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(54) OSCILLATING DEVICE FOR A MOLD OF A CONTINUOUS CASTING LINE

(57) An oscillating device (8) for an ingot mold (6) of a continuous casting steel production system comprises an upper oscillating frame (40) which supports the ingot mold (6) and performs an oscillation along an arcuate trajectory corresponding to the contour of the extrados of the cast steel. [Fig. 3]

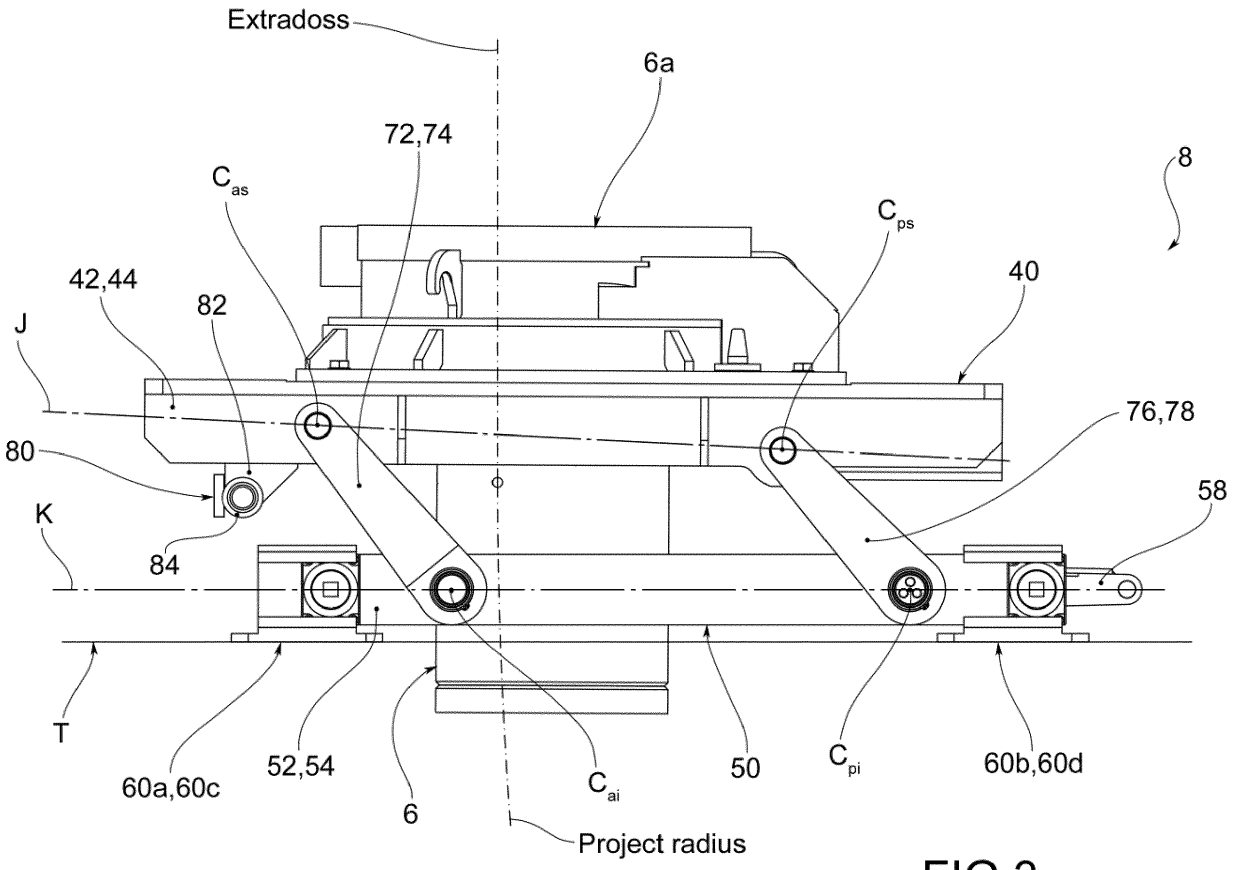

FIG.3

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Description

[0001] The object of the present invention is an oscillating device for an ingot mold of a continuous casting system, in particular for steel production.

[0002] In recent decades, continuous casting steel production systems have taken on considerable importance, to the point that over 95% of the world production uses this technology and, in Northern European countries and in some countries with emerging economies, even 100%.

[0003] As is known, the continuous casting process provides for pouring the liquid steel into an ingot mold, also known as a crystallizer, from which the steel is extracted continuously in the form of billets, blooms or slabs having a solidified shell and a core that has not yet solidified.

[0004] The function of the ingot molds is therefore to provide support for the growth of the thickness of the shell, up to the point wherein it becomes "self-supporting" for the semi-finished product that is extracted; the importance of the shell is evident, since it acts as a container for the liquid steel contained inside and as such must withstand the ferrostatic pressure.

[0005] In order for the billet to be extracted correctly, it is however necessary to be able to detach the shell from the surface of the ingot mold itself; to facilitate such detachment, an oscillating device operates on the ingot mold, forcing an oscillation that is able to cause such detachment.

[0006] There are numerous solutions of oscillating devices for ingot molds.

[0007] The purpose of the present invention is to create an oscillating device for an ingot mold of a continuous casting system, in particular for the production of steel in billets, blooms or slabs, which is particularly effective.

[0008] Such object is achieved by an oscillating device made according to the following claim 1.

[0009] The features and advantages of the oscillating device according to the present invention will be apparent from the description given hereinafter, provided by way of non-limiting example, according to the accompanying figures, wherein:

- Figure 1 shows a system for the production of semi-finished products by continuous casting, comprising an oscillating device according to the present invention;
- Figure 2 shows the oscillating device, according to an embodiment of the present invention;
- Figure 3 shows the oscillating device according to the present invention in a lower limit position;
- Figure 4 shows the oscillating device according to the present invention in an upper limit position; and
- Figure 5 shows an enlarged detail of the oscillating device according to the present invention.

[0010] A continuous casting system 1, for example for copper or steel, is intended for the production of semi-finished products such as billets, blooms or slabs.

[0011] The system comprises a movable ladle 2 suitable to contain the liquid steel, and a tundish 4 or distributor suitable to receive the liquid metal from the ladle, usually by gravity.

[0012] The system 1 further comprises an ingot mold 6, arranged downstream of the tundish 4. The semi-finished product, provided with a surface shell, but not completely solidified, is extracted from the bottom of the ingot mold following a characteristic curve, defined for example by the extrados of the same semi-finished product.

[0013] Moreover, the system 1 comprises an oscillating device 8, engaged with the ingot mold 6, suitable to impose thereon an oscillating movement to avoid the adhesion of the shell of the solidified metal to the wall, thus facilitating the extraction of the semi-finished product.

[0014] The system 1 further comprises a roller device 10, located downstream of the ingot mold, comprising a plurality of pairs of rollers 12 or individual rollers 14 that define a forced path for the semi-finished product coming out of the ingot mold.

[0015] The path defined by the roller device 10 is initially arcuate and then straight, to accompany adequately the semi-finished product.

[0016] The system 1 further comprises a cooling chamber 16, superimposed on at least one section of the path defined by the roller device 10, preferably along the arcuate path, suitable for the forced cooling of the semi-finished product.

[0017] For example, the cooling chamber 16 comprises a plurality of nozzles for spraying the coolant liquid, usually water.

[0018] Moreover, the system 1 comprises a straightener/extractor machine 20, located along the path defined by the roller device and in particular at the end of the arcuate section thereof.

[0019] The straightener/extractor machine 20 is suitable to straighten the semi-finished product, which downstream thereof continues along the straight path, and to extract the semi-finished product from the ingot mold.

[0020] Finally, the system 1 comprises a cutting machine 30, arranged downstream of the straightener/extractor machine 20, along the straight section of the path, suitable to cut the semi-finished product to the predefined length.

[0021] The oscillating device 8 comprises an upper oscillating frame 40 that supports the ingot mold 6 in an integral way; the ingot mold 6 will thus have the same oscillating movement as the oscillating frame 40.

[0022] Generally, the vertical oscillation is ± 5 mm.

[0023] For example, the oscillating frame 40 consists of a pair of cross members 42, 44, spaced transversely, carrying a surface 46, which in turn supports the ingot mold 6.

[0024] Said ingot mold 6 provides for an opening 6a above the plate 46, for the inlet of the liquid metal, and extends for the most part below the oscillating frame.

[0025] The oscillating device 8 further comprises a low-

er translating frame 50, equipped with alternating translational movement on an imaginary horizontal translation plane K.

[0026] The translating frame 50 rests on a horizontal reference plane T, parallel to the translation plane K.

[0027] For example, the translating frame 50 consists of a pair of cross members 52, 54, spaced transversely, between which passes the lower portion of the ingot mold 6, which ends below the reference plane T.

[0028] The translating frame 50 further comprises a transverse axis 56, which connects the two cross members 52, 54 on one side. Said axis 56 is in turn connected to a connection 58, having mainly longitudinal extension, for the connection to actuation means, which will be discussed hereinafter.

[0029] The oscillating device 8 further comprises translation guides for the translating frame 50, suitable to guide said frame 50, and in particular the cross members 52, 54, in the horizontal alternating movement.

[0030] Preferably, four translation guides 60a-60d are provided, arranged two by two to support and guide the respective ends of the cross members 52, 54.

[0031] Preferably, there are further provided wheels 62, applied rotatably to the ends of said cross members 52, 54, housed in said translation guides 60a-60d to facilitate the alternating translational movement.

[0032] The oscillating device 8 further comprises a pair of front arms 72, 74 hinged at their respective ends to the translating frame 50 and to the oscillating frame 40, defining a lower front hinge axis Cai with the translating frame and an upper front hinge axis Cas with the oscillating frame 40.

[0033] Similarly, the oscillating device 8 comprises a pair of rear arms 76, 78 hinged at their respective ends to the translating frame 50 and to the oscillating frame 40, defining a lower rear hinge axis Cpi with the translating frame and an upper rear hinge axis Cps with the oscillating frame 40.

[0034] Advantageously, the lower hinge axes Cai, Cpi lie on an imaginary plane substantially coinciding with the translation plane K of the translating frame 50, which also passes through the point of engagement of the connection 58 with the actuation means.

[0035] In particular, the lower rear hinge axis Cpi coincides with the direction of the axis 56 of the translating frame 50.

[0036] The upper hinge axes Cas, Cps lie on an imaginary inclined plane J, inclined with respect to the translation plane K.

[0037] Advantageously, the different length between the front arms 72, 74 and the rear arms 76, 78, brings the oscillating frame 40 to complete an arcuate trajectory that follows the contour of the extrados of the semi-finished product exiting the ingot mold.

[0038] Moreover, preferably, the oscillating device 8 comprises at least one fixed trajectory guide 80, suitable to guide the oscillating frame 40 along an arcuate trajectory that follows the contour of the extrados of the semi-finished product leaving the ingot mold. Said trajectory guide 80, in the presence of different lengths between the front arms 72, 74 and the rear arms 76, 78, functions as a safety stop.

[0039] Preferably, the oscillating device 8 comprises a trolley 82, preferably equipped with wheels 84, movable in the trajectory guide 80, to constrain the oscillating frame 40 to follow said arcuate trajectory.

[0040] For example, the trajectory guide 80 comprises a box body 81 equipped with a stop wall 83 against which, internally, the wheels 84 abut (figure 5).

[0041] Said stop wall 83 is equipped internally with a guide surface 85, against which said wheels 84 come into contact, having an arcuate profile that follows the contour of the extrados of the semi-finished product coming out of the ingot mold, so as to guide the oscillating frame 40 to follow said arcuate trajectory.

[0042] Consequently, the alternating translation of the translating frame 50 corresponds to an alternating translation of the oscillating frame 40, which remains always parallel to the horizontal plane, but vertically follows an arcuate trajectory corresponding to the extrados of the semi-finished product.

[0043] The actuation means are suitable to move the translating frame 50 with an alternating translational movement and are preferably applied operatively to the connection 58 of the translating frame 50.

[0044] Preferably, said actuation means comprise a linear electric motor, preferably of the type with stroke control, operatively connected to the connection 58.

[0045] Advantageously, this makes it possible to avoid the implementation of a hydraulic circuit, which instead requires some solutions of the prior art that provide for a movement by means of a hydraulic cylinder.

[0046] Advantageously, moreover, this allows the stroke of the translating frame to be adjusted and thus the oscillation stroke of the oscillating frame, which is not possible to adjust on other solutions of the prior art.

[0047] Innovatively, the oscillating device according to the present invention achieves the aforesaid object, since the oscillation, adhering to a trajectory that follows the extrados of the semi-finished product, causes the least disruption to the extraction of the semi-finished product.

[0048] Advantageously, moreover, the attainment of said arcuate trajectory by means of different lengths between the front arms and the rear arms, allows the high loads involved to be supported, without these being supported only by the trajectory guide.

[0049] It is clear that one skilled in the art, in order to meet contingent needs, may make changes to the oscillating device described above, all contained within the scope of protection defined by the following claims.

Claims

1. Oscillating device (8) for an ingot mold (6) of a continuous casting system, comprising:

- an upper oscillating frame (40) supporting the ingot mold (6), a lower translating frame (50), at least one front arm (72,74) hinged to the translating frame (50) and to the oscillating frame (40) respectively in a lower front hinge axis (Cai) and an upper front hinge axis (Cas), at least one rear arm (76,78) hinged to the translating frame (50) and to the oscillating frame (40) respectively in a lower rear hinge axis (Cpi) and an upper rear hinge axis (Cps);
- actuation means adapted to move the translating frame (50) with an alternating translational movement on a translation plane (K);

wherein the lower hinge axes (Cai, Cpi) lie on an imaginary plane substantially coinciding with the translation plane (K) of the translating frame (50) and the upper hinge axes (Cas, Cps) lie on an inclined plane (J), inclined with respect to the translation plane (K), to make said oscillating frame (40) complete an oscillation along an arcuate trajectory.

2. Oscillating device (8) according to claim 1, wherein a semi-finished product having a predefined extrados is extracted from the ingot mold (6) and the arcuate trajectory of the oscillating frame corresponds to the contour of said extrados.

3. Oscillating device according to claim 1 or 2, wherein the translation plane (K) passes through the point of application of said actuation means to the translating frame (50).

4. Oscillating device according to any one of the preceding claims, comprising a trajectory guide (80) cooperating with the oscillating frame (40) as a stop.

5. Oscillating device according to any one of the preceding claims, wherein, during oscillation, the oscillating frame (40) always remains parallel to itself.

6. Oscillating device according to any one of the preceding claims, comprising translation guides (60a-60d) for supporting and guiding the translating frame (50).

7. Oscillating device according to any one of the preceding claims, wherein said actuation means are electric.

8. Oscillating device according to claim 7, wherein said actuation means comprise a linear electric motor engaged with the translating frame (50).

9. Oscillating device according to claim 7 or 8, wherein said actuation means are adapted to adjust the alternating translation stroke to control the oscillating stroke of the oscillating frame (50).

10. System for the production of semi-finished products such as billets, blooms or slabs, by continuous casting, comprising an oscillating device (8) according to any one of the preceding claims.

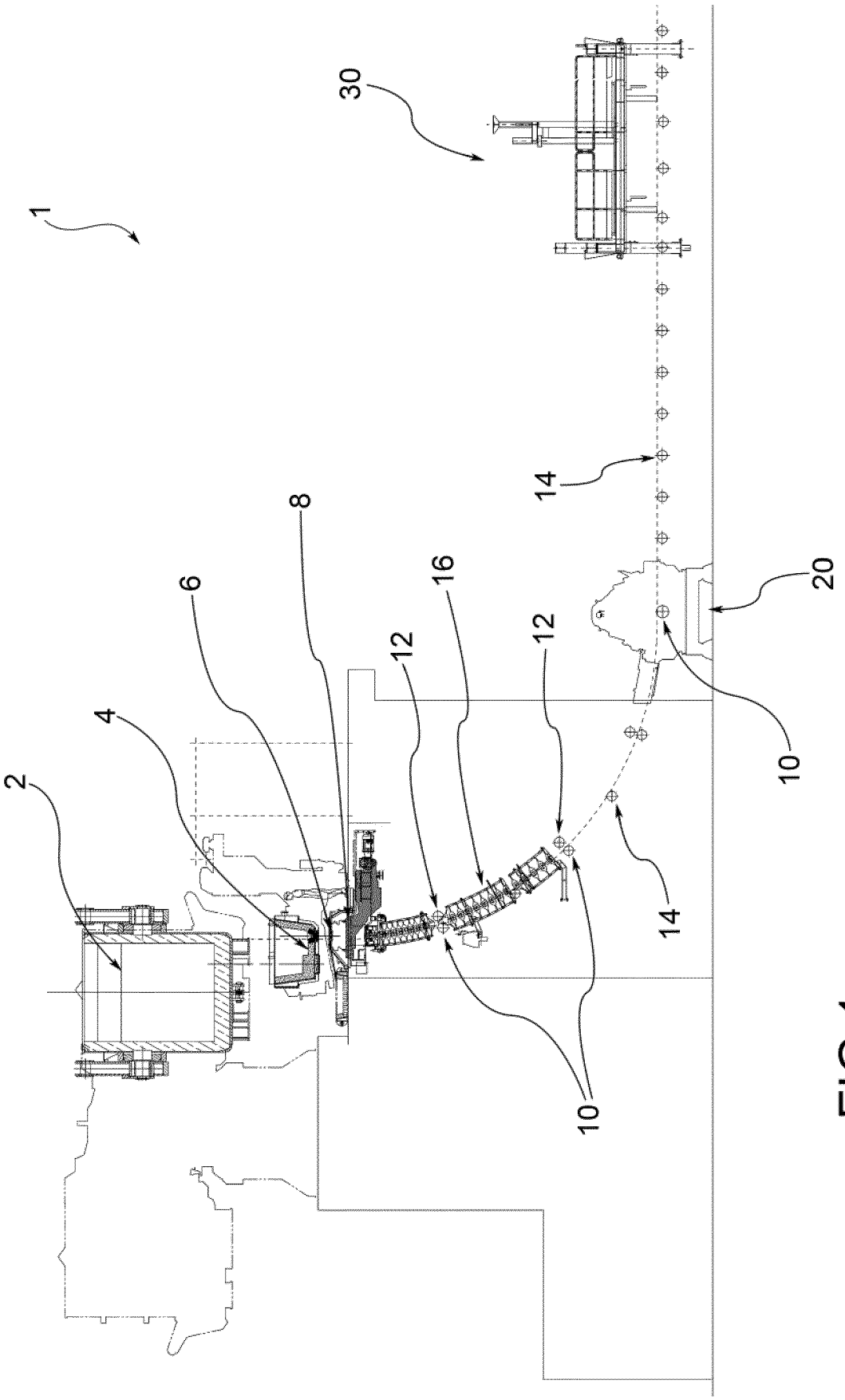


FIG.1

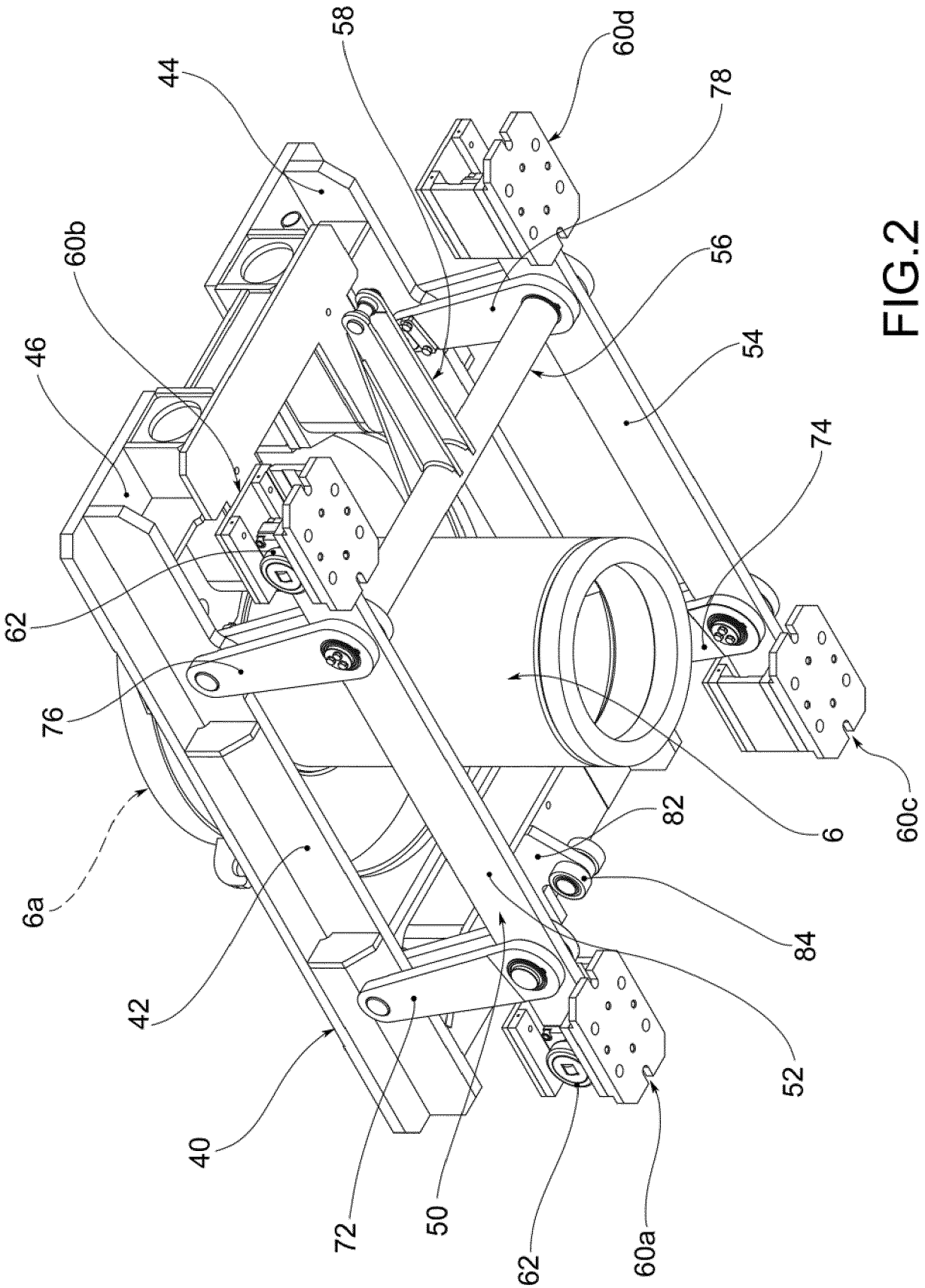
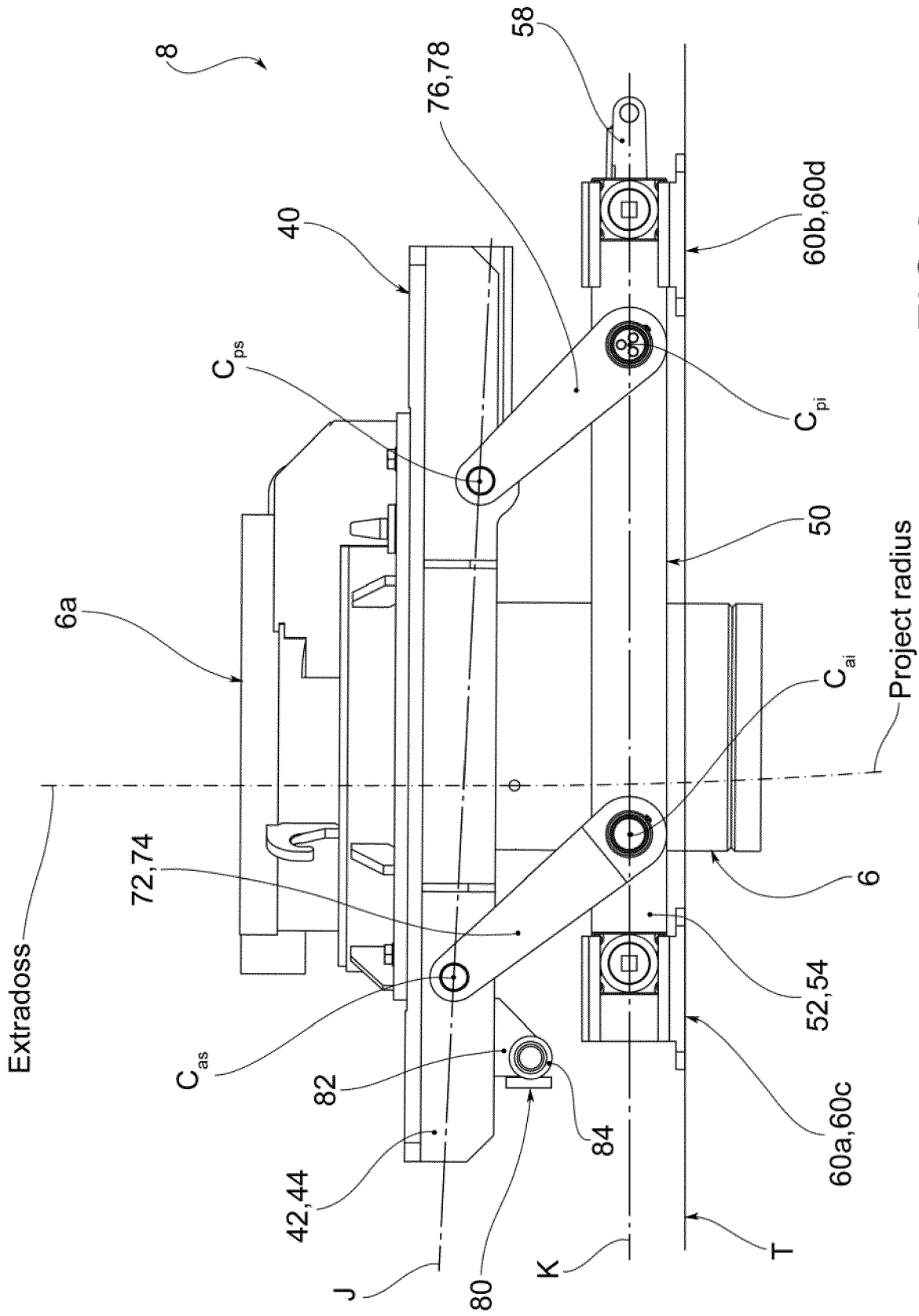


FIG.2


8
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76,78
40
60b,60d
C_{ps}
C_{pi}
50
6a
C_{ai}
Project radius
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60a,60c
42,44
J
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K
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FIG.3

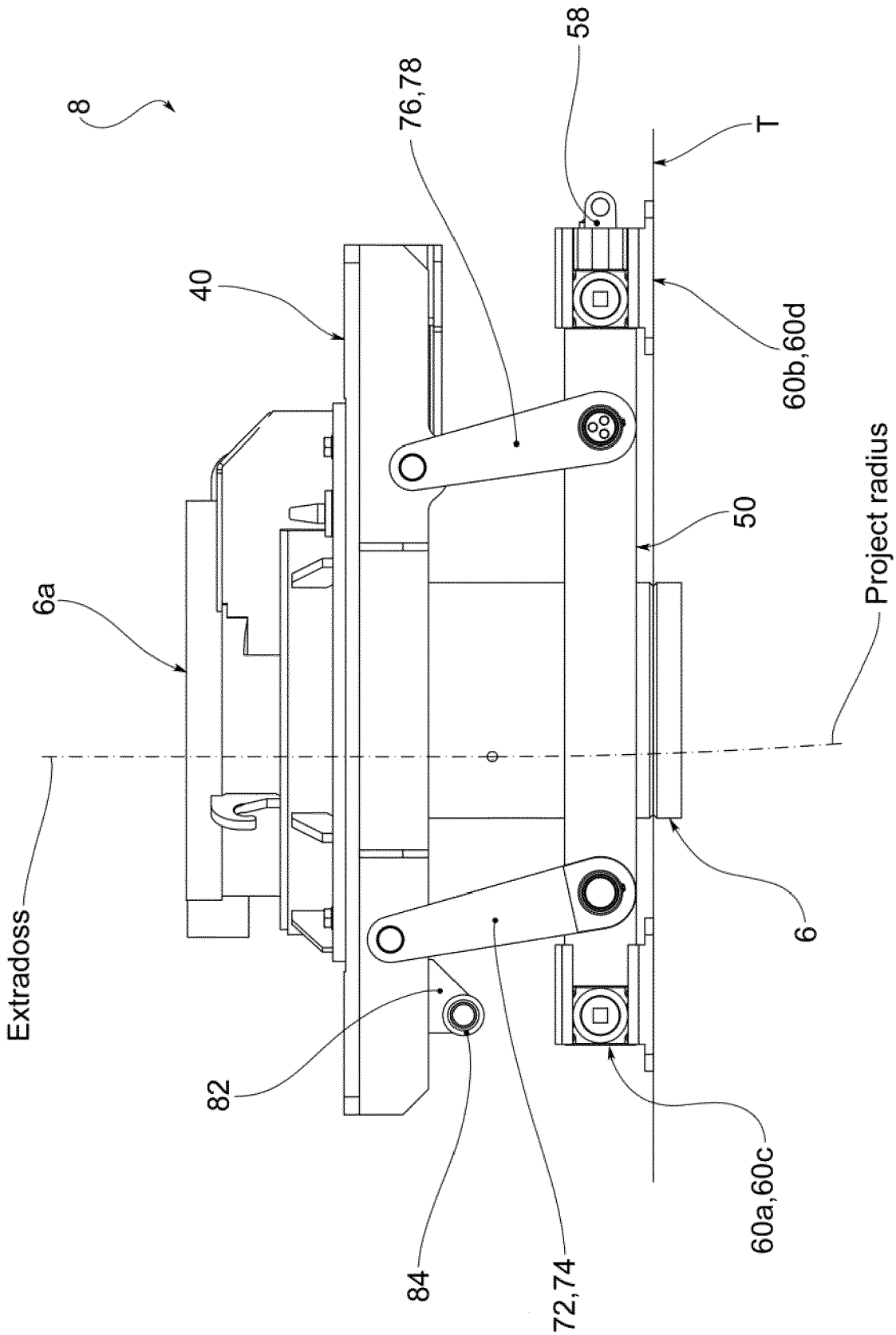
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FIG.4

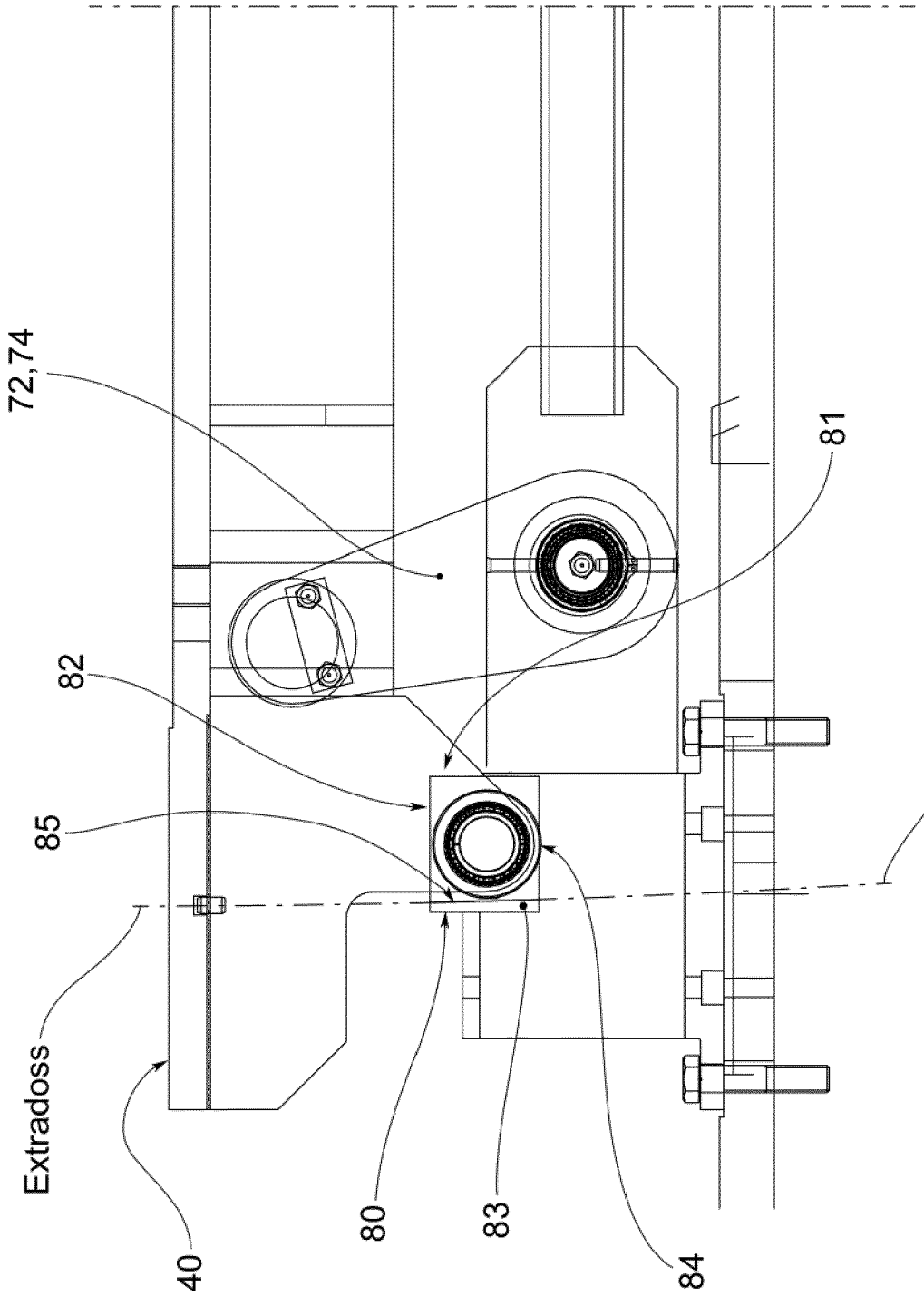

FIG.5

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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 5638

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Y	* column 1, line 7 - line 17 * * column 1, line 59 - column 2, line 24 * * column 3, line 40 - line 59 * * column 4, line 22 - line 36 * * column 4, line 54 - column 5, line 34 * * column 5, line 58 - line 67 * * figures 1,9,10 *	4	

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TECHNICAL FIELDS SEARCHED (IPC)

B22D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	11 July 2019	Desvignes, Rémi

CATEGORY OF CITED DOCUMENTS

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