezing or solidification.

It is further known in the continuous casting of solid castings to supply the jet of molten metal to the mould in a steady uniform manner and to maintain in the centre a small liquid casting head of small depth without deep liquid blowholes or pipes, and in that way to be able always to regulate exactly the shape and the speed of the solidification. In such a process, under the mouth of the supply pipe within the chill mould is preferably arranged a cup-shaped catching or receiving device for the purpose of ensuring in a reliable manner uniform inflow and uniform distribution of the incoming metal without any formation of pipes or blowholes.

According to the invention, the drawbacks of the process mentioned in the first place for continuous casting of hollow bodies are eliminated by maintaining also in this case over the whole cross-section of the chill mould a small liquid casting head, which therefore covers the cores provided for the purpose of producing the hollow spaces. The chill mould is therefore arranged in such a manner that the cores no longer project upwards as hitherto out of the liquid casting head, but begin below the surface whilst above them the liquid metal is uniformly distributed over the whole cross-section. When a pipe is to be cast, there is arranged in the centre of the chill mould, but below the level of the liquid casting head, a hollow core which can be continuously cooled by means of a cooling medium. When in this case a receiving and distributing device is to be used, as mentioned in the foregoing, the core could be arranged under it, or even carrying it. Although in the latter case the core is actually introduced from the top, it is apparent that the cooling action of the core can only begin below the liquid casting head.

It should also be apparent that in this way there could also be made cast bodies with several parallel hollows by providing several cores in the chill mould below the liquid casting head. These cores could then be so constructed that they would completely separate from each other the individual cast bodies, that is to say so that the latter would leave the chill mould as bodies completely independent of each other, or so that the solidified body could readily be subsequently divided into such individual bodies. Care must then be taken that the casting head extending over throughout the whole cross-section of the chill mould should not be brought to solidification by the cores or separation bodies, or in other words, that the cores or separation bodies should begin their cooling action only when a uniform liquid metal distribution over the whole chill mould cross-section throughout the casting process has been ensured.

The cores or separation bodies can be connected to the chill mould so that they participate in any movements of the latter during casting. On the other hand, they may be independent of the chill mould and stand still or make movements of their own during casting.

In this way small as well as large metal quantities can be cast without any difficulties arising, provided only that care is taken to ensure that the liquid casting head remains the same over the whole cross-section of the mould and thereby ensures uniform metal supply and solidification at all points of the said cross-section.

Several constructions according to the invention are diagrammatically illustrated in the drawings, partly in longitudinal section and partly in plan, as follows:

Figure 1 is a longitudinal section of one form of my invention.

Figure 1A is a plan view of the same.

Figure 2 is a longitudinal section of a modified form.

Figure 2A is a plan view of the same.

Figure 3 is a longitudinal section of another modified form.

Figure 3A is a plan view of the same.

Figure 4 is a longitudinal section of another modified form.

Figure 4A is a plan view of the same.

Figure 5 is a longitudinal section of another modified form.

Figure 5A is a plan view of the same.

Figures 6 and 7 are longitudinal sections of other modified forms.

Figure 8 is a plan view of the form shown in Figure 6.

Figure 9 is a longitudinal section of another modified form.

Figure 9A is a plan view of the same.

Figure 10 is a longitudinal section of another modified form.

Figure 10A is a plan view of the same.

Figure 11 is a longitudinal section of another modified form.

Figure 11A is a plan view of the same.

Figure 1 shows the manufacture of a simple pipe. The liquid metal is supplied to the chill mould through the pipe *g*, under the orifice of which is arranged the cup *b*, the object of which is to muffle the jet and, by continuously overflowing, to distribute it uniformly over the whole cross-section of the chill mould. As will be seen clearly from Figure 1, this cup *b* is situated during casting in the liquid casting head *a*. Under the cup *b* is provided a hollow core *c* which has during the casting operation normally the temperature of the metal flowing in, but which can of course be constantly internally cooled by means of water, oil, air or the like. Both parts—the cup *b* and the core *c*—may be connected to the chill mould so that they participate in any of its movements, for instance up and down movements.

The cup or core may be supported in the mould in any suitable manner. This may be easily done by suspending the cup or core by means of thin rods which extend from above the mould into the mould and through the liquid casting head. Such rods are indicated, for example, at *x*, Figures 2 and 3.

The process of casting takes place in the following manner: The metal coming through the pipe *g* passes first into the cup *b* and is distributed thence uniformly over the whole chill mould cross-section so that the liquid casting head *a* is formed. The metal solidifies then not only at the chill mould wall but also, owing to the cooling of the core *c*, at the latter's walls under the casting head, so that at this point there is formed in the solidifying casting a hollow space corresponding to the shape of the core. As in continuous casting the whole cross-section of the casting is constantly pulled down, a continuous hole will be formed through the centre of the casting. But in contrast to known processes, the supply and the solidification of the metal take place in a perfectly uniform manner.

In the construction according to Figure 2, are provided three cores *c*, *d*, *e* which are situated eccentrically in the chill mould and can be connected to the latter. These cores are also arranged so low that they are situated under the liquid casting head, and this casting head *a* is not influenced by the cooling of the cores. Here again there is the cup *b*, the object of which is uniformly to distribute the metal supplied. In this way during casting is produced a body with three continuous hollows as may be seen in plan below Figure 2.

In known processes where the cores are introduced from the top and project upwards out of the casting head, the described irregular metal distribution and more particularly temperature distribution would take place even if the cup *b* were provided. The consequent limitations of known processes are emphasised by the next example.

Figure 3 shows a core or separation body in the form of a hollow ring *c* which is coaxial with the chill mould. The metal inflowing through the pipe *g* is distributed from the cup *b* in a uniform manner over the whole cross-section, including the top of the annular core *c*. In this way the casting from one and the same chill mould produces a round solid body *h* of a diameter *i* corresponding to the inside diameter of the ring *c*, and further a pipe *k* with the outside diameter corresponding to the mould, and inside diameter corresponding to the outside diameter of the ring *c*. During one and the same casting process, there will be produced therefore two different cast bodies. If, as in the known process, the annular core *c* were introduced from the top and were to project out of the liquid casting head, the outer body *k* would not be produced at all, as no metal could reach it from the pipe *g*. It is therefore important that according to the rule given by the invention, the liquid casting head should extend uniformly over the whole cross-section, including the cores or other separation bodies provided for the formation of the hollow spaces.

The further development of the invention gives now the following result:

With the continuous process it has hitherto been impossible to go below certain cross-sections and diameters, as the supply of liquid metal was impossible on purely technical grounds of construction. This drawback can be remedied according to the invention by manufacturing together several small cross-sections in a single chill mould so that it will nevertheless be possible to obtain a sufficiently large casting head suitable for these purposes and common to all these castings. Figures 4 and 5 show some examples of this.

In the construction according to Figure 4, the cup *b* is connected direct to the core *c*, and both can participate in any movements of the mould. Into the mould are fitted separation bodies with corresponding cooling devices for the purpose of obtaining individual castings from the liquid casting head extending over the whole chill mould cross-section. The core *c* arranged under the cup *b* ensures then continuous separation of the individual castings, so that they leave the mould separated from each other.

In the construction according to Figure 5, the same object is aimed at, with the difference only that here the cup *b* is again rigidly secured to the metal supply pipe *g* and ensures only uniform metal supply and distribution, whilst the separation walls or partitions *c* built into the chill mould for the manufacture of the individual bodies, are connected together in the centre and so arranged as to ensure that the common liquid casting head shall be maintained. The hollow space *e* thus formed in the centre can be either heated or cooled by means of any desired devices.

Conversely, it has also been hitherto impossible to cast unlimited large quantities, more particularly on account of the necessity of supplying metal through pipes, and of the necessity of a quick discharge of the heat. Accordingly continuous processes could seldom be used for certain branches of manufacturing, for instance for the casting of steel or other metallurgical products

such as cast iron bars, copper bars, lead bars, etc., as too many installations would have been needed to cope with the large rate of supply of liquid metal. Here also the process and the apparatus according to the invention give however a simple method, namely by building into a large common mould, in the same way as for small quantities but on a larger scale, separation partitions which are so arranged and cooled as to ensure that a common liquid casting head shall be maintained during the whole duration of casting. An example of this is shown in Figure 6 in which again the cup *b* is rigidly secured to the core *c* and participates with it in any movements of the mould. The core *c* and the partitions *m* produce hollow spaces for the castings, so that completely separate cast plates come out of the mould, as is indicated in plan in Figure 8.

The same success is obtained with the construction according to Figure 7, but with the difference that here a core connected to the cup is dispensed with, and the separation of the liquid metal is attained by the requisite shaping of the separation bodies *n* extending inwards from the mould wall, in the same way as in the example according to Figure 5. Here also provision can be made for maintaining correct liquidity of the casting head by heating or cooling.

Figures 9, 10 and 11 show further examples on the same principles.

In the construction according to Figure 9, in a rectangular chill mould cast plates are produced completely separate from each other, whilst in the construction according to Figure 10, the plates come out of the mould connected to a single block. By sawing or other separation, this block can be divided into its individual parts.

The construction according to Figure 11 shows the manufacture of wire rods which leave the chill mould in five uniform cross-sections in the form of endless castings.

The endless plates, bars, rods, hollow bodies or other sections produced in these various ways, can be sawn, after leaving, in a manner well known in itself, into individual pieces, separated by acetylene burners, or divided in any other desired manner. The further usual treatment processes well known in themselves, can of course also be applied. It must be further pointed out that the use of a cup or the like catching device under the orifice of the supply pipe is not an absolute necessity, and that if no special value is attached to obtaining a particularly uniform and homogeneous casting, the cup may also be omitted, and on the other hand (for instance in the constructions according to Figures 5 and 7) the catching devices may be omitted even when a uniform homogeneous casting is to be obtained, as in such a case the space *e* formed by the partitions provides in a way for the catching of the incoming metal jet. Finally, such special guide devices may be dispensed with also when particularly large quantities of metal are to be cast, as for instance in the construction according to Figure 10.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:

Method for the continuous production of metal castings which comprises continuously pouring liquid metal into the open upper end of a mould, said liquid metal being discharged at a point below the surface of the liquid metal head in said mould, continuously forming a hollow passage in said casting by obstructing the flow of liquid metal within an interior zone extending from a point below the surface of the liquid metal head to a point immediately below the upper surface of the solidified casting, continuously cooling said interior zone, and continuously withdrawing solidified casting from the lower end of said mould.

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