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(54) **Apparatus and method for trimming scrap from metal castings**

(57) A trimming press apparatus for trimming scrap from metal castings (G), particularly die castings, comprises a press assembly having a stationary lower bed (4) and a load-bearing frame (2) which supports an upper head (9) movable along first guide means (6) relative to the stationary bed (4), a trimming die assembly (3) with an upper member (11), fitted with trimming means (15, 16), which may be associated to the movable head and with a lower member (13) having at least one workpiece support (14). The apparatus also includes a manipulator device (20) for supporting and handling the lower member (13) of the trimming die and its workpiece support (14), which causes them to rotate about a substantially horizontal axis (H) through an angle sufficient to ensure the free fall of scrap (S) cut from castings and the discharge thereof into an underlying collection container (21). A trimming method includes the steps of: a) preparing the trimming press die (3), (b) loading a casting (G) onto the workpiece support (14), (c) trimming scrap (S) from the casting (G) by drawing the upper member (11) and the lower member (13) of the die closer together, d) rotating the workpiece support (14) about a substantially horizontal axis (H) through an angle sufficient to ensure the fall of the cutting scrap (S) and the discharge thereof into an underlying collection container (21).

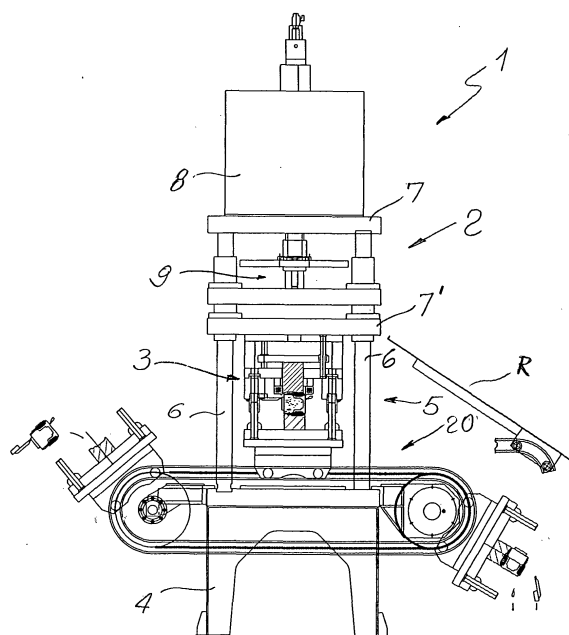


FIG. 2

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Description

Technical field

[0001] The present invention generally relates to the field of die casting and particularly addresses a method and an apparatus for cutting scrap from metal castings.

[0002] The invention may be used particularly but not exclusively, in robotic die casting systems.

Background art

[0003] Die-casting of mechanical parts requires injection of molten metal in pasty form into a die, which is made of several parts coupled together by a press.

[0004] Pieces obtained after cooling and hardening, known as castings contain, in addition to their basic parts, possibly reproduced in several items or shapes, other parts resulting from the casting process, that will not be maintained in the finished pieces, such as runners, deadheads, pits, as well as flashes due to the metal being drawn between the members of the die, which are generally known as scrap.

[0005] Scrap shall be severed from castings, typically by one or more trimming steps, to obtain semifinished pieces for further processing.

[0006] It is known that scrap trimming may be performed by using a trimming die assembly, provided on a press adapted to perform such operation, which is generally situated downstream of the die casting machine.

[0007] Robotic systems may be associated to such apparatus, for handling the material, e.g. for drawing the liquid metal from the holding furnace and feeding it to the die casting machine, for drawing the hot hardened casting and positioning it on the cutting machine, and for drawing finished pieces.

[0008] Obviously, scrap trimming is performed by bringing an upper movable member, fitted with special tools, and a lower member, which holds the casting and acts as a contrast element, closer together. The "clean" scrapless pieces are first held by the tools of the upper member, and then released therefrom by means of pistons or other similar members. Finally, they are discharged onto a special chute which conveys them outwards.

[0009] The trimmed scrap is discharged through appropriate apertures or passages formed in the lower die and in the press bolster plate and are fed to the smelter for recovery.

[0010] The above processing steps and machines all form a processing cycle, which may also include possible mechanical processing steps, such as boring, threading, studding, or else.

[0011] Trimming die apparatus are known which are used for trimming castings of the above mentioned type.

[0012] An example of prior art, which is schematically shown in Fig. 1, comprises a press P, having a fixed

frame B, an upper head T movable along first guide means C, and a trimming die M, having an upper member U fitted with trimming means that may be associated to the press head T, and a lower member L which has at least one workpiece support W which supports the casting G during scrap S trimming.

[0013] The lower member L of the die has appropriate apertures or passages A for discharging the scrap S severed from castings, which fall to the ground or into an underlying container. Also, a side chute R is typically provided, which may be placed thereat for discharging the casting G from the upper member U of the die after scrap removal.

[0014] Prior art apparatus of the above type have a few well-known drawbacks.

[0015] A first important drawback consists in that the discharge apertures and passages formed in the lower member of the die may not be sufficient to ensure the scrap fall and discharge from the cutting area.

[0016] In fact, although the shape and the position of such passages are the most critical and complex aspect of the whole die design, the scrap cut from the casting, which is made of a malleable metal material, such as a zinc or aluminum alloy, may still and is likely to remain in the cutting area and hinder the motion of the die, thereby restricting or preventing the stroke thereof or of the press. This may cause the machine and the whole robotic system, including the die casting machine, due to a cascade effect.

[0017] In the most serious cases, this may require the replacement of the die, which involves a high cost increase.

[0018] In these cases, removal and discharge must be carried out manually, which might be particularly difficult for small scrap, such as the flashes generated by the drawing of the melt through the closures of the dies, and are unavoidable after a certain service life of the die.

[0019] No reliable inexpensive system is currently available which ensures full removal of trimmed scrap, without any manual intervention, and such as to allow die cleaning automation.

[0020] Another drawback consists in the long dead times occurring as the castings are loaded onto the dies and particularly onto the workpiece supports mounted on their lower member. The scrap shall be fully removed from the workpiece support before loading a new casting to be cut thereon, hence such step cannot be fully automated.

Disclosure of the invention

[0021] A general object of this invention is to obviate the above mentioned drawbacks, by providing a method and an apparatus for trimming scrap from castings, which allows full, reliable and easily repeatable removal of scrap from the die.

[0022] A further object is to provide a trimming and die casting method and apparatus, which allows to re-

duce dead times in the loading of castings to increase productivity.

[0023] Yet another object is to provide a scrap trimming method and apparatus, wherein the loading of the casting is particularly facilitated, and simplified robotic systems may be used.

[0024] These and other objects, which will appear more clearly hereinafter, are achieved by a method for trimming scrap from castings which, in accordance with claim 1, includes the steps : preparing a trimming press die, which has a lower member fitted with a workpiece support and an upper member having trimming means, said die being insertable in a cutting press, loading a casting to be trimmed onto said workpiece support, trimming scrap from the casting by drawing said upper member and said lower member of the die closer together, rotating the workpiece support about a substantially horizontal axis by an angle sufficient to ensure that the trimmed scrap fall, stripping the scrapless casting.

[0025] In a further aspect of the invention, a trimming press apparatus is provided, designed to trim scrap from castings, for carrying out the above method which, in accordance with claim 7, comprises a press unit having a fixed lower base, and a load-bearing frame, which supports an upper head, movable along first guide means relative to said fixed base, a trimming die unit which has an upper member fitted with trimming means that may be associated to said movable head and a lower member having at least one workpiece support, characterized in that it comprises a device for supporting and handling said lower member of the trimming die unit and the associated workpiece support to cause it to rotate about a substantially horizontal axis, by an angle sufficient to ensure that the scrap trimmed from the casting fall free and discharge into an underlying collection area.

[0026] Thanks to such a method and apparatus, scrap may be trimmed from castings, and fully discharged into an underlying collection area, in a simple, fast and effective manner.

[0027] Moreover, thanks to the structure and operation of the lower member of the die, scrap discharging times may be shortened, thereby reducing the dead times between the various steps of loading castings on to the dies.

Brief Description of the Drawings

[0028] Further features and advantages of the invention will be more clearly understood from the following detailed description of an apparatus and a method for trimming scrap from die castings, illustrated by way of a non-limiting example with the aid of the annexed drawings, in which:

Fig. 1 is a schematic front view of a prior art trimming press apparatus;

Fig. 2 is a schematic side view of a trimming press apparatus according to this invention, as seen in

partial section along a vertical axial plane in one operating step;

FIG. 3 is a schematic enlarged view of a detail of the apparatus of Fig. 2;

FIG. 4 is a flowchart of the operation of the apparatus of Figs. 2 and 3.

Detailed description of a preferred embodiment

[0029] Fig. 1 shows a trimming press apparatus as generally described with reference to prior art.

[0030] Referring to Figures 2 and 3, a trimming press apparatus according to the invention is shown, which is overall designated with numeral 1, for trimming scrap S, such as deadheads, runners, pits, flashes, from castings G obtained, for instance, by die casting or chill casting processes.

[0031] The apparatus 1 substantially comprises a press assembly, overall designated as 2, and a trimming die assembly, overall designated as 3.

[0032] Particularly, the press assembly 2, which is known per se, comprises a fixed lower bed 4, a load-bearing frame 5 being linked thereto, which is in turn formed by a plurality of substantially vertical columns 6, whose tops are joined together by substantially horizontal cross members 7, 7'.

[0033] Hydraulic pushing units 8 are mounted on the upper cross member 7, and a head 9 is secured at their lower end, which head is slideable along first guide means, e.g. formed by the vertical columns 6 themselves.

[0034] The trimming die assembly, or die 3, which is better shown in Fig. 3, is placed within the space 10 of the frame 5, enclosed by the vertical columns 6.

[0035] The die 3 is essentially formed by an upper member 11, which may be secured to a bolster plate 12 integral with the head 9, and a lower member 13, having a support for the casting G or workpiece support 14.

[0036] The upper member 11 of the die has trimming means 15, e.g. blades mounted on a central plate 16, movable along vertical rods 17.

[0037] A stripper plate 18 may also slide along the vertical rods 17, a casting pusher being linked 19 thereto, to push the casting against the workpiece support 14, so as to keep it in position during scrap S trimming. The casting pusher 19 is also used to eject the casting G at the end of the scrap trimming step.

[0038] The casting G, including its processing scrap S will be drawn from the die casting machine by a service robot, not shown, and placed on the workpiece support 14, after being cooled and checked for integrity.

[0039] An end-of-stroke device, not shown, may be provided on the lower member 13 of the die, which is designed to interact with the upper movable member 11 to allow operation of any possible radial trimming units and/or any possible mechanical processing units, none of them being shown.

[0040] When the upper movable member 11 is fully

closed against the lower member 13 of the trimming die, the scrap S is trimmed from the casting G.

[0041] In order that the scrapless casting G may be discharged automatically, there may be provided a discharging member 19, as seen in Fig. 3, which allows the casting to slip outwards after being risen upwards. When the stripper plate 18 has completed its stroke, thereby ensuring a "clean" discharge of the casting G, a new trimming cycle is authorized.

[0042] According to the present invention, a manipulator device is provided, overall designated with numeral 20, for supporting and handling the lower member 13 of the trimming die and its workpiece support 14, so as to cause them to rotate about a substantially horizontal axis, designated as H, through an angle sufficient to ensure the free fall of scrap S trimmed from castings and the discharge thereof into an underlying collection container 21.

[0043] Advantageously, the manipulator device 20 has both rotating means for rotating the workpiece support 14 about the axis H and translating means, for causing the workpiece support 14 to move along a substantially horizontal direction, so as to cause the scrap to fall by gravity far from the trimming area.

[0044] Preferably, the rotating and translating means may be provided as a single member, consisting of at least one carriage 22, which is designed to support the lower member 13 of the die, together with its workpiece support 14, the latter being slideably mounted on second guide means, collectively designated by numeral 23.

[0045] Particularly, the second guide means 23 may consist of a pair of opposed side guides 24, attached to the sides of the bed 4, and designed to guide the wheels 25 of the carriage 22.

[0046] Each guide 24 may have a substantially annular shape, consisting of a pair of parallel, substantially straight portions 26, 26', joined by a pair of substantially semicircular portions 27, 27'.

[0047] Actuator means may be provided to cause the automatic displacement of the carriage 22 along the guide means 23, e.g. an endless chain 28 wound on two pinion gears 29, 29', which are mounted on parallel end axes, concentric with the semicircular guide portions 27, 27'.

[0048] An electric motor reducer 30 is fitted on one of the two gears, for instance the left gear 29. Automatic connection means, not shown, are also provided, to selectively couple the carriages to the chain 28, in such a manner as to cause the carriage 22 to move in synchronism with the trimming operation of the apparatus 1.

[0049] Thanks to the manipulator device 20, the carriage 22 may cause the lower member 13 of the die, together with its workpiece support 14, to rotate through 180°, i.e. enough to ensure the free fall of all the scrap S collected on the surfaces of such members of the die. Also, the carriage may move the lower member 13 of the die away from the trimming area, thereby causing

scrap to be discharged out of such area, and allowing the workpiece support 14 to be loaded with a new casting to be trimmed, as schematically shown in the left portion of Fig. 3.

[0050] Advantageously, in order to reduce dead times and accelerate the loading of castings, a plurality of carriages 22 may be provided, which will be automatically linked with corresponding lower members 13 of the die and the associated workpiece supports 14, for connection with a single upper member 11 of the die, and cause sequential trimming of several castings G.

[0051] A microprocessor control unit, not shown, is provided to control the operation of the trimming press 1, and synchronize it with that of the manipulator device 20, while minimizing dead times, which unit controls the power supply both to the hydraulic pushing means 8 and to the motor reducer 30 and the means for automatic connection between the chain 30 and the carriages.

[0052] In operation, the casting G is loaded in an off-set position C relative to the trimming press alignment and closure direction D1.

[0053] First, the loading robot lays the casting G to be scrap-trimmed on the workpiece support 14 in the position C. Then, the carriage 22, with its workpiece support 14 on which the casting G has been laid, is brought to the trimming position A. Once the die 3 is opened, the carriage 22, with the lower member 13 and its respective workpiece support 14 is displaced to the position B, wherein it is overturned to discharge the scrap S.

[0054] Fig. 4 schematically shows a flowchart of the method for trimming scrap S from metal castings G, which may be accomplished by using the trimming press apparatus 1 and the manipulator device 20 as described above.

[0055] Particularly, the method includes a first step a) of preparing the die 3, with its lower member 13 fitted with a workpiece support 14 and its upper member 11 having trimming means 15.

[0056] This is followed by a step b) of loading a casting G to be trimmed onto the workpiece support 14.

[0057] This step is followed by a step c) of trimming the scrap S of the casting G by drawing the upper and lower members 11, 13 of the die 3 closer together.

[0058] A step d) follows, of rotating the workpiece support 14 about a substantially horizontal axis H by a sufficient angle to ensure the trimmed scrap S to fall and discharge into an underlying collection area. Finally, a step e) is executed of stripping the casting F free from scraps S.

[0059] It shall be noted that step d) of rotating the workpiece support 14 is preceded by a step f) of translation thereof along a substantially horizontal direction.

[0060] Particularly, step f) is executed by sliding the lower member 13 from a first trimming position A, vertically aligned with the upper movable member 11, to a second discharge position B, which is horizontally staggered relative to the first position.

[0061] Step b) of loading the casting G onto the work-

piece support 14 is executed with the lower member 13 in a third loading position C, which is staggered relative to the other two positions A and B.

[0062] It will be further understood that the step f) of translating the workpiece support 14 is synchronized with step c) of trimming and with step b) of loading the casting G onto the workpiece support 14, to minimize the dead times between the two steps.

[0063] The method and apparatus of this invention are susceptible to a numerous modifications and changes falling, within the inventive concept disclosed in the appended claims. All the details thereof may be replaced by other technically equivalents, without departure from the scope of the invention.

[0064] While the method and apparatus has been described with particular reference to the accompanying figures, the numerals referred to in the disclosure and claims are only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed scope in any manner.

[0065] The instant application is based upon and claims priority of patent application no. VI2002A000093, filed on 16.10.2002 in Italy, the disclosure of which is hereby expressly incorporated here in reference thereto.

Claims

1. A method for trimming scrap from metal castings, particularly die castings, including the steps of:
 - a) preparing a trimming press die (3), which has a lower member (13) fitted with a workpiece support (14) and an upper member (11) having trimming means (16);
 - b) loading a casting (G) to be trimmed onto said workpiece support (14);
 - c) trimming the scrap (S) of the casting (G) by drawing said upper member (11) and lower member (13) of the die closer together;
 - d) rotating the workpiece support (14) about a substantially horizontal axis (H) by a sufficient angle to ensure that the trimmed scrap (S) fall free and discharge into an underlying collection container (21);
 - e) stripping the scrapless casting (G).
2. Method as claimed in claim 1, **characterized in that** said step (d) of rotating the workpiece support 14 is preceded by a step (f) of translation thereof along a substantially horizontal direction.
3. Method as claimed in claim 2, **characterized in that** said step (f) of translating the workpiece support (14) is executed by sliding said lower member (13) from a first trimming position (A), vertically aligned with said upper movable member (11), to a

second discharge position (B), which is horizontally staggered relative to the first position (A).

4. Method as claimed in claim 2, **characterized in that** said step (b) of loading the casting (G) onto the workpiece support (14) is executed with said lower member (13) in a third loading position (C), which is staggered relative to the other two positions (A, B).
5. Method as claimed in claim 1, **characterized in that** said step (f) of translating the workpiece support (14) is synchronized with said step (c) of trimming and with said step (b) of loading the casting (G) onto said workpiece support (14), to minimize the dead times between said steps.
6. Method as claimed in claim 1, **characterized in that** the path followed by said workpiece support (14) during said rotation and translation step (f) is a closed loop path.
7. A trimming press apparatus for carrying out the method according to one or more of the preceding claims, comprising:
 - a press assembly (1) having a stationary lower bed (4) and a load-bearing frame (2) which supports an upper head (9) movable along first guide means (6) relative to the stationary bed (4);
 - a trimming die assembly (3) with an upper member (11), fitted with trimming means (15, 16), which may be associated to the movable head and with a lower member (13) having at least one workpiece support (14);

characterized in that it further includes a manipulator device (20) for supporting and handling said lower member (7) of the trimming die and its workpiece support (17), which causes them to rotate about a substantially horizontal axis (H) by an angle sufficient to ensure the scrap (S) cut from castings fall free and discharge into an underlying collection container (21).
8. Apparatus as claimed in claim 7, **characterized in that** said device (20) comprises means for rotating said workpiece support (14) about a substantially horizontal axis (H) and for translating said workpiece support (14) along a substantially horizontal direction.
9. Apparatus as claimed in claim 8, **characterized in that** said means for rotating and translating said device (20) include at least one carriage (22) designed to support said lower member with its workpiece support, movable along second guide means (23).

10. Apparatus as claimed in claim 9, **characterized in that** said second guide means (23) comprise a pair of side guides (24) having a substantially annular shape, formed by a pair of substantially straight portions (26, 26'), joined by a pair of substantially semicircular portions (27, 27'). 5
11. Apparatus as claimed in claim 10, **characterized in that** it provides actuator means for automatic translation of said at least one carriage (22) along said side guides (24). 10
12. Apparatus as claimed in claim 10, **characterized in that** said actuator means comprise rope or chain drive means (28, 29, 29'), which are driven by motor means (30) and are connected to said at least one carriage (22). 15
13. Apparatus as claimed in claim 9, **characterized in that** it comprises a plurality of workpiece supports (14), mounted on respective lower members (13), which are adapted to be coupled with said upper member (11) for sequentially trimming several castings (G), each of said lower members (13) being mounted on a carriage (23), coupled to said actuator means (28, 29, 29', 30) for independent handling with respect to the other carriages (22). 20 25
14. Apparatus as claimed in claim 9, **characterized in that** said second guide means (23) of said device (20) may be secured to said fixed bed (4). 30
15. Apparatus as claimed in claim 12, **characterized in that** it provides a microprocessor-based control unit for controlling the head (9) of said press assembly (1) and said motor means (20) which drive said manipulator device (20), in such a manner as to synchronize its handling and minimize the dead times between steps. 35 40
16. A manipulator device (20) for supporting and handling a workpiece support (14) of a trimming die (3), applicable to a trimming press apparatus (1) according to one or more of claims 7 to 15, **characterized in that** it comprises means for rotating said workpiece support (14) about a substantially horizontal axis (H) through a sufficient angle to ensure the free fall of the scrap trimmed from the casting and the discharge thereof to an underlying collection area. 45 50
17. Device as claimed in claim 16, **characterized in that** it comprises means for rotating and translating said lower member (13) with its workpiece support (14) along a substantially horizontal direction. 55
18. Device as claimed in claim 17, **characterized in that** said means for rotating and translating said device (20) consist of at least one carriage (22) suitable to support said workpiece support (14), said at least one carriage (22) being slideably mounted along second guide means (23).
19. A trimming die assembly (3) for trimming flashes and scrap (S) from a casting (G), adapted for use as trimming press apparatus (1) according to one or more of claims 7 to 15, and in combination with a manipulator device (20) according to claims 16 to 19, comprising an upper member (11) fitted with trimming means (15), which may be secured to a movable head (9) of a press unit, and a lower member (13), having at least one workpiece support (14), **characterized in that** said lower member (13), with its workpiece support (14) may be removably and selectively coupled to said upper member (11), and is capable of rotating about a substantially horizontal axis (H) through a sufficient angle to ensure the free fall of scrap and the discharge thereof to an underlying collection area.
20. Assembly as claimed in claim 19, **characterized in that** said lower member (13), with its workpiece support (14) may be translated along a substantially horizontal direction in such a manner as to stagger said workpiece support (14) relative to the trimming direction (D1) to allow automatic loading of a new casting to be trimmed.

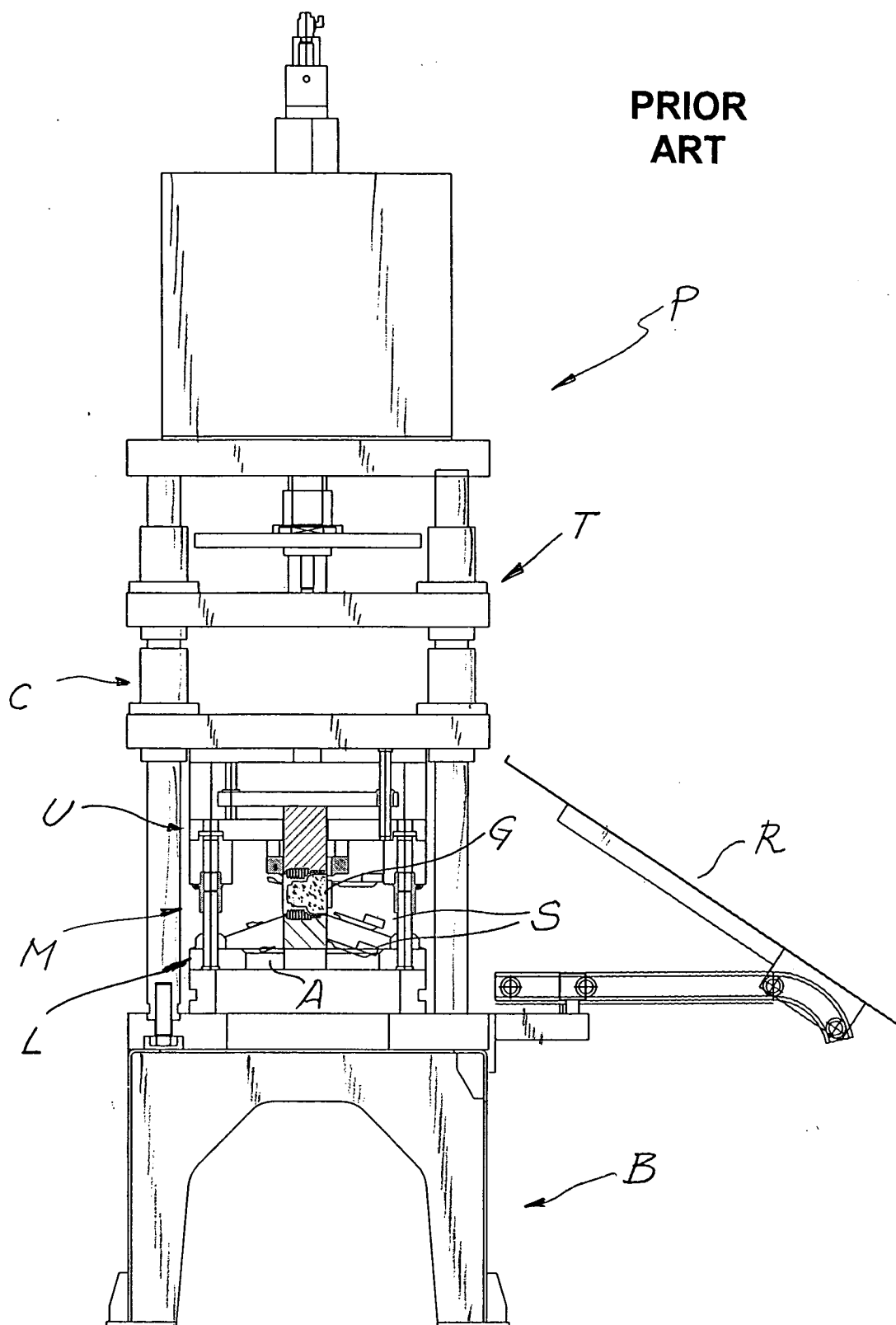


FIG. 1

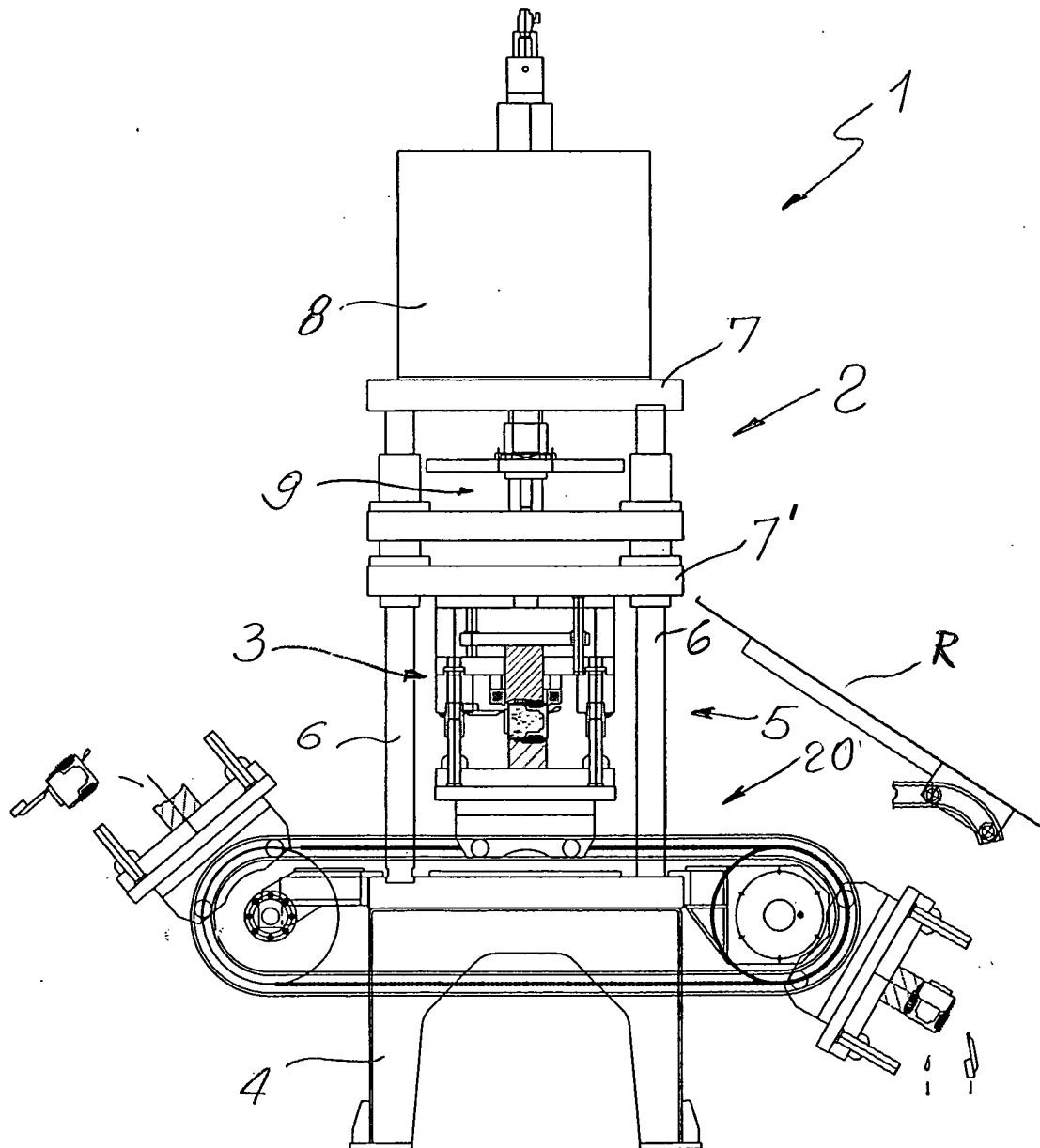


FIG. 2

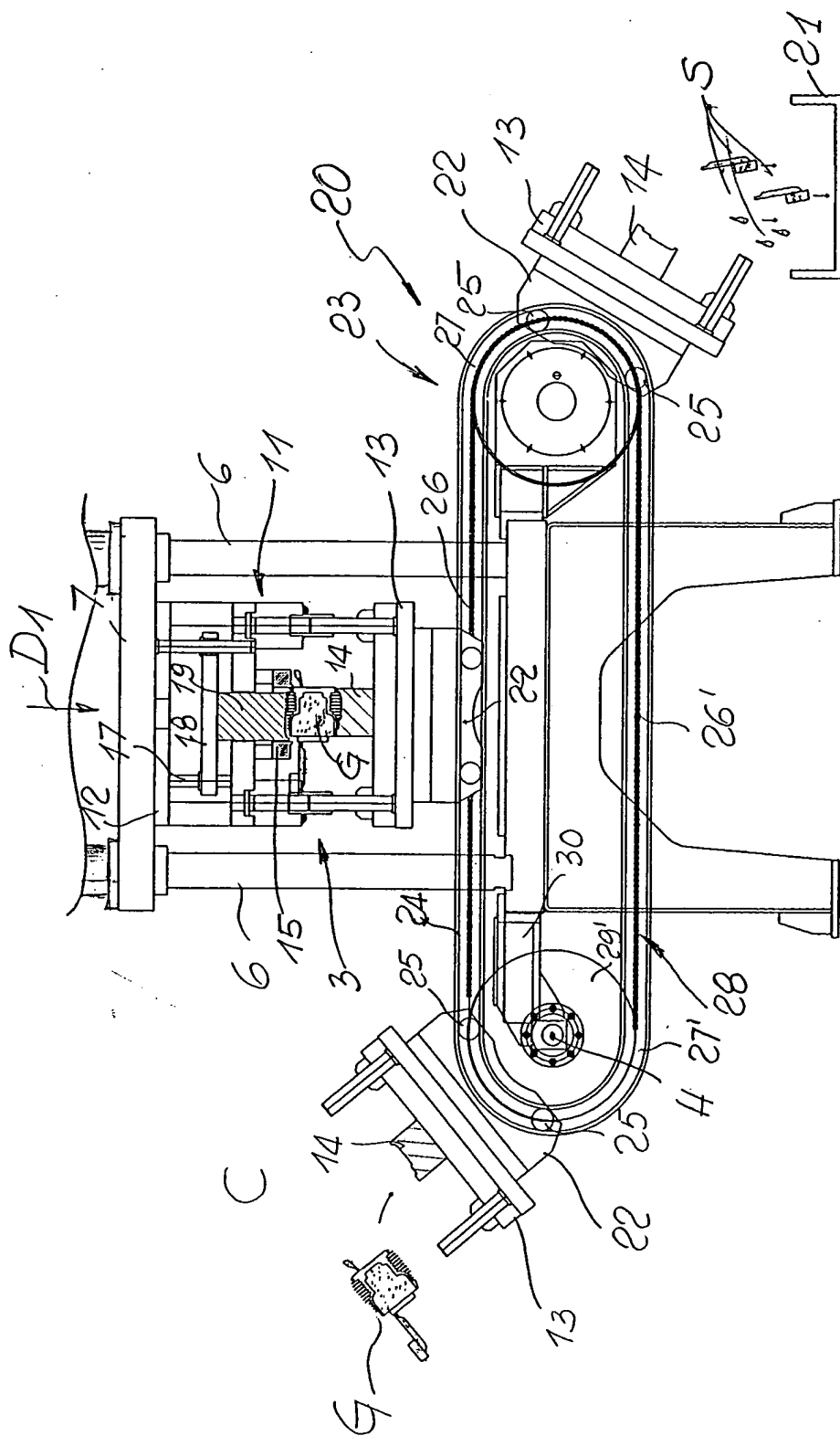


FIG. 3

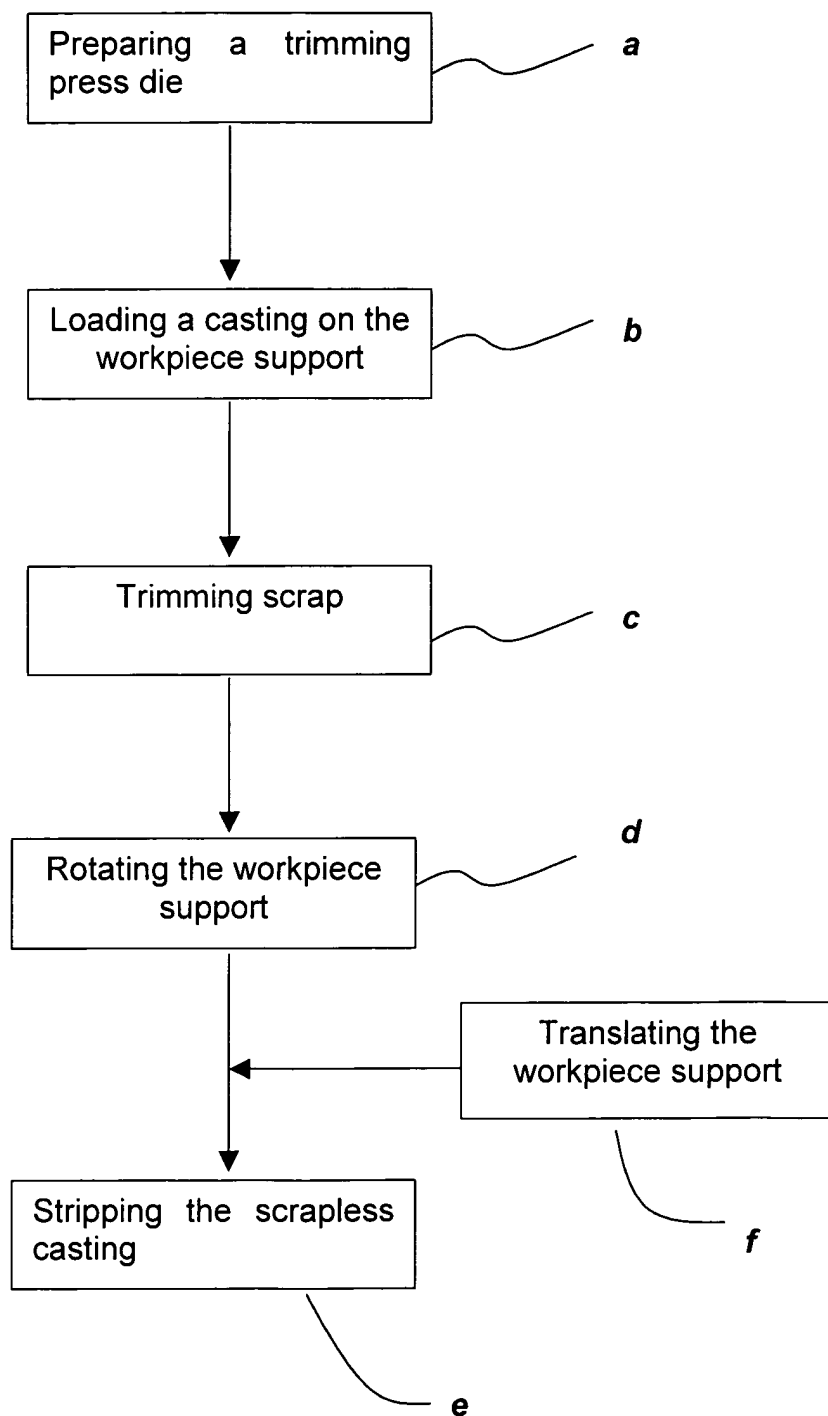


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 03 02 3363

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
MUNICH		2 February 2004	Baumgartner, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)



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EUROPEAN SEARCH REPORT

Application Number
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Place of search		Date of completion of the search	Examiner
MUNICH		2 February 2004	Baumgartner, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 02 3363

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The members are as contained in the European Patent Office EDP file on
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