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(54) Title: A MOULD TOOL FOR INJECTION MOULDING

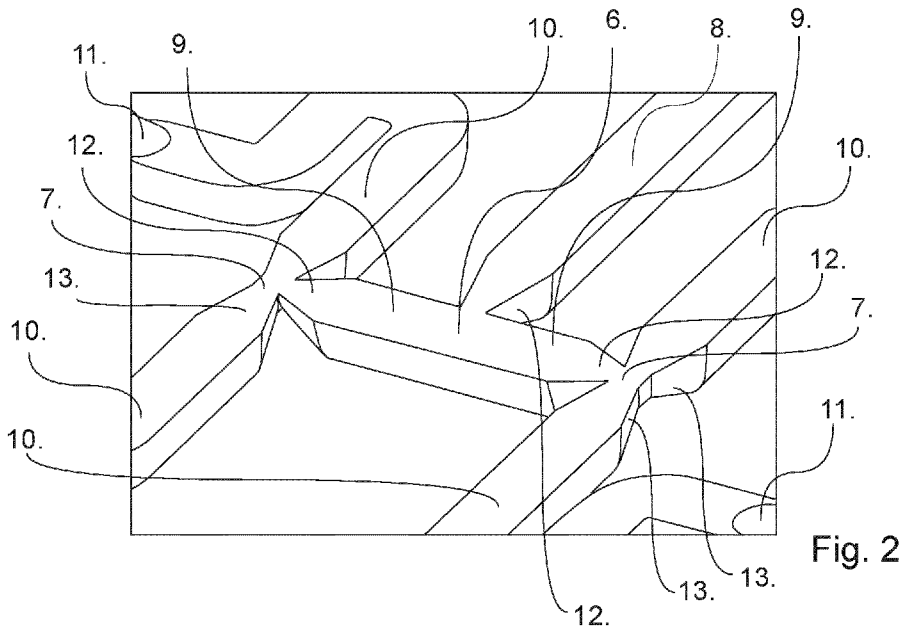

Fig. 2

(57) Abstract: An injection-moulding tool configured with at least two separate mould parts forming a set of mould cavities, and a set of runner channels (8, 9, 10) extending between the mould inlet and leading the melt flow to the mould cavities, and where the set of runner channels (8, 9, 10) comprises a number of junctions (6, 7), each junction (6, 7) dividing a downstream end of a primary runner channel extending upstream from the junction (6, 7) into two or more separate secondary runner channels extending downstream from the junction (6, 7), and wherein a stretch of the downstream end of the primary runner has a cross section area being smaller than the cross section area of the primary runner further upstream from the junction (6, 7).

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Title:

A mould tool for injection moulding

Prior art:

The present invention relates to an injection-moulding tool configured for being mounted in an injection-moulding apparatus for automated moulding of work pieces in plastics, said injection-moulding tool, in its closed position, comprises at least two separate mould parts forming a set of mould cavities, and where the separate mould parts comprises an inlet mould part having a mould inlet for injection of liquid plastics from the injection-moulding apparatus, and a second mould part, and where the mould parts has abutting side faces facing a common mould separation plane, and where the abutting side faces forms a set of runner channels extending between the mould inlet and leading the melt flow to the mould cavities, and where the set of runner channels comprises a number of junctions, each junction dividing a downstream end of a primary runner channel extending upstream from the junction into two or more separate branches or secondary runner channels extending downstream from the junction

When designing injection-moulding tools of the above mentioned kind it is a recurring challenge to ensure even supply of molten material to an increasing number of separate mould cavities. This is primarily due to the problem that even though the all the melt supplied to the injection-moulding tool has the same temperature, then some of the material in the flowing through the runner system is exposed to a higher shear and thereby having a higher temperature and a lower viscosity than other parts of the material, and that the geometry of the runner

systems, especially at runner junctions where a single primary runner is divided into two or more secondary runners or branches, may lead more of the melt having a higher temperature and lower viscosity to one mould cavity than to another mould cavity.

Therefore several different constructions of runner channels such as especially cold runner channels are suggested in order to ensure even distribution of the molten material often referred to as balancing the runner. In the prior art a lot of different examples of such runner systems are suggested comprising different embodiments of melt flippers and melt mixers.

Object of the invention:

Based on this, it is the object of the present invention to provide an injection-moulding tool with runners, such as cold runners, being well balanced, and allowing on the one hand that the cold runners or injection runners convey molten material to all mould cavities, but without using complex runner geometry.

This is accomplished by the invention as set forth in claim 1, specifying that the downstream end of the primary runner has a cross section area being smaller than the cross section area of the primary runner further upstream from the junction, and smaller than the largest cross section of the secondary runners.

The baling effect is obtained due to the fact that the reduced area of the runner at the junction thereby locally creates a high shear of more of the melt flowing through the junction and at the same time it provides a mixing effect so that the high shear material and the low shear

material is more mixed after the junction than it was before the junction.

According to a preferred embodiment of the moulding tool the cross section area of the downstream end of the primary runner gradually decreases in the flow direction.

Furthermore the cross section area of the upstream end of each of the secondary runners may advantageously be smaller than the cross section area of the secondary runner further downstream from the junction.

In this relation the cross section area of the upstream end of the secondary runner may furthermore gradually increase in the flow direction.

Preferably the smallest cross section area of at least one primary or secondary runner connected via a junction is less than 75% and preferably less than 50% of the cross section area of the same runner at a distance from the junction. The selected optimal reduction depends on e.g. the characteristics of the plastic material supplied though the runners, and the aim is to increase the shear rate in the supplied plastic material significantly at least before the junction.

In an especially simple embodiment of the invention one of or both the primary and the secondary runners are formed by groves arranged in the abutting side face of either the inlet mould part or the secondary mould part, or each of the primary and the secondary runners at least at a distance downstream and upstream from the junction are formed by groves arranged in only one of the abutting side faces of either the inlet mould part or the secondary mould part.

The drawing:

Figure 1: Is a principle drawing showing an embodiment of an injection moulding tool.

Figure 2: shows is an enlarged drawing showing a section of the injection moulding tool in figure 1, and in an embodiment according to the present invention.

Figure 3: Is a perspective drawing showing a junction insert forming one junction part of the runner channels shown in figure 2.

Figure 4: Is a perspective drawing showing a junction insert forming another junction part of the runner channels shown in figure 2.

Description of an embodiment:

Figure 1 illustrates the principle of a conventional injection moulding tool with an inlet mould part 1 and a second mould part shown with dotted lines. The inlet mould part 1 and the second mould part 2 have abutting surfaces forming a separation plane 5 also shown in dotted lines. The inlet mould part has an inlet 4 connected to multiple mould cavities 3 via a sprue 14 and a set of runner channels 8, 9 and a set of runner junctions 6, 7. In figure 1 the design of the mould cavities 3, the sprue 14, the runner channels 8, 9 and the runner junctions 6, 7 are illustrated as the shape of the moulded component, including the sprue, the runners and the moulded products/work pieces, that are produced in such an injection moulding tool.

An embodiment of the present invention will, in the following, be explained in principle with reference to the embodiment of an injection moulding tool as shown in figure 1, but it will be evident to the skilled person that the present invention may also be implemented in various different types of injection moulding tools, such as moulding tools having an intermediate mould part between the inlet mould part 1 and the second mould part 2.

In this relation figure 2 shows an enlarged section 20 of the set of runners as shown in figure 1, where runner junctions 6, 7 divides primary runner channels 8, 9 into secondary runner channels 9, 10 respectively, so that the primary runners 8 extending from the sprue 14 are divided into secondary runners 9 by the runner junction 6, and the secondary runners 9, when looked at from the runner junctions 7 are now primary runners 9, being divided into secondary runner 10 via the runner junctions 7. In this way the set of runners may be further subdivided several times into further secondary runners that the most downstream end of the runners is connected to the mould cavities 3 via runner gates 11.

Figure 3 and 4 discloses two junction inserts 21, 22 each forming a runner junction 6, 7 as shown in figure 2 for dividing the most downstream end of a primary runner channel 8, 9 (partly shown in dotted lines), into the most upstream end of the secondary runner channels 9, 10 respectively (partly shown with dotted lines). The junction inserts are made as blocks being adapted for insertion into a correspondingly shaped socket in the second mould part 2, and a screw hole 23 is arranged for the purpose of securing the junction inserts in the mould part 2. In this way it is possible to change the junction inserts with

other junction inserts having different geometries, e.g. when the injection moulding tool is to be used with other plastic materials, or to work under different conditions.

According to the principle of the invention, and with the purpose of ensuring more even filling of the mould cavities 3, then the downstream end of the primary runner 8 as shown in figure 3 has a cross section area being significantly reduced with respect to the cross section of the same runner 8 at a position upstream. In the embodiment shown in figure 3 a stretch 12 of the downstream end of the primary runner 8 is gradually decreasing in the flow direction in the runner 8, and it has its smallest cross section just before the junction 6 where the primary runner channel is divided into the two secondary runner channels 9.

In the same way the secondary runners 9 in figure 3 becomes the primary runner 9 in the embodiment shown in figure 4 where the primary runner 9 in the same way has a significantly reduced cross section at its most downstream position just before the junction 7, where the primary runner 9 is divided into two secondary runners 10. In this embodiment however, each of the secondary runner channels 10 at their most upstream end has the smallest cross section area and the cross section at a stretch 13 of the upstream end of each of the secondary runner channels 10 are gradually increasing in the flow direction.

From the description above it will be apparent to the skilled person that the present invention may be implemented in many different embodiments apart from the embodiment shown in the figures. As mentioned above the principle of the invention may also be used e.g. with moulding tools having an intermediate mould part between the inlet mould part 1 and the second mould part 2, or moulding tools equipped

with a hot runner system, or even a combination of hot and cold runners. Furthermore it will also be apparent to the skilled person that the runner system may comprise more or less mould cavities requiring more or fewer runner channels and junctions for distribution of the plastic material to the mould cavities.

Claims:

1. An injection-moulding tool configured for being mounted in an injection-moulding apparatus for automated moulding of work pieces in plastics, said injection-moulding tool, in its closed position, comprises at least two separate mould parts forming a set of mould cavities, and where the separate mould parts comprises an inlet mould part having a mould inlet for injection of liquid plastics from the injection-moulding apparatus, and a second mould part, and where the mould parts has abutting side faces facing a common mould separation plane, and where the abutting side faces forms a set of runner channels extending between the mould inlet and leading the melt flow to the mould cavities, and where the set of runner channels comprises a number of junctions, each junction dividing a downstream end of a primary runner channel extending upstream from the junction into two or more separate secondary runner channels extending downstream from the junction, and wherein a stretch of the downstream end of the primary runner has a cross section area being smaller than the cross section area of the primary runner further upstream from the junction, and smaller than the largest cross section of the secondary runners.

2. An injection-moulding tool according to claim1 wherein the cross section area of all, or at least the most upstream end, of the stretch of the downstream end of the primary runner gradually decreases in the flow direction.

3. An injection-moulding tool according to claim 2 wherein the most downstream end of the stretch of the downstream end of the primary runner has a uniform cross section area being smaller than

the cross section area of the primary runner further upstream from the junction.

4. An injection-moulding tool according to claim 1, 2 or 3, wherein the cross section area of a stretch of the upstream end of each of the secondary runners are smaller than the cross section area of the secondary runner further downstream from the junction.

5. An injection-moulding tool according to claim 2 wherein the most upstream end of the stretch of the upstream end of the primary runner has a uniform cross section.

6. An injection-moulding tool according to claim 5, wherein the cross section area of all, or at least a stretch, of the upstream end of the secondary runner gradually increases in the flow direction.

7. An injection-moulding tool according to one or more of the preceding claims, wherein the smallest cross section area of at least one primary or secondary runner connected via a junction is less than 75% and preferably less than 50% and most preferably less than 20% of the cross section area of the same runner at a distance from the junction.

8. An injection-moulding tool according to claim 1 or 2, wherein both the primary and the secondary runners are formed by groves arranged in only one of the abutting side faces of either the inlet mould part or the secondary mould part.

9. An injection-moulding tool according to claim 1 or 2, wherein each of the primary and the secondary runners at least at a distance downstream and upstream from the junction are formed by groves

arranged in only one of the abutting side faces of either the inlet mould part or the secondary mould part.

10. An injection-moulding tool according to one or more of the preceding claims, wherein the downstream end of the primary runner and the upstream end of the secondary runners are arranged in an insert that can be releasably attached to the inlet mould part or the secondary mould part forming the remaining parts of the primary and secondary runners.

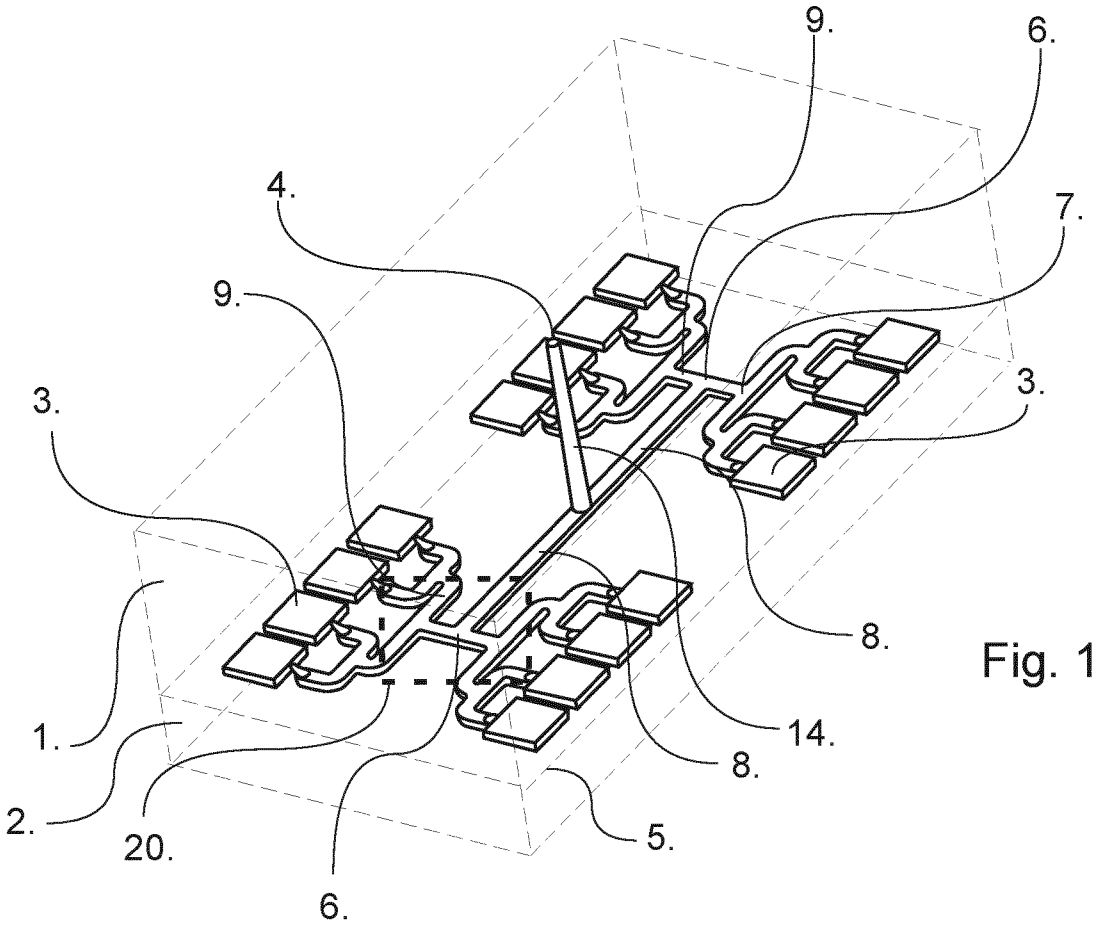

Fig. 1

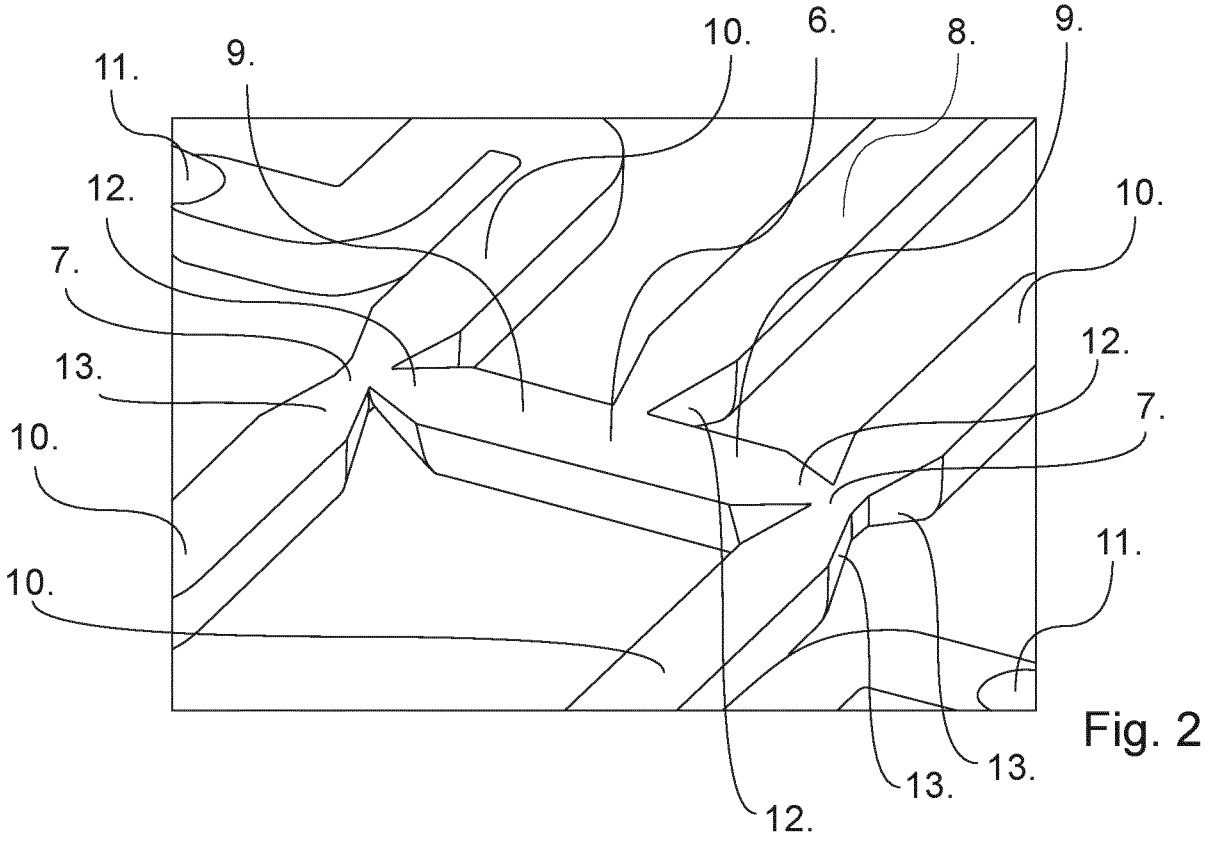

Fig. 2

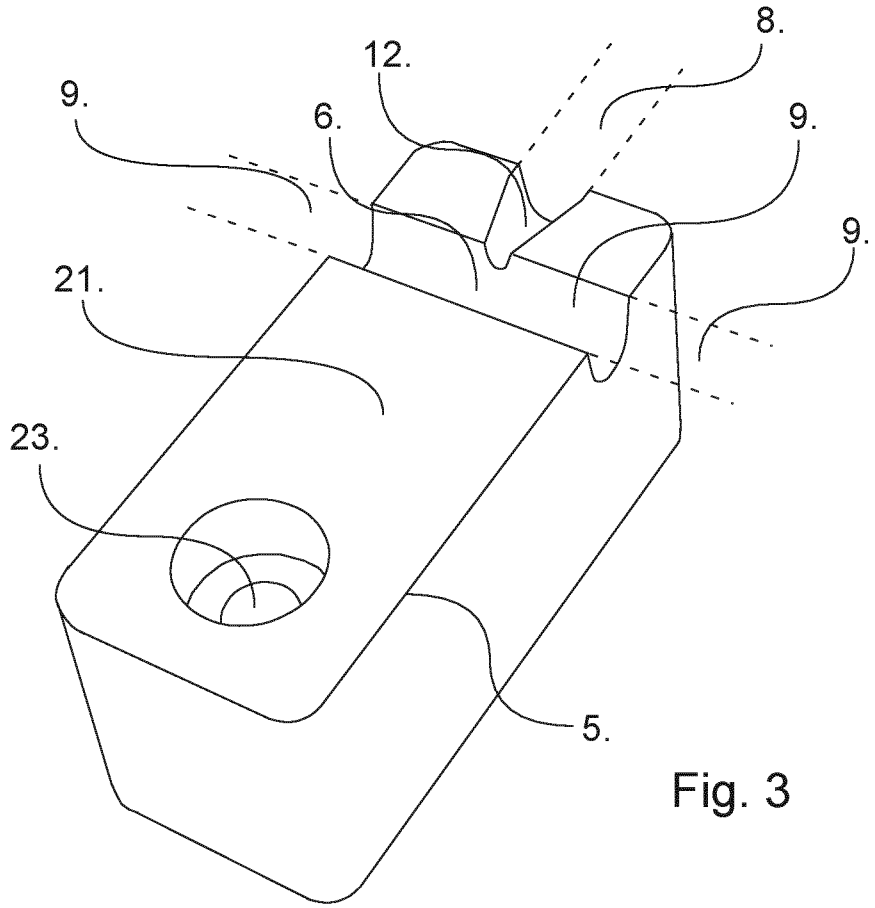

Fig. 3

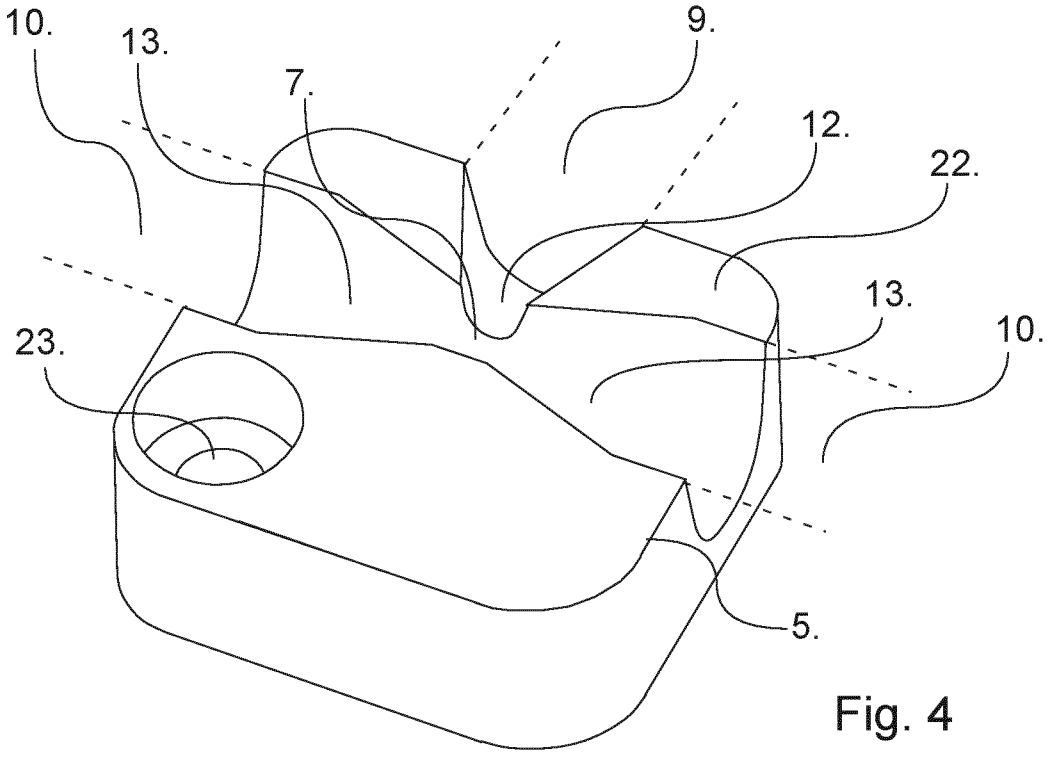

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/086924

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29C45/27
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP H06 71745 B2 (CANON KK) 14 September 1994 (1994-09-14) paragraphs [0001] - [0003]; figures 1-5	1-3,5, 7-9 10
Y A	WO 2015/157151 A1 (MACLEOD DARRIN ALBERT [US]; BRAND DIETMAR TIEMO [CA] ET AL.) 15 October 2015 (2015-10-15) figures 1-5	10 1
Y A	EP 0 523 549 A2 (MOLD MASTERS LTD [CA]) 20 January 1993 (1993-01-20) figures 1-6	10 1
A	EP 1 052 078 A1 (HEKUMA HERBST MASCHINENBAU GMB [DE]) 15 November 2000 (2000-11-15) figures 1-6	1-10

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
8 March 2021	17/03/2021

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Raicher, Gerald

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/086924

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2008/317896 A1 (BOXWALA HAKIM [US] ET AL) 25 December 2008 (2008-12-25) figures 1-15	1-10

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2020/086924

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H0671745 B2	14-09-1994	JP H0671745 B2	14-09-1994
		JP S62220313 A	28-09-1987
WO 2015157151 A1	15-10-2015	NONE	
EP 0523549 A2	20-01-1993	CA 2047461 A1	20-01-1993
		EP 0523549 A2	20-01-1993
EP 1052078 A1	15-11-2000	EP 1052078 A1	15-11-2000
		JP 2000343566 A	12-12-2000
US 2008317896 A1	25-12-2008	EP 2162272 A1	17-03-2010
		US 2008317896 A1	25-12-2008
		WO 2009000080 A1	31-12-2008