

Dec. 17, 1940.

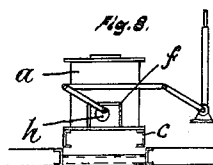
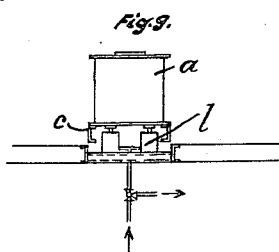
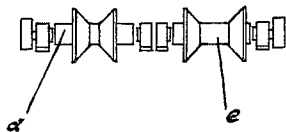
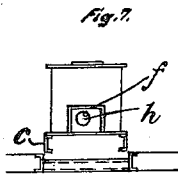
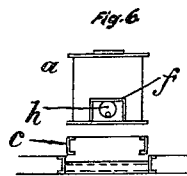
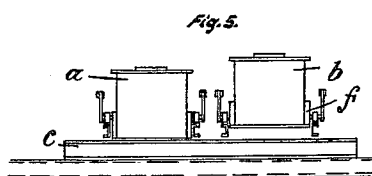
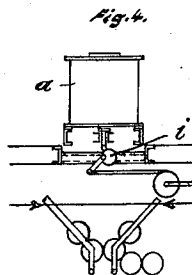
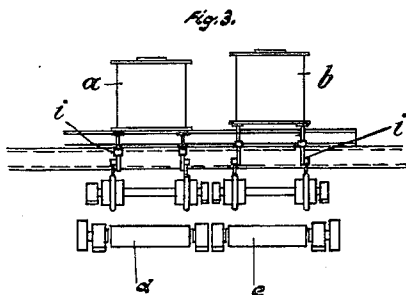
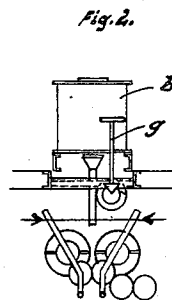
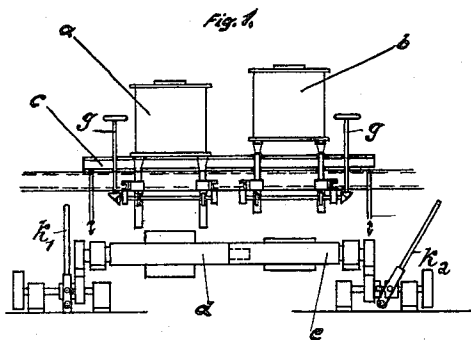
S. JUNGHANS

2,225,416

CONTINUOUS CASTING PROCESS

Filed May 6, 1938

3 Sheets-Sheet 1



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CONTINUOUS CASTING PROCESS

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3 Sheets-Sheet 2

Fig. 10.

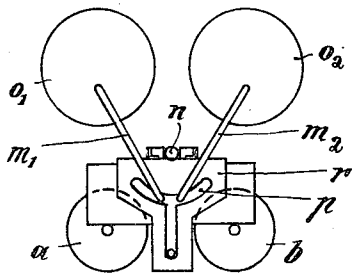


Fig. 11.

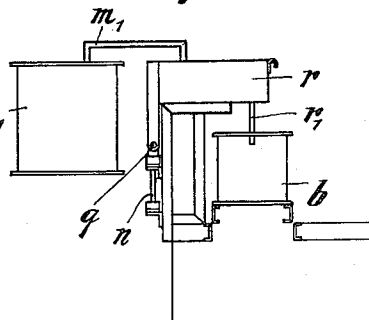


Fig. 12.

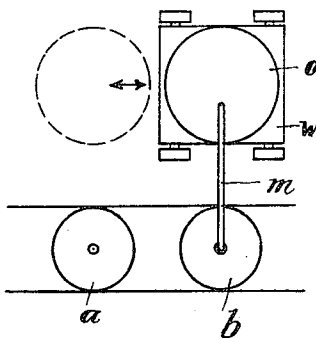


Fig. 13.

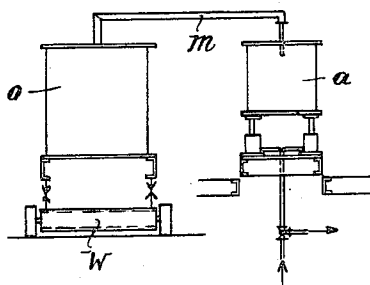
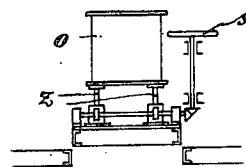


Fig. 14.



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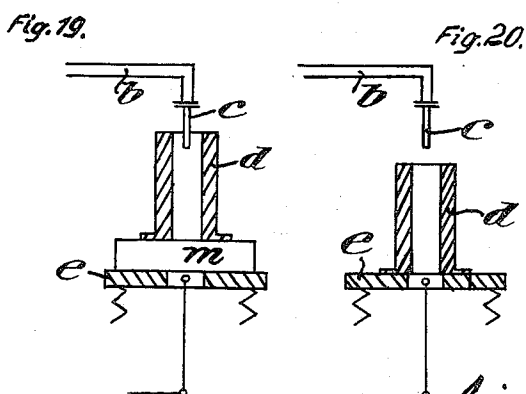
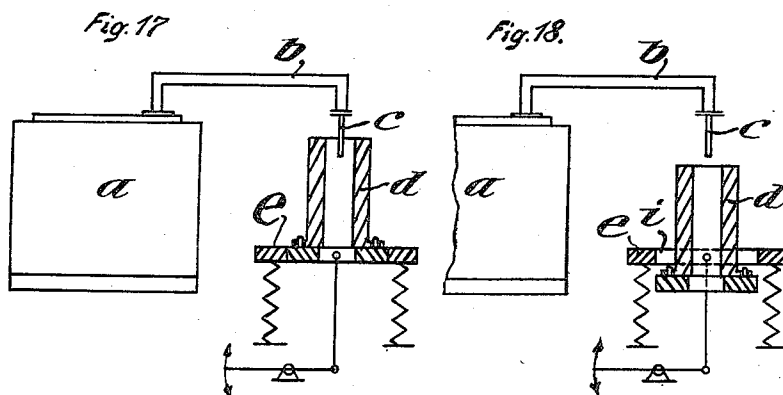
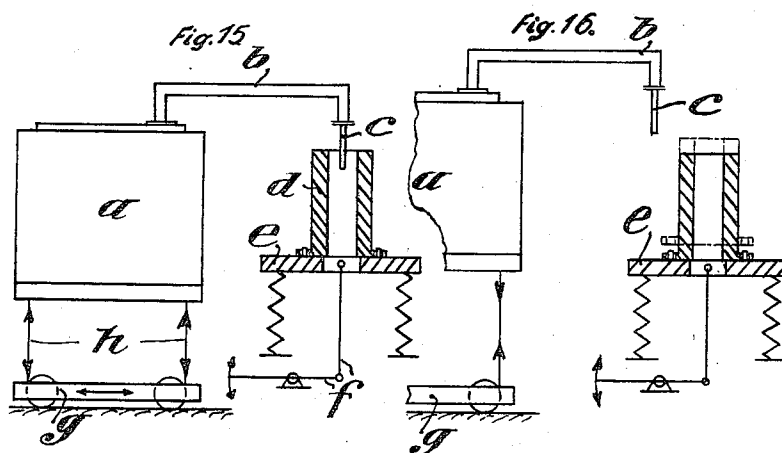
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2,225,416

CONTINUOUS CASTING PROCESS

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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CONTINUOUS CASTING PROCESS

Siegfried Junghans, Stuttgart, Wurttemberg,
GermanyApplication May 6, 1938, Serial No. 206,367
In Germany May 8, 1937

4 Claims. (Cl. 22—57.3)

In the continuous casting processes, it is frequently desirable not to cast with one and the same cross-section of cast lengths or chill moulds through out a whole working period, that is to say for about a week. On the contrary it is frequently necessary to alter this cross-section to suit any orders that may be received. The change of the chill mould then required makes it necessary to stop the working, not only of the foundry, but also of the melting plant. As the change of the chill mould, with all the preparations for running in the chill mould, takes as a rule 1½ to 2½ hours, the loss of production caused thereby is not inconsiderable. When for instance a brass foundry treats 3 tons per hour, a stoppage of two hours gives a loss of output of 6 tons. In addition to that, the molten metal in the melting plant must be kept warm during that time, which means a waste of fuel and operators' time.

It may further happen that during a working period, the kind of metal cast has to be altered. In such a case it is therefore necessary to start another furnace, the switching-in of which, with the present proceeding and present plants, also means a loss of output which is by no means negligible.

The elimination of these drawbacks is the object of the present invention according to which the different furnace, intermediate furnaces or other molten metal supply means, well known in themselves and usual in continuous casting processes, can be switched in and out at will, to different chill moulds which can also be switched-in at will.

A plant for carrying out this process may consist in allotting to each smelting furnace a plurality of chill moulds which can be brought selectively into operation according to requirements, in such a manner that the change of chill moulds produces practically no interruption of the working. The term "chill mould" is to be understood as including auxiliary devices such as soaking furnaces, guide troughs or the like where these are in permanent association with the actual moulds.

In this way it is possible, when the chill mould has to be changed for some reason, merely to divert the supply of metal from one chill mould to the other one, whereby no practically noticeable interruption is caused. The plant can therefore remain working practically continuously.

In the same way also, in place of one melting furnace there may be provided several such furnaces, say for different metals, so that one of the furnaces can be switched over at any time to one

of the chill moulds as may be required by the circumstances.

Several constructions of such plants are diagrammatically shown by way of example in the accompanying drawings.

Figures 1 and 2 show a first form of construction of the invention in side and end view respectively.

Figures 3 and 4 show in side and end view respectively examples of raising and lowering mechanism, by which the moulds may be moved relatively to the lifting table.

Figure 5 shows in side view one form of construction of the lifting mechanism, which operates with a pair of cam disks.

Figure 6 shows an end view of the mechanism according to Figure 5, whereby the cam disk is shown in the lifting position. The conveyor rollers for the cast bar are not shown in this figure.

Figure 7 likewise shows the mechanism according to Figure 5 in end view, whereby the cam disk is shown in the position in which the mould is not raised. In this case also, as in Figure 6, the conveyor rollers are not shown.

Figure 8 corresponds to Figure 7, whereby however, the operating rod for the cam disk is also shown.

Figure 9 likewise shows in end view a mould that is raised or lowered by hydraulic or pneumatic means.

Figure 10 shows in plan view, and

Figure 11 shows in end view an arrangement in which the metal from two moulds is conveyed into a distributor channel, which may be switched or shifted at will to one of a pair of moulds.

Figures 12 and 13 show in plan and end view respectively a further form of construction, which enables the metal from one furnace to be distributed at will to moulds.

Figure 14 shows a purely mechanical raising and lowering mechanism for a mold.

Figures 15 and 16 show in end view and partially in section a form of construction in which, for the purpose of connecting the furnace to a mould, the furnace is disposed so that it may be raised and lowered, and on a car, whereby the mould is stationary, or can at the most make the periodic upward and downward movement required for casting bar continuously.

Figures 17 and 18 show in end view and partially in section a further form of construction in which the furnace is stationary, and the mould is so housed or installed in a recess of a base or support that during the mould change the con-

nection between the base or support and the mould is released or disconnected, and the mould may be lowered into the recess, whereupon the furnace is displaced. Figure 17 shows the mould in the operating position; and Figure 18 shows the same in the lowered position, in which the furnace may be displaced.

Figures 19 and 20 correspond to Figures 17 and 18, with the difference however that the base or support for the mould is not provided with a recess for lowering the mould, but is provided with an intermediate piece, which, when removed, permits a lowering of the mould.

In the construction according to Figures 1 and 2, on the lifting table *c* are arranged side by side two chill moulds *a* and *b*, in such a manner that they can be coupled to, or uncoupled from, the lifting table which imparts to the chill mould the movement required during the casting. In Figure 1, the chill mould *a* is coupled to the lifting table *c*, whilst the chill mould *b* is raised by means of the gear *g* to such an extent that it is a little above the highest position of the lifting table, that is to say can no longer be influenced by the latter.

Under the chill moulds *a* and *b* are arranged the corresponding transport rollers *d* or *e* which also can be coupled or uncoupled according to the requirements, by means of the control couplings *k1* and *k2*. According to Figure 1, the transport rollers *d* under the chill mould *a* which at work, are thrown in, whilst the transport rollers *e* of the chill mould *b* are thrown out.

As long as the chill mould *a* is working, it is possible without an interruption being required, to get the chill mould *b* ready for casting. This is done in the well known manner by closing the chill mould from below, the closing device being locked by the transport rollers. When the chill mould *b* is to be worked, the molten metal is supplied to it, it is lowered on to the lifting table and the transport rollers *e* are then thrown in whilst the chill mould *a* is raised by the corresponding gear above the lifting table, and its transport rollers are stopped by disconnecting the coupling *k1*. An interruption of working practically does not take place at all.

It goes without saying that the arrangement could also be made in such a manner that the gear *g* for lifting or lowering the chill moulds *a* and *b* would be so connected to the corresponding couplings for the transport rollers that a simultaneous actuation of corresponding members would take place.

In Figures 3 to 9 are given several constructions of the lifting and lowering devices by means of which the chill moulds *a* and *b* are moved relatively to the lifting table.

In the construction according to Figures 3 and 4, are provided eccentric sheaves *i* with lifting pins and cable pulley. The chill mould is therefore lifted or lowered by pulling the cable, which can be effected in any desired manner by hand or by power, the latter being taken if desired from a driving part of the casting machine itself.

In the construction according to Figures 5 to 8, the raising and the lowering of the chill moulds are effected by an eccentric or cam disc *h* which engages with an abutment *f* on the chill mould, whilst the movement can be brought about by rods and toothed rack or worm and lever gear.

In the construction according to Figure 9, for the raising and lowering of the chill mould there

is provided a hydraulic or pneumatic raising and lowering device *l*.

The coupling and uncoupling of the transport rollers *d* and *e* can be effected in various convenient ways.

In Figure 1, the transport rollers *d* and *e* are mounted on a divided main shaft which can rotate as a single unit so that both transport rollers are working, or the individual sections of the main shaft can be selectively rotated so that only the appropriate roller *d* or *e* will rotate. The adaptation to the different thicknesses of the cast cross-sections is effected by mounting on the main shaft bodies in two parts which are so dimensioned that they produce the desired cross-section. In the constructions according to Figures 3 and 5, the transport rollers *d* and *e* are mounted on shafts separated from each other, but here also arrangements could be made for coupling the two rollers together. In Figure 5 the transport rollers are shown as cone pulleys axially adjustable on the driving shaft, and the adaptation to the different cross-sections of the casting can be effected by an axial shifting of the said pulleys, without any change of rollers.

In addition to these constructions given here merely by way of example, it is possible to imagine also other arrangements giving the same results.

In the construction according to Figures 10 and 11, there are also provided two chill moulds *a* and *b* which can be built and arranged in the manner illustrated in the preceding figures. Together with these chill moulds *a* and *b* are provided two furnaces *o1* and *o2*. They may be smelting or soaking furnaces. From these furnaces, pipes *m1* and *m2* convey the molten metal to a trough *r* which is arranged in the centre above the chill moulds *a* and *b*. This trough *r* is rotatable about a vertical pin *n*, and the pipes *m1* and *m2* are introduced into the trough through an arc-shaped slot *p*. It follows that the trough *r* can be so turned that its discharge pipe *r1* is brought over one or the other of the chill moulds *a* and *b*, so that the metal from one of the furnaces *o1* or *o2* can be supplied to one of the chill moulds *a* or *b*. As the discharge pipe of the trough *r* projects in the working position down into the chill mould *a* or *b*, preferably to a point below the level of the liquid casting head in the chill mould, it is necessary, when changing the chill moulds, first to lift the discharge pipe *r1* out of the stopped chill mould, and then, after turning it, to lower it again into the chill mould to be brought into working. In the construction according to Figures 10 and 11, the trough *r* is therefore also arranged to tilt about a horizontal pin *q* so that the change of the chill moulds can be easily and quickly effected. Here also, both the change of the chill moulds and the change of the furnaces, say for casting a different metal, can be effected without an interruption becoming practically noticeable.

In the construction according to Figures 12 and 13, it is assumed that between the two chill moulds *a* and *b* and the furnace *o* there is no trough, but that the metal is introduced directly from the furnace *o* through the pipe *m* into the chill mould *a* or *b*. The furnace *o* is here mounted on a truck *w* so that it can be moved from one chill mould to the other. A change of furnace can of course be effected also here, by bringing a second furnace on another truck into the place of the first one.

In order to make possible here the introduction and the lifting out of the nozzle of the pipe *m*, each chill mould is arranged on the lifting table in a vertically adjustable manner by means of a hydraulic or pneumatic or any other suitable mechanical. The chill mould to be put out of working is therefore first lowered so that the nozzle is brought clear of the upper chill mould edge, then the furnace *o* is moved until its nozzle is brought above the chill mould to be put in working, and this chill mould is thereupon raised until the nozzle projects into it to a sufficient extent. This raising and lowering of the chill moulds may be of course effected also in some other manner, say, for instance, as indicated in Figure 14 where a chill mould is shown connected to a rack and pinion gear *z* which can be moved by hand wheel *s* by means of intermediate gears.

In Figures 15-20 are shown constructions according to the invention in which the furnace with the delivery pipe and the casting nozzle is vertically adjustable relatively to the chill mould (by means of a raising and lowering device) and also laterally adjustable (by means of a carriage or rollers). In these constructions the chill mould is itself vertically adjustable relatively to the furnace and to the pipes or casting nozzle connected to it. This gives the possibility of having to make the furnace only laterally adjustable whilst the vertical adjustment of the same is replaced by the vertical adjustment of the chill mould.

In Figures 15 and 16, *a* is for instance a soaking furnace into which the liquid metal coming from a smelting furnace is poured and maintained at a constant temperature during the process of casting. A rising pipe *b* for instance leads from this soaking furnace to the casting nozzle *c*. The liquid material is conveyed from the soaking furnace *a* through the rising pipe to the nozzle *c* by pneumatic pressure. The nozzle *c* opens into the chill mould *d* which in the present construction is arranged for a continuous casting process. The chill mould *d* rests on a table *e*. The table *e* and the chill mould *d* may be fixed. The chill mould may however also constantly move up and down during the process of casting, which is an advantage in certain continuous casting processes. For the constant vertical reciprocation of the chill mould during the casting is provided a driving device *f* which is done away with when the chill mould is to remain constantly fixed during the casting.

In the construction illustrated, the furnace *a* is mounted on a roller truck *g* and is vertically adjustable on the said truck by means of any desired well known devices *h*, such as for instance winches and the like.

When the chill mould *d* is to be exchanged, that is to say, replaced by another chill mould, for instance when bolt casting is to be changed to plate casting, the lifting device *h* on the roller truck is simply actuated, that is to say the furnace raised until the bottom end of the nozzle *c* comes out of the chill mould. The furnace with the pipe *b* and the nozzle *c* with the roller truck *g* is then moved laterally away (compare Figure 16). The chill mould can now be exchanged whereupon the furnace is moved laterally back until the nozzle *c* is again over the centre of the chill mould cross-section. The furnace is then lowered on the truck *g*, and the process of casting with the new chill mould can begin.

In the construction according to Figures 17 and 18, the furnace *a* with the pipes *b* and *c* is stationary in space, whilst the chill mould can be removed through an opening *i* in the table *e* downwards, that is to say away from the nozzle *c* (Figure 18). The substitute chill mould is introduced from below upwards and secured to the table *e* whereupon the nozzle automatically assumes its correct position in the chill mould.

In Figures 19 and 20, the mobility of the chill mould relatively to the stationary furnace *a* is obtained by inserting during the casting, between the table *e* and the chill mould *d*, an intermediate piece *m*, the height of which corresponds to the correct position of the nozzle *c* in the chill mould. For exchanging the chill mould, the intermediate piece *m* is simply pushed away, and the chill mould *d* lowered on to the table *e* (Figure 20) owing to which the nozzle is released and the chill mould can be moved away for the purpose of exchange.

With such arrangements it is possible therefore to comply with any working conditions occurring and in every case it is possible to maintain a really uninterrupted working, independently of the fact whether during a working period different cross-sections or different metals are to be cast.

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:

1. Equipment for the continuous production of cast bars, consisting of furnaces, of pipes that are connected with the said furnaces, and that are adapted to convey molten metal from the furnaces, of moulds with passages through them, that are adapted to produce continuous cast bars in them, and into the upper end of at least one of the moulds at least one of the said pipes extends, of means to withdraw said bars continuously of a lifting table, on which a plurality of moulds are disposed, of means to enable the lifting table to be moved up and down periodically, and of means to raise the moulds selectively clear of the lifting table.

2. Equipment for the continuous production of cast bars, consisting of furnaces, of pipes that are connected with the said furnaces, and that are adapted to convey molten metal from the furnaces, of moulds with passages through them, that are adapted to produce continuous cast bars in them, and into the upper end of at least one of the moulds at least one of the said pipes extends during the casting, of bases or supports upon which the moulds stand, and of means to enable the moulds to be displaced vertically independently of the said tables.

3. Equipment for the continuous production of cast bars, consisting of furnaces, of pipes that are connected with the said furnaces, and that are adapted to convey molten metal from the furnaces, of moulds with passages through them, that are adapted to produce continuous cast bars in them, and into the upper end of at least one of the moulds at least one of the said pipes extends during the casting, of bases or supports, upon which the moulds stand, and that have an opening in them that is somewhat wider than the diameter of the moulds, of means to retain the moulds in these openings and to release the moulds from the openings in the base or support, and of means to enable the moulds to be

displaced vertically in the said openings independently of the tables.

4. Equipment for the continuous production of cast bars, consisting of furnaces, of pipes that are connected with the said furnaces, and that
5 are adapted to convey molten metal from the furnaces, of moulds with passages through them, that are adapted to produce continuous cast bars in them, and into the upper end of at least
10 one of the moulds at least one of the said pipes

extends during the casting, of bases or supports, of intermediate parts that rest on the bases and upon which the moulds are set, said intermediate parts serving to raise the moulds to casting position, and which may be removed from between the bases and the moulds, so that the
5 moulds rest directly on the bases for removal from position below their respective pipes.

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