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(54) REFRIGERANT COMPRESSOR

(57) Refrigerant compressor (1) including a compressor housing (2) with a compressor housing base (3) and a compressor housing cover (4), which compressor housing (2) hermetically encloses a cylinder housing (5) and a drive assembly (6), the refrigerant compressor (1) further comprising a cylinder (7) and a piston (8) which are arranged inside the cylinder housing (5), said piston (8) being drivable by the drive assembly (6), in order to move back and forth in the cylinder (7) for compressing a refrigerant, the cylinder housing (5) being mounted at the compressor housing base (3) by means of at least one spring element (11), in order to allow for a movement and to damp vibrations of the cylinder housing (5), wherein a ring-shaped element (12) is provided, which is rigidly connected to the cylinder housing (5) and is arranged between the cylinder housing (5) and the compressor housing cover (4), and wherein a cover pin (13) is provided, which is rigidly connected to the compressor housing cover (4) and is extending into an annular recess (14) of the ring-shaped element (12), in order to limit the movement of the cylinder housing (5). According to the present invention it is provided that the ring-shaped element (12) comprises a coating with or is made of a rubber material.

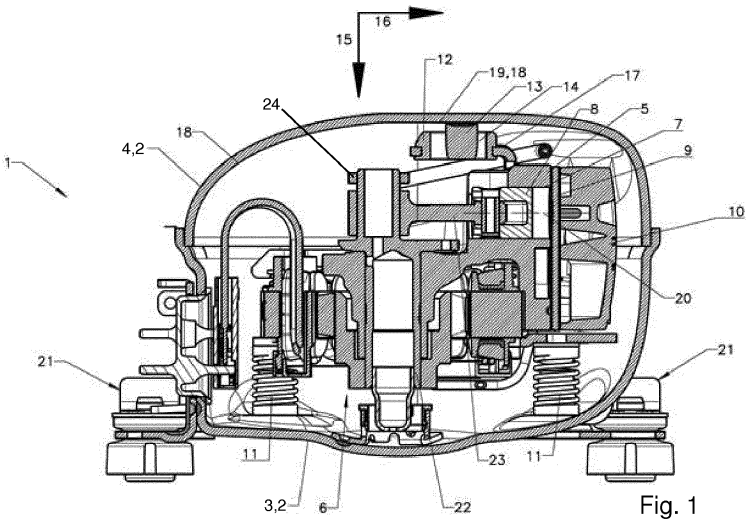

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a refrigerant compressor including a compressor housing with a compressor housing base and a compressor housing cover, which compressor housing hermetically encloses a cylinder housing and a drive assembly, the refrigerant compressor further comprising a cylinder and a piston which are arranged inside the cylinder housing, said piston being drivable by the drive assembly, in order to move back and forth in the cylinder for compressing a refrigerant, the cylinder housing being mounted at the compressor housing base by means of at least one spring element, in order to allow for a movement and to damp vibrations of the cylinder housing, wherein a ring-shaped element is provided, which is rigidly connected to the cylinder housing and is arranged between the cylinder housing and the compressor housing cover, and wherein a cover pin is provided, which is rigidly connected to the cylinder housing cover and is extending into an annular recess of the ring-shaped element, in order to limit the movement of the cylinder housing.

STATE OF THE ART

[0002] Currently, ever higher demands concerning the reduction of noise have to be met by refrigerant compressors, particularly in mobile applications. For that purpose it is known to mount a cylinder housing of a piston-cylinder-unit at a compressor housing, in which interior the piston-cylinder-unit is arranged, by means of spring elements. On the one hand the spring elements facilitate movement of the cylinder housing within the compressor housing, on the other hand damping of noise causing vibrations of the cylinder housing is achieved.

[0003] In order to limit the movement of the cylinder housing within the compressor housing, in the prior art a ring-shaped element is suggested, which is rigidly connected to the cylinder housing and which cooperates with a cover pin, which cover pin is rigidly connected to the compressor housing cover. Thereby, contacting of the ring-shaped element with the cover pin limits the movement of the cylinder housing. However, said contacting produces undesired contacting noise, which precludes the refrigerant compressor from certain applications where low noise is key.

OBJECTIVE OF THE INVENTION

[0004] It is thus an objective of the present invention to provide a refrigerant compressor with reduced contacting noise.

SUMMARY OF THE INVENTION

[0005] In order to reduce said contacting noise, in a refrigerant compressor including a compressor housing with a compressor housing base and a compressor housing cover, which compressor housing hermetically encloses a cylinder housing and a drive assembly, the refrigerant compressor further comprising a cylinder and a piston which are arranged inside the cylinder housing, said piston being drivable by the drive assembly, in order to move back and forth in the cylinder for compressing a refrigerant, the cylinder housing being mounted at the compressor housing base by means of at least one spring element, in order to allow for a movement and to damp vibrations of the cylinder housing, wherein a ring-shaped element is provided, which is rigidly connected to the cylinder housing and is arranged between the cylinder housing and the compressor housing cover, and wherein a cover pin is provided, which is rigidly connected to the compressor housing cover and is extending into an annular recess of the ring-shaped element, in order to limit the movement of the cylinder housing, according to the invention it is provided that the ring-shaped element comprises a coating with or is made of a rubber material. The resilience of the rubber material enables effective dampening of the contacting noise, i.e. whenever the ring-shaped element contacts the cover pin.

[0006] The term "rubber material" includes any natural or synthetic rubber, e.g. fluoroelastomers or fluoropolymers.

[0007] In order to improve material properties of the rubber material, particularly its resilience and its resistence against high temperatures and chemicals, in a preferred embodiment of the refrigerant compressor according to the present invention, it is provided that the rubber material is a nitrile butadiene rubber (NBR) material.

[0008] Since the ring-shaped element is arranged inside the compressor housing, the ring-shaped element can come into contact with oil and refrigerant. Moreover, temperatures inside the compressor housing may become relatively high. In order to further improve the endurance of the NBR material of the ring-shaped element under these harsh conditions, in a preferred embodiment of the refrigerant compressor according to the present invention, it is provided that the nitrile butadiene rubber material is hydrogenated nitrile butadiene rubber.

[0009] Hydrogenated nitrile butadiene rubber (HNBR) keeps its favourable properties, like its resilience, also after long-term exposure to heat, oil and chemicals. Moreover, the tensile strength of HNBR can be fine tuned by filler selection and loading.

[0010] In order to further dampen any noise when the ring-shaped element impacts on the cover pin, in a preferred embodiment of the refrigerant compressor according to the present invention, it is provided that the cover pin is coated with or is made of a second rubber material. The second rubber material can be identical with or can be different from the rubber material.

[0011] In order to improve material properties of the second rubber material, particularly its resilience and its resistence against high temperatures and chemicals, in

a preferred embodiment of the refrigerant compressor according to the present invention, it is provided that the second rubber material is a second nitrile butadiene rubber (NBR) material. The second NBR material can be identical with or can be different from the NBR material.

[0012] Since also the cover pin is arranged inside the compressor housing, also the cover pin can come into contact with oil and refrigerant. Again, temperatures inside the compressor housing may become relatively high. In order to further improve the endurance of the second NBR material of the cover pin under these harsh conditions, in a preferred embodiment of the refrigerant compressor according to the present invention, it is provided that the second nitrile butadiene rubber material is a second hydrogenated nitrile butadiene rubber. The second HNBR can be identical with or can be different from the HNBR.

[0013] In principle, the cylinder housing can move inside the compressor housing vertically, i.e. parallel to a vertical direction, as well as laterally, i.e. parallel to a lateral direction. In order to limit the lateral movement of the cylinder housing, in a preferred embodiment of the refrigerant compressor according to the present invention, it is provided that the cover pin extends into the annular recess parallel to a vertical direction, in order to limit the movement of the cylinder housing parallel to a lateral direction, the lateral direction being normal to the vertical direction.

[0014] The vertical movement of the cylinder housing can then simply be delimited by the compressor housing, i.e. when the ring-shaped element contacts an inner surface of the compressor housing, particularly of the compressor housing cover. In order to improve the dampening of the corresponding noise resulting from the impact of the ring-shaped element on the inner surface of the compressor housing, in a preferred embodiment of the refrigerant compressor according to the present invention, it is provided that the compressor housing cover comprises an inner surface, the inner surface comprising a section next to the ring-shaped element, which section is coated with a third rubber material. Preferably, said section of the inner surface is facing towards the ring-shaped element. The third rubber material can be identical with or can be different from the rubber material and/or the second rubber material.

[0015] In order to improve material properties of the third rubber material, particularly its resilience and its resistence against high temperatures and chemicals, in a preferred embodiment of the refrigerant compressor according to the present invention, it is provided that the third rubber material is a third nitrile butadiene rubber (NBR) material. The third NBR material can be identical with or can be different from the NBR material and/or the second NBR material.

[0016] Naturally, also said section of the inner surface of the compressor housing cover can come into contact with oil and refrigerant and can be exposed to relatively high temperatures. In order to further improve the endurance of the third NBR material of the section of the compressor housing cover under these harsh conditions, in a preferred embodiment of the refrigerant compressor according to the present invention, it is provided that the third nitrile butadiene rubber material is a third hydrogenated nitrile butadiene rubber.

[0017] In order to ensure that the ring-shaped element is connected to the cylinder housing in a way which does not compromise the movement of the cylinder housing and of the ring-shaped element, respectively, in a preferred embodiment of the refrigerant compressor according to the present invention, it is provided that a rigid holder is provided for connecting the ring-shaped element to the cylinder housing, the holder having a recess delimited by a surrounding section of the holder, wherein a section of the ring-shaped element is imposed on the surrounding section of the holder such that the annular recess of the ring-shaped element is arranged within the recess of the holder.

BRIEF DESCRIPTION OF FIGURES

[0018] The invention will be explained in closer detail by reference to a preferred embodiment, with

Fig. 1 showing a sectional view of a refrigerant compressor according to the present invention

Fig. 2 showing a schematic three-dimensional view of the refrigerant compressor of Fig. 1

WAYS FOR CARRYING OUT THE INVENTION

[0019] Fig. 1 shows a sectional view of a refrigerant compressor 1 according to the invention at hand. The refrigerant compressor 1 can be mounted to an appliance with a cooling cycle, in which the refrigerant compressor 1 is placed, by means of support assemblies 21.

[0020] A compressor housing 2, which comprises a compressor housing base 3 and a compressor housing cover 4 for closing the compressor housing base 3, hermetically encloses a cylinder housing 5 which is mounted on a drive assembly 6. In the shown embodiment this drive assembly 6 is realised as an electric motor which drives a crankshaft 22 and a piston rod 23 connected to a piston 8 in a cylinder 7 of the cylinder housing 5, in order to move said piston 8 back and forth in the cylinder 7 along a cylinder axis 20 for compressing a refrigerant.

[0021] A cylinder cover 10 is attached to the cylinder housing 5 while being separated from the cylinder 7 by a valve plate 9. The valve plate 9 comprises an inlet valve (not shown) for drawing refrigerant from an inlet channel (not shown) into the cylinder 7 and comprises an outlet valve (not shown) for discharging the compressed refrigerant into a discharge channel (not shown).

[0022] The cylinder housing 5 - and hence also the drive assembly - is mounted at the compressor housing base 3 by means of spring elements 11. The spring ele-

ments 11 allow for a movement of the cylinder housing 5 and damp vibrations of the cylinder housing 5, which vibrations occur due to the reciprocating and compressing piston 8 in the cylinder 7 when the refrigerant compressor 1 is in an operational state. Furthermore, a counter weight 24 mounted on the crankshaft 22 helps reducing the vibrations.

[0023] In order to limit the movement of the cylinder housing 5 within the compressor housing, a ring-shaped element 12 is provided, which is rigidly connected to the cylinder housing 5 and which cooperates with a cover pin 13, which cover pin 13 is rigidly connected to the compressor housing cover 4. The actual shape of the ring-shaped element 12 can be particularly well discerned in the schematic axonometric view of Fig. 2.

[0024] The cover pin 13 is extending into an annular recess 14 of the ring-shaped element 12. Hence, at a certain amplitude of movement of the cylinder housing 5 the ring-shaped element 12 is contacting or impacting on the cover pin 13, which limits the movement of the cylinder housing 5.

[0025] In order to prevent noise generation by said contacting or impacting, the ring-shaped element 12 is coated with or made of a rubber material, particularly of a resilient nitrile butadiene rubber (NBR) material. In the shown embodiment the NBR material is made of hydrogenated NBR (HNBR), which keeps its favourable properties, like its resilience, also after long-term exposure of the ring-shaped element 12 to heat, oil and chemicals, which exposures can take place inside the compressor housing 2, particularly during the operational state of the refrigerant compressor 1.

[0026] Typically, the cover pin 13 is made of metal or a rigid plastic. However, in order to further reduce the contacting noise, the cover pin 13 can be coated with or made of a second rubber material, preferably of a second NBR material, particularly of a second HNBR.

[0027] In the shown embodiment the cover pin 13 extends into the annular recess 14 parallel to a vertical direction 15. Hence, the movement of the cylinder housing 5 is limited parallel to a lateral direction 16 when the ring-shaped element 12 contacts the cover pin 13, with the lateral direction 16 being normal to the vertical direction 15.

[0028] The vertical movement of the cylinder housing 5 is delimited by the compressor housing cover 4 in that the ring-shaped element 12 contacts an inner surface 18 of the compressor housing cover 4 at a certain amplitude of motion of the cylinder housing 5 parallel to the vertical direction 15. In order to improve the dampening of the corresponding noise resulting from the impact of the ring-shaped element 12 on the inner surface 18 of the compressor housing cover 4, in the shown embodiment of the refrigerant compressor 1 according to the present invention, the inner surface 18 comprises a section 19 next to the ring-shaped element 12, which section 19 is coated with a third rubber material, preferably with a third NBR material, particularly with a third HNBR. As can be seen in Fig. 1, said section 19 of the inner surface 18 is facing towards the ring-shaped element 12.

[0029] In order to ensure that the ring-shaped element 12 is connected to the cylinder housing 5 in a way which does not compromise the movement of the cylinder housing 5 and of the ring-shaped element 12, respectively, in the shown embodiment of the refrigerant compressor 1 according to the present invention, a rigid holder 17 is provided for connecting the ring-shaped element 12 to the cylinder housing 5. Preferably, the holder 17 is made of metal or a rigid plastic. The holder 17 has a recess delimited by a surrounding section of the holder 17, wherein a circumferential section of the ring-shaped element 12 is imposed on the surrounding section of the holder 17 such that the annular recess 14 of the ring-shaped element 12 is arranged within the recess of the holder 17.

List of reference signs

[0030]

1	Refrigerant compressor
2	Compressor housing
3	Compressor housing base
4	Compressor housing cover
5	Cylinder housing
6	Drive assembly
7	Cylinder
8	Piston
9	Valve plate
10	Cylinder cover
11	Spring element
12	Ring-shaped element
13	Cover pin
14	Annular recess of the ring-shaped element
15	Vertical direction
16	Lateral direction
17	Holder
18	Inner surface of the compressor housing cover
19	Section of the inner surface next to the ring-shaped element
20	Cylinder axis
21	Support assembly
22	Crankshaft
23	Piston rod
24	Counter weight

Claims

1. Refrigerant compressor (1) including a compressor housing (2) with a compressor housing base (3) and a compressor housing cover (4), which compressor housing (2) hermetically encloses a cylinder housing (5) and a drive assembly (6), the refrigerant compressor (1) further comprising a cylinder (7) and a piston (8) which are arranged inside the cylinder

housing (5), said piston (8) being drivable by the drive assembly (6), in order to move back and forth in the cylinder (7) for compressing a refrigerant, the cylinder housing (5) being mounted at the compressor housing base (3) by means of at least one spring element (11), in order to allow for a movement and to damp vibrations of the cylinder housing (5), wherein a ring-shaped element (12) is provided, which is rigidly connected to the cylinder housing (5) and is arranged between the cylinder housing (5) and the compressor housing cover (4), and wherein a cover pin (13) is provided, which is rigidly connected to the compressor housing cover (4) and is extending into an annular recess (14) of the ring-shaped element (12), in order to limit the movement of the cylinder housing (5), **characterised in that** the ring-shaped element (12) comprises a coating with or is made of a rubber material.

2. Refrigerant compressor (1) according to claim 1, **characterised in that** the rubber material is a nitrile butadiene rubber material.

3. Refrigerant compressor (1) according to claim 2, **characterised in that** the nitrile butadiene rubber material is hydrogenated nitrile butadiene rubber.

4. Refrigerant compressor (1) according to any one of claims 1 to 3, **characterised in that** the cover pin (13) is coated with or is made of a second rubber material.

5. Refrigerant compressor (1) according to claim 4, **characterised in that** the second rubber material is a second nitrile butadiene rubber material.

6. Refrigerant compressor (1) according to claim 5, **characterised in that** the second nitrile butadiene rubber material is a second hydrogenated nitrile butadiene rubber.

7. Refrigerant compressor (1) according to any one of claims 1 to 3, **characterised in that** the cover pin (13) extends into the annular recess (14) parallel to a vertical direction (15), in order to limit the movement of the cylinder housing (5) parallel to a lateral direction (16), the lateral direction (16) being normal to the vertical direction (15).

8. Refrigerant compressor (1) according to any one of claims 1 to 3, **characterised in that** a rigid holder (17) is provided for connecting the ring-shaped element (12) to the cylinder housing (5), the holder (17) having a recess delimited by a surrounding section of the holder (17), wherein a section of the ring-shaped element (12) is imposed on the surrounding section of the holder such that the annular recess (14) of the ring-shaped element (12) is arranged within the recess of the holder (17).

9. Refrigerant compressor (1) according to any one of claims 1 to 3, **characterised in that** the compressor housing cover (4) comprises an inner surface (18), the inner surface (18) comprising a section (19) next to the ring-shaped element, which section (19) is coated with a third rubber material.

10. Refrigerant compressor (1) according to claim 9, **characterised in that** the third rubber material is a third nitrile butadiene rubber material.

11. Refrigerant compressor (1) according to claim 10, **characterised in that** the third nitrile butadiene rubber material is a third hydrogenated nitrile butadiene rubber.

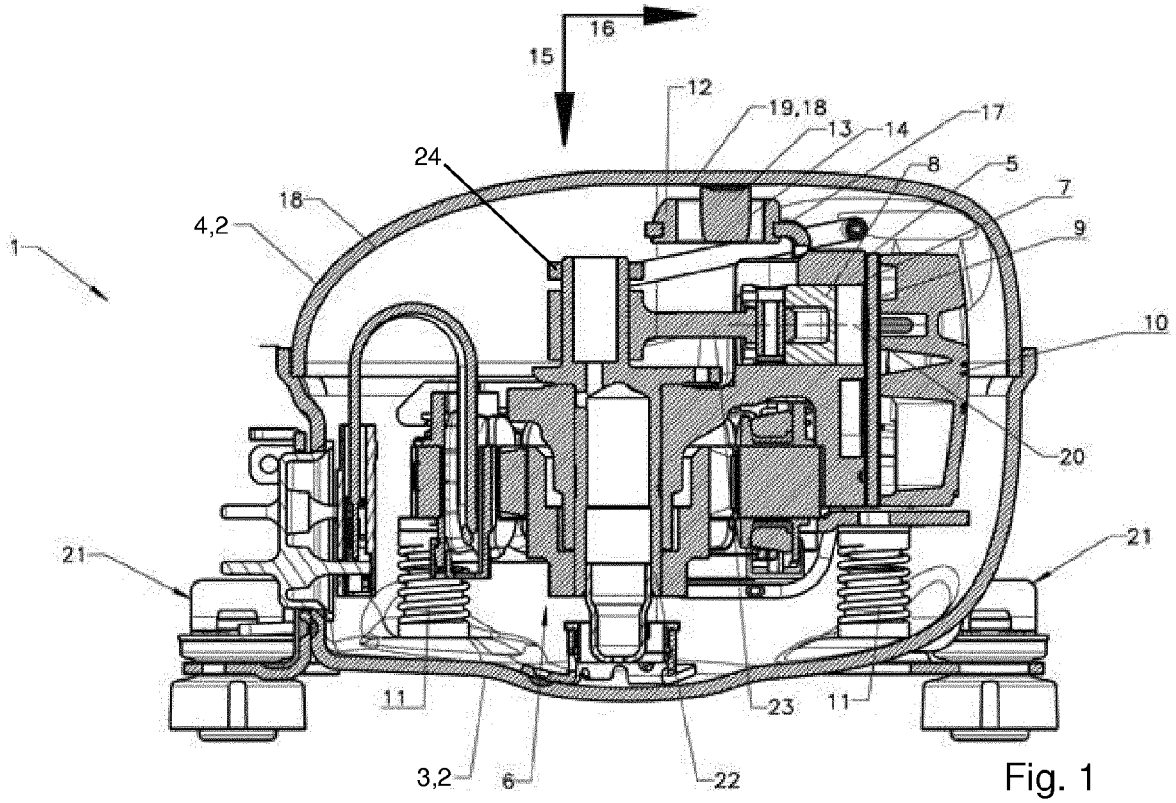
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Fig. 1

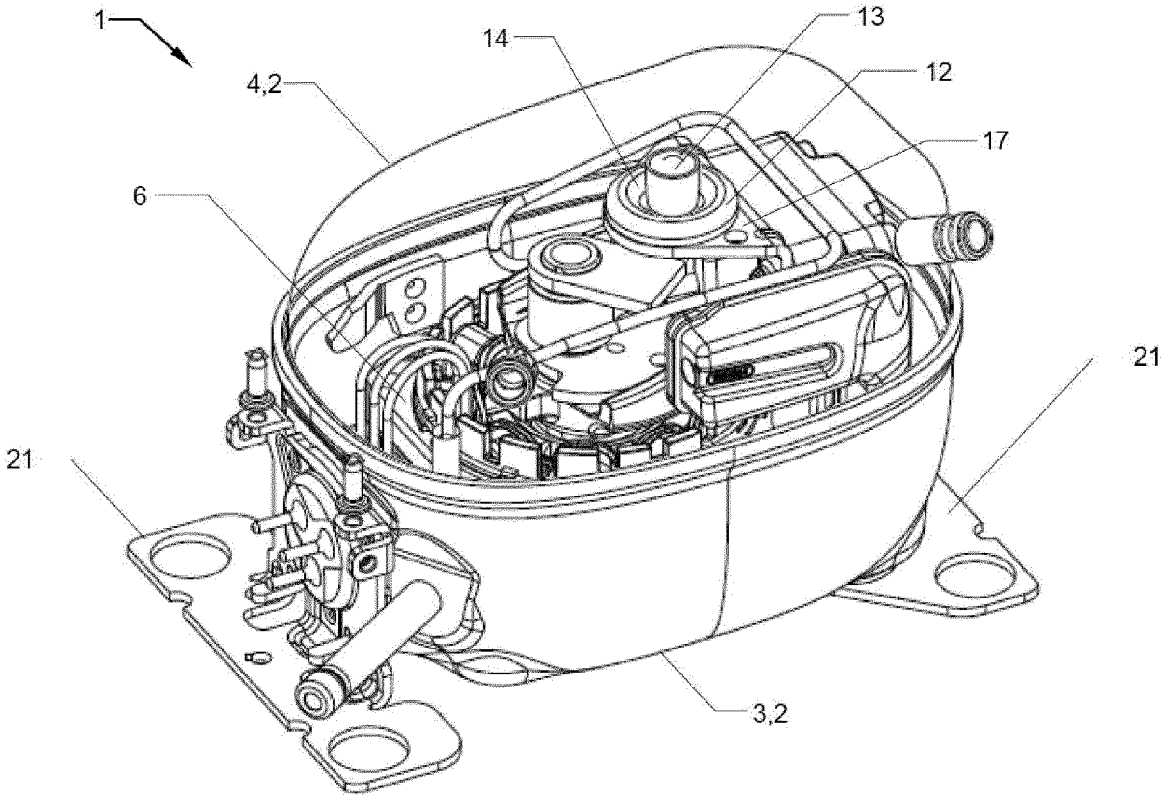
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Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 17 15 9120

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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	11 July 2017	Homan, Peter

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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