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(54) **BRAKE DISC**

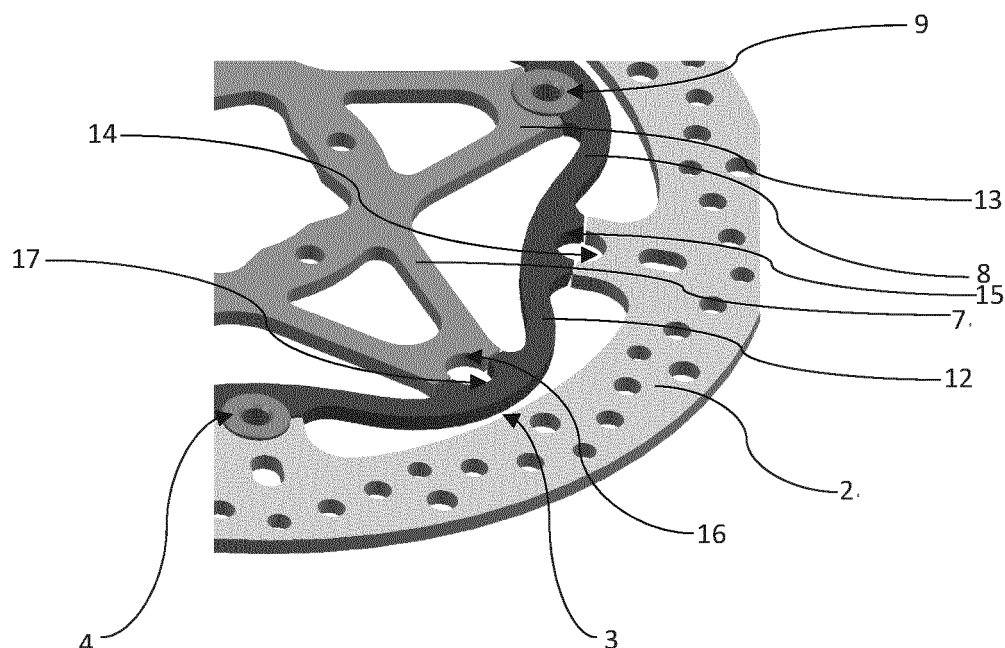
(57) Described is a brake disc, rotating about its own axis of rotation (1a), comprising a brake strip (2), an element (3) for supporting the brake strip (2) and a plurality of first elements (4) for connecting the brake strip (2) with the supporting element (3) which can be elastically deformed in such a way as to allow a relative movement of the brake strip (2) with respect to the supporting element (3).

The supporting element (3) comprises at least a first

component (7) and a second component (8) connected to the brake strip (2) by means of the first connecting elements (4).

A plurality of second connecting elements (9) of the first component (7) and of the second component (8) are elastically deformable in such a way as to allow a relative movement between the first component (7) and the second component (8).

Fig.2



EP 3 889 455 A1

Description

[0001] This invention relates to a brake disc.

[0002] More specifically, the brake disc according to this invention is preferably for use by bicycles or motorcycles with two or more wheels, without thereby limiting the scope of the invention.

[0003] As is known from the prior art, the brake strip of a brake disc is subjected to a high level of heating during braking and is particularly sensitive to thermal expansion due to its thickness, which is to be considered reduced in relation to the considerable extension of its surface.

[0004] This heating may induce deformations of the brake strip both in the diametric direction and in the axial direction of the disc, creating considerable problems in the mechanics of the braking.

[0005] To overcome these problems, which are especially evident in the systems of motorcycles with high-performance and for sports use, use is made of the so-called "floating" and "semi-floating" brake discs which usually consist of an internal support, an external brake strip and an elastic system for attaching the support with the brake strip which allows a relative movement, or misalignment, of the brake strip with respect to the support in the diametric direction or in the axial direction or in both directions.

[0006] In order to increase the compliance of the connection between the brake strip and the support, the need is felt of making a brake disc, rotating about its own axis of rotation, comprising a brake strip, an element for supporting the brake strip and a plurality of first elements for connecting the brake strip with the supporting element, which can be elastically deformed in such a way as to allow a relative movement of the brake strip with respect to the supporting element.

[0007] The supporting element comprises at least a first component, designed to be connected to a hub of a rotary element, and at least a second component connected to the brake strip by means of the first connecting elements.

[0008] A plurality of second connecting elements of the first component and of the second component are elastically deformable in such a way as to allow a relative movement between the first component and the second component.

[0009] Advantageously, the elastic connections are divided into at least two groups connected in series, the compliance of the connections is doubled in a radial direction and quadrupled in a direction parallel to the axis of rotation, under equal conditions of compliance of all the elastic connections.

[0010] The features of the brake disc according to the invention will become more apparent from the following detailed description of a preferred, non-limiting embodiment of it, illustrated by way of example in the accompanying drawings, in which:

- Figure 1 is a schematic front view of a first embodiment of a brake disc according to the invention;
- Figure 2 is a schematic perspective view of a detail of the brake disc of Figure 1, with some parts cut away to better illustrate others.

[0011] With reference to the accompanying drawings, the numeral 1 denotes a brake disc according to the invention.

[0012] The brake disc 1 rotates about its axis of rotation 1a.

[0013] The brake disc 1 comprises a brake strip 2.

[0014] In the embodiment described, the brake strip 2 of the brake disc 1 is an annular strip having a thickness defined by the distance between end faces, preferably parallel, defining the zones of contact with friction means (not illustrated) for braking or the transmission of a torque by friction.

[0015] It should be noted that the brake strip 2 may have a specific shape, such as, for example, in the shape of "waves".

[0016] The brake disc 1 comprises an element 3 for supporting the brake strip 2. The supporting element 3 is configured to be keyed, centrally, to the hub of a rotary element or to a wheel of the vehicle (bicycle or motorcycle or vehicle of other types not illustrated).

[0017] The brake disc 1 comprises a plurality of first elements 4 for connecting the brake strip 2 with the supporting element 3.

[0018] The brake strip 2 has a plurality of seats 14 each of which partly houses a respective first connecting element 4.

[0019] The first connecting elements 4 are elastically deformable in such a way as to allow a relative movement of the brake strip 2 relative to the supporting element 3.

[0020] In that sense, the brake disc 1 according to the invention is a so-called "floating" brake disc.

[0021] In a preferred embodiment, as illustrated, each first connecting element 4 comprises a cylindrical pawl 5.

[0022] According to the invention, the supporting element 3 comprises at least a first component 7 and a second component 8.

[0023] A plurality of second connecting elements 9 of the first component 7 and of the second component 8 are elastically deformable in such a way as to allow a relative movement between the first component 7 and the second component 8.

[0024] The first component 7 has a plurality of seats 16 each of which partly houses a respective second connecting element 9.

[0025] The second component 8 has a plurality of seats 17 each of which partly houses a respective second connecting element 9.

[0026] With reference to each second connecting element 9, it is housed partly in the respective seat 16 of the first component 7 and partly in the respective seat 17 of the second component 8 of the supporting element 3. Preferably, each second connecting element 9 compris-

es a cylindrical pawl 10.

[0027] The second component 8 is connected to the brake strip 2 by the first connecting elements 4.

[0028] The second component 8 of the supporting element 3 has a plurality of seats 15 each of which partly houses a respective first connecting element 4.

[0029] It should be noted that according to the embodiment illustrated, with reference to the second component 8, the seat 15 for partial housing of a respective first connecting element 4 is positioned in an alternating fashion with the seat 17 for partial housing of a respective second connecting element 9.

[0030] In an alternative embodiment, it is possible that, with reference to the second component 8, one or more seats 15 for partial housing of a respective first connecting element 4 are positioned in an alternating manner with one or more seats 17 for partial housing of a respective second connecting element 9.

[0031] The seat 15 for partial housing of a respective first connecting element 4 faces towards the brake strip 2.

[0032] The seat 17 for partial housing of a respective second connecting element 9 faces towards the first component 7.

[0033] With reference to each first connecting element 4 it is housed partly in the respective seat 14 of the brake strip 2 and partly in the respective seat 15 of the second component 8 of the supporting element 3.

[0034] Advantageously, the elastic connections are divided into at least two groups connected in series, the compliance of the connections is doubled in a radial direction and quadrupled in a direction parallel to the axis of rotation, under equal conditions of yieldable connections.

[0035] It should be noted that, with reference to rigidity in a direction parallel to the axis of rotation, a floating disc of known type with 10 connecting elements having all equal elastic constant k has a rigidity equal to $K_{tot} = 10k$, the brake disc 1, according to the invention, which has 5 first connecting elements 4 all having equal elastic constant k and 5 second connecting elements 9 all having equal elastic constant k has a rigidity of $1/K_{tot} = 1/5k + 1/5k = 2/5k$, that is to say, $K_{tot} = 5k/2 = 2.5k$. According to a first variant embodiment, the first connecting elements 4 allow a respective axial movement, parallel to the axis of rotation 1a of the brake disc 1, of the brake strip 2 relative to the second component 8 of the supporting element 3.

[0036] According to the first variant embodiment, the second connecting elements 9 allow a respective axial movement, parallel to the axis of rotation 1a of the brake disc 1, of the second component 8 relative to the first component 7.

[0037] According to a second variant embodiment, the first connecting elements 4 allow a respective radial movement, in an orthogonal direction relative to the axis of rotation 1a of the brake disc 1, of the brake strip 2 relative to the second component 8 of the supporting element 3.

[0038] According to the second variant embodiment, the second connecting elements 9 allow a respective radial movement, in an orthogonal direction relative to the axis of rotation 1a of the brake disc 1, of the second component 8 relative to the first component 7.

[0039] According to a third variant embodiment, the preferred embodiment, the first connecting elements 4 allow a respective radial and axial movement, relative to the axis of rotation 1a of the brake disc 1, of the brake strip 2 relative to the second component 8 of the supporting element 3 and the second connecting elements 9 allow a respective diametric and axial movement, relative to the axis of rotation 1a of the brake disc 1, of the second component 8 relative to the first component 7.

[0040] Advantageously, the presence of the first connecting elements 4, positioned between the brake strip 2 and the second component 8 of the supporting element 3, and second connecting elements 9, positioned between the second component 8 and the first component 7 of the supporting element 3, quadruples, with the same connecting elements, the compliance of the brake disc 1 in an axial direction, that is to say, in the direction of the axis of rotation 1a of the brake disc 1, and doubles, with the same connecting elements, the compliance in a radial direction, relative to the axis of rotation 1a of brake disc 1.

[0041] According to the embodiment described, the first connecting elements 4 and the second connecting elements 9 are positioned along a same circumference having as the centre the axis of rotation 1a of the brake disc 1.

[0042] Advantageously, the possibility of preserving the same number of connecting elements, summing the first and second connecting elements, positioned along the same circumference of a floating brake disc of known type allows the total interchangeability of the brake disc 1 according to the invention and the floating brake disc of known type.

[0043] In order to prepare the first connecting elements 4 and the second connecting elements 9 along a same circumference, having as the centre the axis of rotation 1a of the brake disc 1, the second component 8 has a plurality of lobes 12 each of which has the seat 17 which partly houses a respective second connecting element 9 and the first component 7 has a plurality of spokes 13, each of which partly houses a respective second connecting element 9 at the respective end.

[0044] Advantageously, the shape of the second component 8 makes it possible to obtain the second component 8 from the supporting element 3 starting from the same semi-worked element as the floating brake disc of known type; in this way there are no increases in the cost of the brake disc 1 for use of additional raw material.

[0045] Alternatively, it should be noted that the first connecting elements 4 and the second connecting elements 9 may be positioned along different circumferences, with reference to the axis of rotation 1a of the brake disc 1.

[0046] Lastly, it should be noted that, compared with a prior art floating disc solution, the double compliance is obtained with the same number of elastic connecting elements, with the same circumference on which all the elastic connecting elements are positioned, and therefore with the same equipment for processing the components (same tools, same programs, same equipment) and with the same equipment for assembling the discs (same assembly programs, same small parts, same assembly masks).

Claims

1. A brake disc, rotating about its own axis of rotation (1a), comprising a brake strip (2), an element (3) for supporting the brake strip (2) and a plurality of first elements (4) for connecting the brake strip (2) with the supporting element (3) which can be elastically deformed in such a way as to allow a relative movement of the brake strip (2) with respect to the supporting element (3);
characterised in that
the supporting element (3) comprises at least a first component (7) and a second component (8) connected to the brake strip (2) by means of the first connecting (4); a plurality of second connecting elements (9) of the first component (7) and of the second component (8) are elastically deformable in such a way as to allow a relative movement between the first component (7) and the second component (8).
2. The brake disc according to independent claim 1, **characterised in that** the first connecting elements (4) allow a respective axial movement, parallel to the axis of rotation (1a) of the brake disc (1), of the brake strip (2) relative to the second component (8) of the supporting element (3).
3. The brake disc according to claim 1 or 2, **characterised in that** the second connecting elements (9) allow a respective axial movement, parallel to the axis of rotation (1a) of the brake disc (1), of the second component (8) relative to the first component (7).
4. The brake disc according to any one of the preceding claims, **characterised in that** the first connecting elements (4) allow a respective radial movement, relative to the axis of rotation (1a) of the brake disc (1), of the brake strip (2) relative to the second component (8) of the supporting element (3).
5. The brake disc according to any one of the preceding claims, **characterised in that** the second connecting elements (9) allow a respective radial movement, relative to the axis of rotation (1a) of the brake disc (1), of the second component (8) relative to the first component (7).
6. The brake disc according to any one of the preceding claims, **characterised in that** the first connecting elements (4) and the second connecting elements (9) are positioned along a same circumference having as the centre the axis of rotation (1a) of the brake disc (1).
7. The brake disc according to any one of the preceding claims, **characterised in that** each first connecting element (4) comprises a cylindrical pawl (5).
8. The brake disc according to any one of the preceding claims, **characterised in that** each second connecting element (9) comprises a cylindrical pawl (10).
9. The brake disc according to any one of the preceding claims, **characterised in that** each second connecting element (9) is housed partly in a respective seat (16) of the first component (7) and partly in a respective seat (17) of the second component (8) of the supporting element (3).
10. The brake disc according to any one of the preceding claims, **characterised in that** each first connecting element (4) is housed partly in the respective seat (14) of the brake strip (2) and partly in the respective seat (15) of the second component (8) of the supporting element (3).
11. The brake disc according to claim 9 or 10, **characterised in that**, with reference to the second component (8), at least one seat (15) for partial housing of a respective first connecting element (4) is positioned in an alternating fashion with at least one seat (17) for partial housing of a respective second connecting element (9).
12. The brake disc according to any one of claims 9 to 11, **characterised in that** the second component (8) has a plurality of lobes (12) each of which has a seat (17) which partly houses a respective second connecting element (9) and the first component (7) has a plurality of spokes (13), each of which houses partly a respective second connecting element (9) at the respective end.

Fig.1

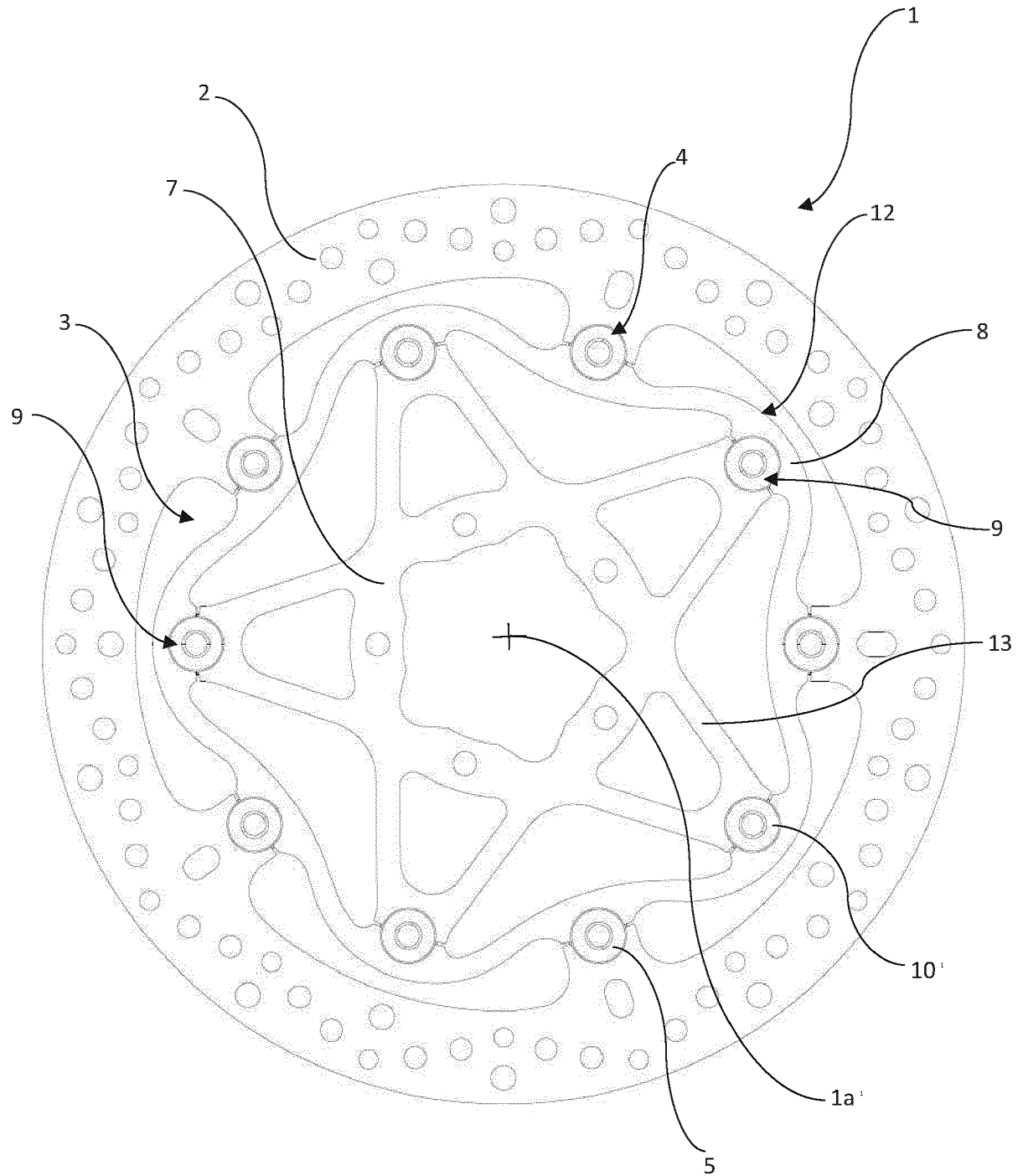
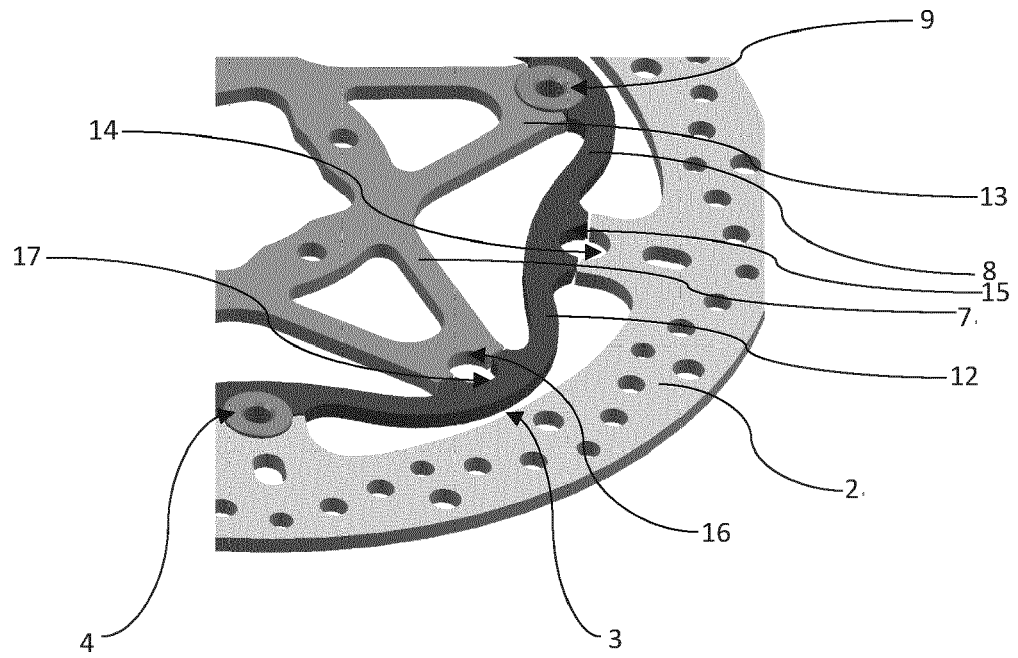


Fig.2





EUROPEAN SEARCH REPORT

 Application Number
 EP 21 16 1759

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2013/133996 A1 (IWAI TORU [JP] ET AL) 30 May 2013 (2013-05-30) * figure 11 *	1-12	INV. F16D65/10 F16D65/12
A	US 2017/198774 A1 (WEN YUAN-HUNG [TW]) 13 July 2017 (2017-07-13) * figure 2 *	1-12	
A	US 2017/114846 A1 (CHEN HUI-CHUAN [TW]) 27 April 2017 (2017-04-27) * figure 3 *	1-12	
A	TW M 473 984 U (CHIA CHERNE INDUSTRY CO LTD [TW]) 11 March 2014 (2014-03-11) * the whole document *	1-12	
A	EP 2 128 476 A1 (YAMAHA MOTOR CO LTD [JP]) 2 December 2009 (2009-12-02) * the whole document *	1-12	
A	CN 109 424 672 A (TIEN HSIN INDUSTRIES CO LTD) 5 March 2019 (2019-03-05) * the whole document *	1-12	TECHNICAL FIELDS SEARCHED (IPC)
A	CN 104 976 252 A (ZENG YUJUAN) 14 October 2015 (2015-10-14) * the whole document *	1-12	F16D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 June 2021	Examiner Ranieri, Sebastiano
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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 EPO FORM 1503 03.82 (P04C01)

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

EP 21 16 1759

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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30-06-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013133996 A1	30-05-2013	CN 103133573 A	05-06-2013
		DE 102012221351 A1	29-05-2013
		TW 201321621 A	01-06-2013
		US 2013133996 A1	30-05-2013
US 2017198774 A1	13-07-2017	NONE	
US 2017114846 A1	27-04-2017	NONE	
TW M473984 U	11-03-2014	NONE	
EP 2128476 A1	02-12-2009	EP 2128476 A1	02-12-2009
		JP 2009287632 A	10-12-2009
CN 109424672 A	05-03-2019	NONE	
CN 104976252 A	14-10-2015	NONE	