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Reis

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[54] **METHOD OF CASTING AND SUBSEQUENTLY DEBURRING OF WORKPIECES AND A DEVICE FOR CARRYING OUT THE METHOD**

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[51] **Int. Cl.** **B23p 17/00,** B23p 23/04

[58] **Field of Search** ..... 29/527.5, 527.6, 29/DIG. 5, 33 A; 164/76, 262, 270

[56] **References Cited**

UNITED STATES PATENTS

1,077,709	11/1913	Hastings	28/527.6
3,445,904	5/1969	Harrison et al.	29/527.6 UX
1,955,367	4/1934	Hall	29/527.5
3,066,401	12/1962	Morel et al.	29/527.6 X

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[57] **ABSTRACT**

A method of producing castings and subsequently deburring and also machining the castings if necessary. According to this method, the castings are removed from a casting machine while still in a hot state and conveyed by a gripper assembly to a deburring machine. This machine includes a pattern device into which the hot casting is placed. The device is slowly closed as the casting cools thereby shrinking the casting upon the pattern. As a result, appreciable deformation of the casting is effectively prevented. When the casting is substantially cooled and has thus reached its final configuration it is deburred in the deburring machine and if necessary surface finished.

There is also disclosed a device for carrying out the afore-described casting and deburring steps in automated sequence.

10 Claims, 7 Drawing Figures

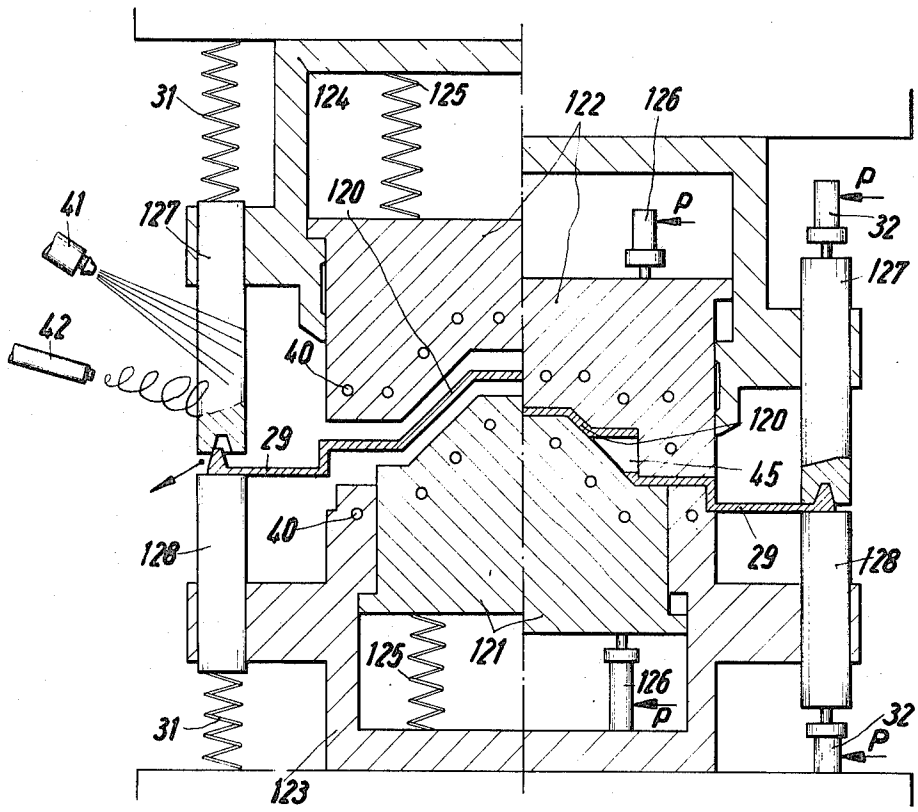


Fig.2

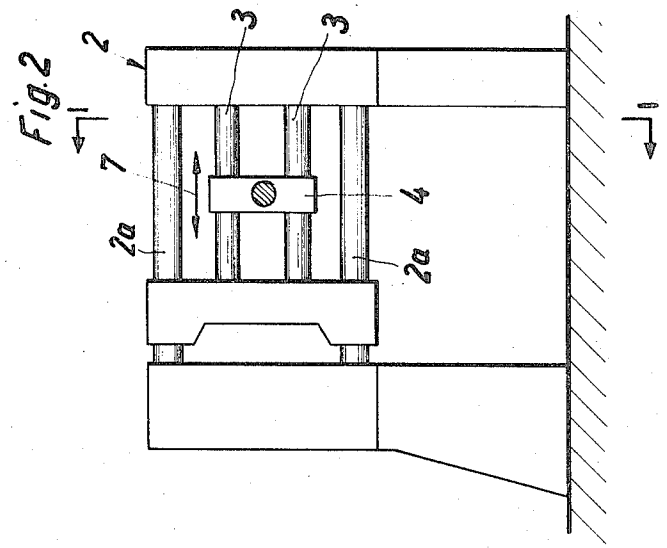


Fig.1

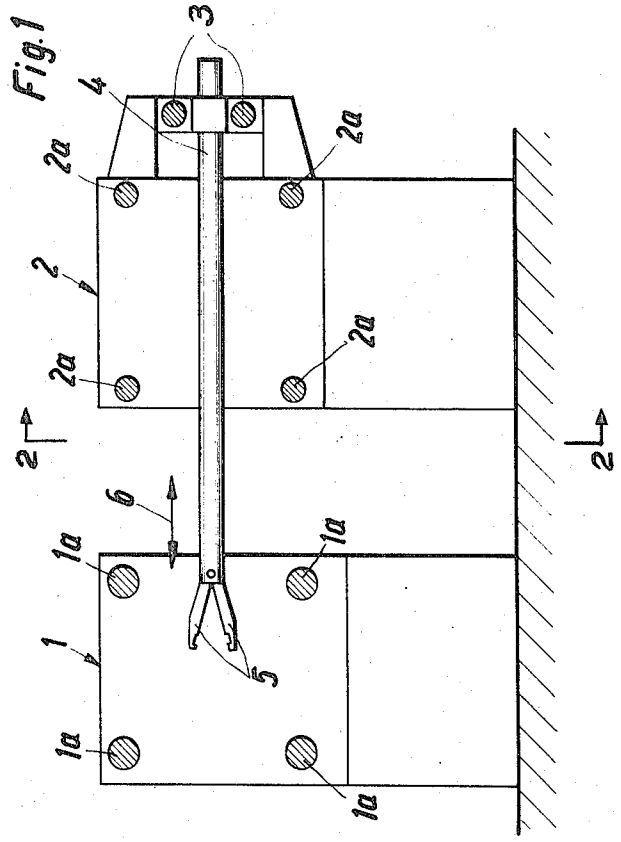


Fig.4

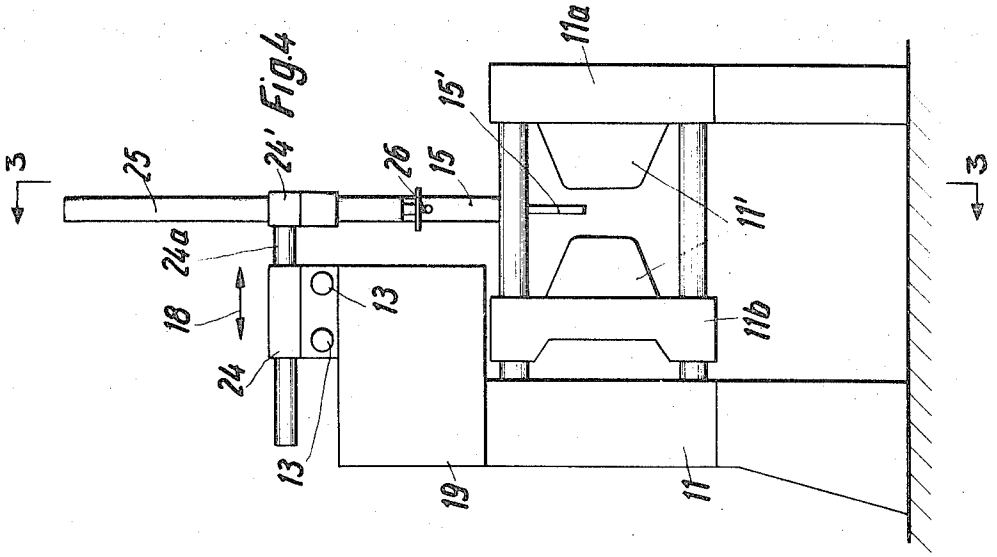
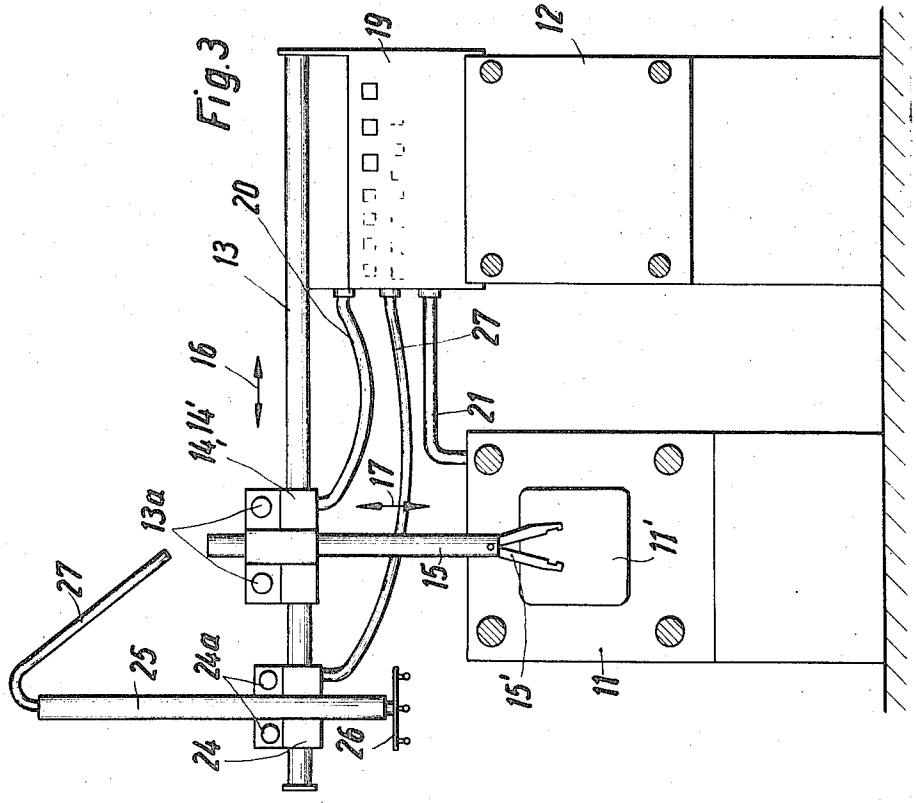

3
25
24'
26
15
15'
11a
11'
24a
18
13
24
11b
13
19
11
3

Fig.3


19
12
20
13
27
16
21
14,14'
17
13a
11'
15
27
25
24a
15'
11
24
26

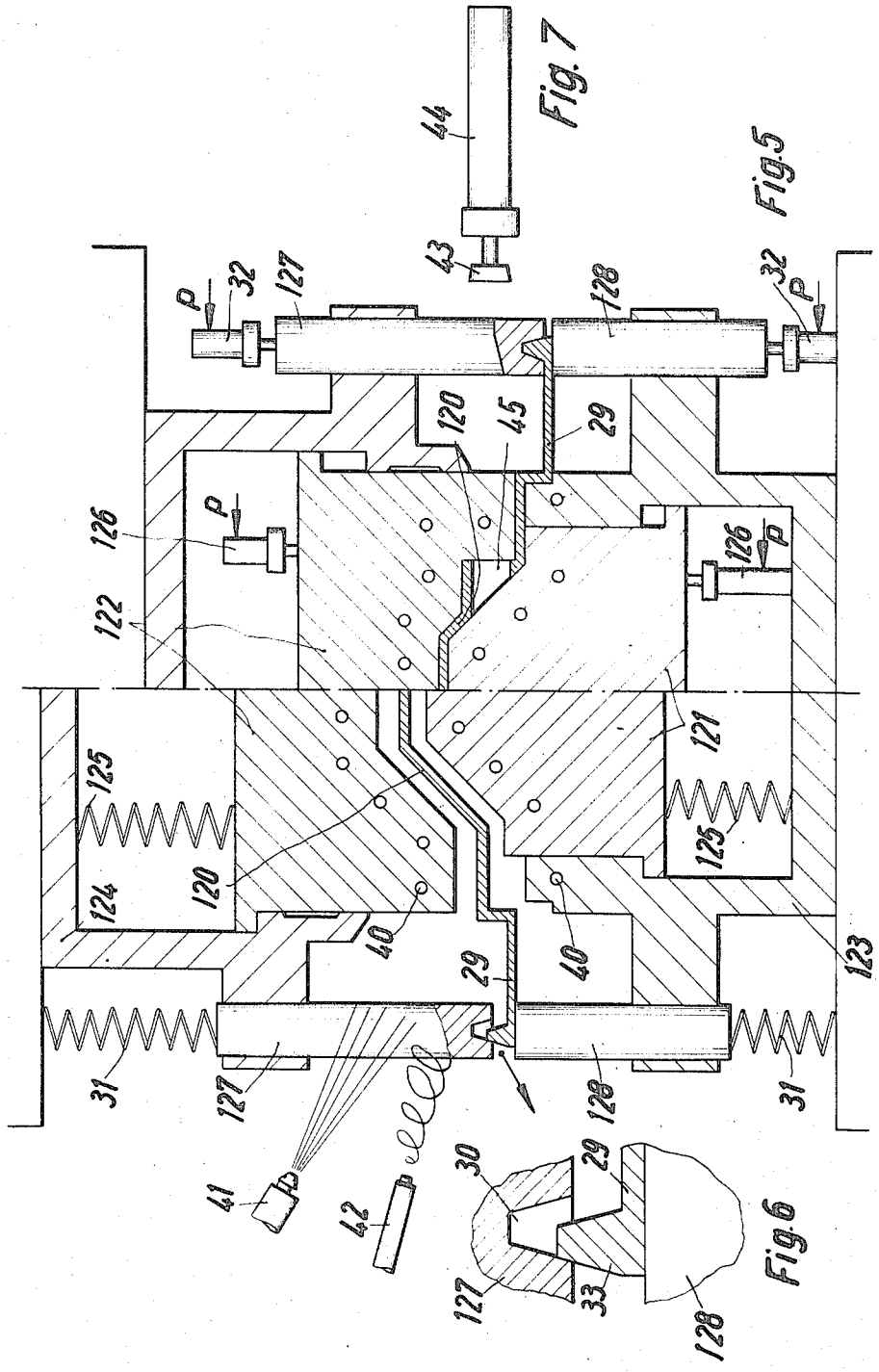


Fig. 7

Fig. 5

Fig. 6

METHOD OF CASTING AND SUBSEQUENTLY DEBURRING OF WORKPIECES AND A DEVICE FOR CARRYING OUT THE METHOD

The present invention relates to a method of casting and deburring workpieces, and particularly to a method of casting and deburring workpieces in an automated operation. The invention further relates to a device for casting and deburring workpieces.

BACKGROUND

It is well known that the quality of the cast and the deburred workpieces is strongly affected by the uniformity of the cycle of operation. In particular, the uniformity of the operational cycle is important with respect to the caloric conditions in the casting molds. Temperature variations in the molds result in a considerable reduction of the useful life of the molds, and moreover, affect very much the shrinkage percentage and thus the obtainable tolerance accuracy of the castings.

In view of the criticality between uniformity of the operational cycle and temperature control, various devices for withdrawing the castings from the casting machine have been developed. There are known, for instance, removal devices which grip the castings after opening of the halves of the casting molds and then carry the removed casting from the casting cavity of the casting machine. Subsequently, the castings are deposited on a conveyor or in a delivery station.

Various types of automated grippers have been developed which are programmed to perform a sequence of functions. This programming may control the grippers to dip a casting into a coolant bath and subsequently to deliver the cooled casting to a deburring or flashing press.

The linking of an extrusion casting machine and of a subsequent deburring or flashing machine by an automated gripper assembly as now known, has various technical disadvantages and is also economically burdensome in that the installation costs for such automated system are very high.

The cooling of the castings either by air flow or by liquid flow or by dipping into a bath results in tensional differentials which may cause a distortion of the castings. To avoid such distortions it is known to place the castings in a gauging block device. Obviously, the resulting additional operations cause an increase in the overall costs of the operation or make it even impossible to automate the entire operation with the means now available for the purpose, the more so as the present trend in industry is to reduce more and more the time allocation for the operational cycle. The result is that there is not sufficient time available in the cycle for removing a casting automatically from the gauging device and then delivering the casting to a deburring or flashing machine. Moreover, during the cooling, residues and waste deposits may form on the casting which subsequently must be removed in many instances.

Dipping of castings, especially aluminum alloy castings into a coolant tends to cause a surface hardening of the castings. This is undesirable as in most instances a subsequent machining is necessary such as stamping, milling, drilling, threading, etc. Obviously, hardening of the surface increases the required machining time.

THE INVENTION

It is a broad object of the invention to provide a novel

and improved method of casting and deburring workpieces which permits a substantial reduction of the overall installation costs and also eliminates at least in most instances the need for gauging devices.

It is a further broad object of the invention to provide a novel and improved device for producing castings and subsequently deburring and/or otherwise machining the casting.

SUMMARY OF THE INVENTION

The aforepointed out objects, features and advantages, and other objects, features and advantages which will be pointed out hereinafter, are obtained by removing a produced casting from the casting machine by a conveying and gripping assembly while it is still hot and placing the casting into a deburring or flashing machine. While the casting is cooling in this machine it is shrunk upon a pattern means in the deburring machine by slowly closing the pattern means in correlation with the cooling of the casting. Finally, the casting is deburred or flashed while it is shrunk upon the pattern means.

An installation according to the invention comprises a preferably horizontally arranged deburring machine and a gripping and conveying assembly. The deburring or flashing machine with reference to the extrusion casting machine for supplying castings to the deburring machine can be selected as convenient by a suitably arranged movement of gripper arms of the gripping means. In other words, the casting machine and the deburring machine can be placed in relative positions which are most suitable for the specific conditions involved.

A particularly suitable and convenient arrangement is a position which permits placement of the working spaces in the casting machine and the deburring machine side-by-side and parallel to the discharge directions of both machines.

It is essential for the concept of the invention that a casting removed from the casting machine is immediately and without interruption conveyed to the working space in the deburring machine. The manner in which such immediate conveyance is effected is usually not critical. For instance, for moving castings gripping assemblies may be used which are mounted posterior of the deburring machine and can be inserted through the opened deburring machine into the also opened casting machine and withdrawn in the same manner. It is also possible to arrange for both machines an overhead conveyor which removes castings by suitably disposed gripper means and then inserts such castings into the deburring machine. It is essential that the hot castings are now placed into a tool which is not designed for hot working but for cold working such as working at room temperature.

A very important advantage of the invention resides in that maintenance of close tolerances is possible and that the deburring or flashing tools do not have to be specially designed since the castings can be machined to the desired true dimensions at room temperture. The shrinking processes of the castings are not completed due to the elevated temperature which the casting has immediately after removal from the casting machine (generally in practice between 100°to 400°C). Insertion of such hot castings into a machining in the deburring machine is not practical. Accordingly, conical pins or otherwise shaped locating elements are provided on

the casting if not already present to permit convenient preliminary centering of the casting. After insertion of the hot and thus still over-dimensioned casting into the device for preliminary centering the same, the deburring machine is closed to an extent such that the casting can be pressed by means of suitable counter holders into its preliminarily centered position.

After such closing of the deburring machine, the grippers holding the casting are released and can now be withdrawn from the deburring cavity of the deburring machine.

Simultaneously with the pressing of the casting by means of the counter holders into the device for preliminarily centering, cooling of the casting begins. The cooling can be effected by natural heat dissipation or it can be assisted by suitable blowers. In special cases, forced cooling by use of liquid coolant is also suitable. Such cooling is effected while the gripping means are again moved into a ready position for accepting the next casting. After a selectable period of time, the deburring machine can be further closed and the casting, depending upon the shrinking process, can be pressed into a working space of a machining tool. Additionally, the counter-holding force must be adjusted in accordance with the requirements. Such adjustment can be effected by continually or step-wise slowly closing the deburring machine or by a preselected increase in the closing pressure.

Due to the progress of the cooling of the casting the same is now ready, assisted by the holding pressure, to slide into or upon the pattern means of the deburring machine in which it remains until it is fully cooled and in which it is forced into its predetermined configuration in a manner similar to which occurs in a conventional gauging block device.

When this condition is accomplished, a final machining is effected, either by flashing off any protrusions, lugs, excess material, removal of surface irregularities, etc. This process can be continued by final surface finishing in a conventional manner.

After completion of all machining, the deburring machine is opened; the casting and all waste material are removed and the deburring machine is now ready for machining the next casting.

If it be desirable to keep the operational cycle as short as possible, for instance if very rapid sequence of castings is necessary, the closing of the pattern means, the positioning of the locating means and the cooling process can be simultaneously accelerated by the use of suitable coolants which may be liquid or gaseous. With such accelerated cycle it is essential to provide for the deburring or flashing steps and sometimes also for the finishing operations a suitable selection of materials and corresponding construction methods.

The method as hereinbefore described results due to a controlled rapid cooling in the production of castings substantially free of distortions which simultaneously can be deburred or flashed into the pattern means also used for correcting or preventing distortions. In this connection it should be pointed out that in comparison with the tolerance accuracy obtainable with the heretofore conventional deburring at high temperatures a much closer tolerance can be readily accomplished, and in comparison with the deburring of cooled castings as heretofore practiced an operational simplification is obtained, and thus a saving in the process steps and devices required for carrying out the process steps.

Moreover, the cooling progress can be so controlled that, for instance, inlet spouts of substantial cross-sectional area for the casting material and tap spouts need not to be forcibly cooled. An immediate return of still hot metal waste into the melting furnace is quite possible thereby reducing the required energy output. Forced cooling by using of liquid coolants can be so controlled that the residual heat of the castings and other parts effects evaporation of the coolant.

It is further within the concept of the invention that the holders for the finishing or cutting tools and available surfaces are utilized as heat exchangers. In such case, provisions must be made for an efficient dissipation of the heat, for instance by providing suitably placed ducts or channels through which a suitable coolant is directed.

To sum up, the following advantages are obtained among others:

A fully automated production and considerable saving of labor are obtained. Operations can be carried out in a uniform casting cycle. By controlling cooling of castings in correlation with the opening of the casting machine and of the deburring machine, castings are obtained which are substantially uniform and free of distortion without requiring the use of a special gauging device. Careful orientation of the castings is not necessary since by clamping the workpiece in the deburring machine with its preselected pressure and by accurately guiding of the castings in the machining means arbitrary and uncontrolled shrinking and distortions are precluded. The removal of castings from the casting machine can be effected at an earlier stage than heretofore possible since the deburring machine also effects gauging of the casting. As a result, the casting cycle can be correspondingly accelerated.

In comparison with the heretofore customary deburring or flashing at hot temperatures, closer tolerances are readily obtainable. In comparison with the heretofore also used cold deburring or flashing the important advantage of full automation and corresponding reduction in the production costs are obtained.

DETAILED DESCRIPTION OF THE INVENTION

In the accompanying drawings, several embodiments of the invention are shown by way of illustration and not by way of limitation.

In the drawing:

FIG. 1 is a sectional side view of a casting and deburring installation according to the invention taken on line 1—1 of FIG. 2;

FIG. 2 is a sectional edge view of the installation of FIG. 1 taken on line 2—2 of FIG. 1;

FIG. 3 is a sectional side view of a modification of the installation taken on line 3—3 of FIG. 4;

FIG. 4 is a sectional edge view of FIG. 3 taken on line 4—4 of FIG. 3;

FIG. 5 shows schematically and partly in section a deburring device according to the invention, the left side of the figure showing the device in a first lowered position and the right side in a fully closed position;

FIG. 6 is a detail of FIG. 5 on a larger scale; and

FIG. 7 is a side view of a machining tool to be used in conjunction with the deburring device of FIG. 5.

FIG. 1 shows diagrammatically a horizontally disposed generally conventional casting machine 1 which may be an extrusion casting machine, an injjection casting machine, etc. The mounting guides of the ma-

chine are designated by 1*a*. Next to machine 1 and parallel or aligned with the working direction thereof there is diagrammatically shown a deburring or flashing machine 2 the guides for which are designated by 2*a*. The deburring maching 2 mounts on the guides 3 connected with it on conveying and gripping means 4 which carries at its ends suitable grippers 5. The gripper means are controlled from a suitable control device (such as control device 19 of FIG. 3) so that the grippers 5 can be opened and closed and that the gripper means is movable in the direction of the arrows 6 and also in the direction of the arrows 7 as a unit. The gripper means 4 serves to lift a casting out of the casting machine 1 and to insert it slowly into a hereinafter further described tool of the deburring machine 2.

In the embodiment according to FIGS. 3 and 4, the conveying and gripping means 14 are not shown as in the previous embodiment at about the mid-level of the casting machine and the deburring machine but above the top level of the same. The casting machine 11 is merely indicated by components adjacent to its mold 11'. A deburring machine 12 operating in a generally conventional manner is disposed parallel with the casting machine.

A guide rail 13 is fixedly secured on the deburring machine 12 and a conveying and gripping means is guided on guide rails 13. The gripping means comprise a carrier or slide arrangement 14, 14' with a built-in drive means. The slide 14 is movable in the direction of arrow 16 and the support arm of the gripper is slidable in the direction of the arrow 17. Further support rails 13a are movable in the direction of arrow 18. The gripper 15 can be opened and closed.

The afore-referred to movements are controlled by a control device 19 via a control conduit 20. This control device is connected with the deburring machine. The casting machine is connected to the control device 19 via a control conduit 21. The deburring machine is also controlled as to its working cycle by this control device. The control device 19 should be visualized as a conventional device; many suitable types of control devices are well known in the art. It may be a servo-motor system, an electrical switching system or an electronic system. As it is evident, there must be available two operations for each function, such as opening or closing of a gripper. Buttons for activating the device are indicated at 19*a*.

The gripping means take a completed but still hot casting out of the casting machine and insert it into the deburring machine for cooling and subsequent deburring.

In practice, it is necessary to lubricate the mold in the casting machine and/or to smooth casting holder in the deburring machine. This is usually manually effected. According to the invention, the existing control device and the guide rails for the gripping means are further used to guide and control a finishing device.

The finishing device comprises a slide assembly 24, 24', corresponding to the slide or carrier assembly 14, 14' with guide rails 24*a* and 25 which are movable in the directions of arrows 16, 17 and 18. The guide rail 25 mounts a nozzle arrangement 26 which via a conduit 27 is supplied with a finishing agent such as a lubricant. The control of slide 24 or 24' and the afore-indicated movements is effected automatically via a conduit 27 by control device 19 in the sequence of the working operations of the shown coupling of the machines.

The casting machine and the deburring machine do not have to be arranged as shown in the horizontal position. The invention is, of course, also applicable to upright disposed machines.

In FIG. 5 a casting is designated by 120, a lower pattern half by 121 and an upper pattern half by 122. Each of these two pattern halves are parts of a pattern which has a lower half 123 and an upper half 124. The two halves of the pattern are preferably held in position by springs 125, or can be controllably driven by suitable pistons 126 acting upon the pattern.

The pattern further comprises holder pins 127 and 128 for holding therebetween the casting 120 by engaging burrs 29 thereon. Holders 127 and 128 also serve for centering the casting by means of recesses 30 engageable with noses 33 on burrs 29. The holders may be spring-loaded relative to the casting as it is indicated by springs 31, or they may be provided with separate drive pistons 32. Recesses 30 are so disposed that the noses 33 can just enter the recesses when the casting is still hot and thus expanded, and that when the pattern half 122 is finally settled upon the casting the same is clamped with a close fit between pattern halves 121 and 122. Deburring can now proceed in a conventional manner.

The deburring machine can be provided with cooling ducts 40. Instead of, or in addition, a cooling device 41 for spraying a coolant or a device 42 for directing steam upon the casting can be provided.

As shown in FIG. 7, the deburring machine can additionally be provided with machining devices such as, for instance, a milling tool 43 which is controlled by a drive piston 44 and serves to mill out an opening 45 in workpiece 20 to the desired dimensions. As it is evident, the pattern half 122 must be lifted before opening 45 can be milled.

The operation of the illustrated and described installation may be summed up as follows:

1. Gripper 5 or 15' moves the casting 120 into the open pattern means shown in FIG. 5 and holds it tight in this means.
2. The holder pins 127 and 128 move into the position shown on the left half of FIG. 5.
3. Gripper 5 or 15' releases the casting and is again moved toward the casting machine.
4. Pattern halves 121 and 122 move into the positions shown on the left half of FIG. 5.
5. The pattern halves 121 and 122 are moved slowly and with little pressure into engagement with casting 120.
6. The holders 127 and 128 are moved into the position shown on the right half of FIG. 5 while the casting is cooling and shrinking.
7. When casting 120 has sufficiently cooled, pattern halves 121 and 122 are moved toward each other under heavy pressure thereby exerting corresponding pressure against the casting thus forcing the same into its final shape.
8. The deburring or flashing member 124 is now lowered and cuts off the overhanging burrs 29 on the casting.
9. Pattern halves 121 and 122 are again reopened and holders 127 and 128 are withdrawn. The finished casting now drops downwardly out of the deburring machine.

It is obvious that details of the invention can be varied in accordance with the specific purpose for which the assembly of the invention is to be used.

What is claimed is:

1. A method of producing finished castings in continuous operation, said method comprising the steps of:
providing a casting machine and a deburring machine including a closable pattern means;
casting a casting of predetermined configuration in the casting machine;
removing the casting from the casting machine and conveying the same to the pattern means in the deburring machine while the casting is still in its hot state;
slowly closing the pattern means as the casting cools in said means while applying pressure sufficient to conform the casting onto the pattern means thereby correcting any changes in said configuration of the casting as may be caused due to deformation during cooling of the casting and also locking the casting in position by the pattern means; and
deburring the casting when the cooling thereof and the conforming onto the pattern means is essentially completed and the casting is locked in position by the pattern means.

2. A device for producing finished castings in continuous operation, said device comprising:
a casting machine for casting therein a casting of predetermined configuration and a deburring machine for truing and deburring therein a casting cast in the casting machine fixedly coupled to each other, said casting machine including means for closing and opening said machine for removing therefrom a casting and said deburring machine including pattern means including two parts movable relative to each other for placing a casting therebetween, means for opening the pattern means for inserting thereinto a casting removed from the casting machine and means for pressure closing the pattern means, said pressure closing pressing the casting into conformity with the contours of the pattern parts thereby truing the casting to said predetermined configuration and also locking the casting in position;
conveying means including gripping means for removing castings from the casting machine and delivering the same between the parts of the pattern means in the deburring machine;
deburring means included in said deburring machine for deburring a casting locked between said pattern means; and
cycling control means sequentially actuating the opening and closing means of the casting machine for opening the conveying means for withdrawing, one by one, castings while still hot from the casting machine and delivering the same to the pattern means, actuating the opening and closing means of the pattern means for first opening and then slowly pressure closing the pattern means to conform the casting to the pattern means as the casting cools, actuating the deburring means, and actuating the opening and closing means of the pattern means for reopening said means.

3. The device according to claim 2 wherein said deburring means comprise cushioning holder means for holding the casting in position while being deburred.

4. The device according to claim 2 wherein said conveying means comprise guide means for guiding the castings as they are being delivered from the casting machine to the deburring machine under the control of said control means, and further comprising machining means also controlled by said control means for machining castings after having been deburred by the deburring means.

5. The device according to claim 4 wherein said machining means comprise lubricating means.

6. The device according to claim 4 wherein said machining means comprise surface finishing means.

7. The device according to claim 1 wherein said two parts of the pattern means define therebetween a cavity matching the contour of a casting in its cool state, said means for opening and closing the pattern means including adjustable pressure means for controlling the pressure with which said pattern parts are moved toward said closed position.

8. The device according to claim 7 and comprising yieldable support means for each of said pattern parts.

9. The device according to claim 7 and comprising cooling means for cooling said pattern parts to accelerate the cooling of a casting inserted thereinto.

10. The device according to claim 1 wherein each casting when withdrawn from the casting machine comprises a laterally protruding burr, each of said burrs being dimensioned to block movement of the two parts of the pattern means into the closed position while and when the expansion of a casting due to the casting heat is above a predetermined limit and to release the pattern parts for movement into the closed position in response to shrinking of the casting below said limit due to cooling.

* * * * *