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Itt, Motion Technologies, Via San Martino, 87, I-12032 Barge (IT).

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(74) Agents: **JORIO, Paolo** et al.; Studio Torta S.r.l., Via Viotti, 9, I-10121 Torino (IT).

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(71) Applicant (for all designated States except US): **ITT MANUFACTURING ENTERPRISES, INC.** [US/US]; 1105 North Market Street, Suite 1217, Wilmington, Delaware 19801 (US).

(72) Inventors; and

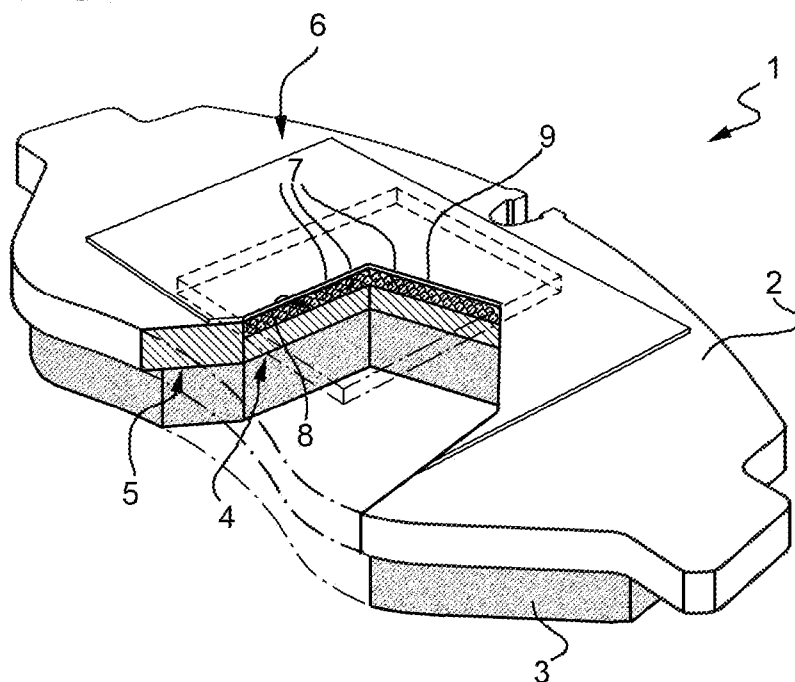
(75) Inventors/Applicants (for US only): **SANTAMARIA RAZO, Diego, A.** [IT/IT]; Itt, Motion Technologies, Via San Martino, 87, I-12032 Barge (IT). **MARTINOTTO, Luca** [IT/IT]; Itt, Motion Technologies, Via San Martino, 87, I-12032 Barge (IT). **DONZELLI, Daniele** [IT/IT];

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[Continued on next page]

(54) Title: BRAKE PLATE

FIG. 1



(57) Abstract: Brake plate (1) for a braking system of a motor vehicle, comprising a back plate (2), a friction layer (3) and a particle damping device (4).



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— with international search report (Art. 21(3))

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

- 1 -

BRAKE PLATE

TECHNICAL FIELD

The present invention relates to a brake pad for a
5 breaking system, preferably for a motor vehicle.

BACKGROUND ART

A brake pad cooperates with a brake disc to dissipate kinetic energy by friction and decrease the angular speed of the disc. In particular the disc can be rigidly
10 connected to the wheel of a car or a motorcycle so that during braking the vehicle decelerates. In principle a brake pad consists at least of a rigid back plate or carrier and a layer of friction material.

Friction between the brake pad and the brake disc
15 generates heat and noise. In particular, the latter effect is undesirable.

It is known from WO-A-0014425 to use a particle damping device in a braking system to avoid undesired noise. The above application relates to breaking pads made
20 of a thermo-structural material, i.e. carbon-carbon composite. In particular, the friction layer is made of a carbon-carbon composite so that this layer has also an independent structural function and can be manufactured in parallel to the back plate and then assembled. In
25 particular, the above mentioned document discloses that the cavity housing for the particles is defined by the friction layer. However, some brake pads comprise a friction layer that is deposited on the back plate and then sintered.

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A brake pad provided with a non-structural friction layer provides some open issues relating to the cost efficiency of the manufacturing method because of the fact that the friction layer is substantially inconsistent, i.e. is a mix of organic & inorganic powders and a binder, before the heat and pressure treatment.

DISCLOSURE OF INVENTION

The scope of the present invention is to provide a brake pad provided with a particle damping device and a cost efficient manufacturing method for a sintered friction layer.

The scope of the present invention is achieved by a brake pad according to claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described in a non-limiting preferred embodiment with reference to the accompanying drawings, in which:

- figure 1 is a transversal section of a perspective view of a brake plate according to the present invention; and

- figure 2 is a graph comparing the frequency response function of a traditional brake plate (dashed) and a brake plate according to the present invention (solid).

BEST MODE FOR CARRYING OUT THE INVENTION

In figure 1 reference number 1 indicates as a whole a brake plate for a braking system of a motor vehicle, in particular a car or a motorbike.

Brake plate 1 comprises a back plate 2 made preferably

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of steel or cast iron, a friction layer 3 preferably sintered on back plate 2, and a particle damping device 4. Back plate 2 has a first surface 5 defining an interface with friction layer 3 and a second surface 6 opposite to first surface 5 and contacting known support elements of the braking system, such as pistons and callipers. Friction layer 3 is preferably a composite material constituted by a powder and matrix that needs to be heat treated, e.g. hot pressed or sintered, on back plate 2. Such a powder is a mix of different compounds, i.e. a mix of friction compounds, a mix of lubricant compounds, a mix of inert compounds, and a mix of metals. Therefore, the powder is a mix of organic and inorganic compounds. The matrix is preferably a polymeric compound, more preferably a phenolic resin.

Particle damping device 4 comprises a granular material having a plurality of particles 7 housed in at least a cavity 8 preferably defined by brake plate 1 and having preferably a rectangular/squared perimeter. Particles 7 are free to move in cavity 8, which means free to translate in three orthogonal direction and free to rotate about three mutually orthogonal axes, i.e. they have 6 degrees of freedom (DOF).

Particles 7 can be of any shape, preferably spherical and their characteristic dimension, in particular diameter, ranges from a fraction of a millimetre, for example from 0.1mm, to 10mm depending on the dimension of the brake plate. According to the present invention, good empirical

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results were obtained with dry particle damping, i.e. particles are not combined with a fluid. However, particles combined with a gel may be of advantage if during certain manufacturing handling the cavity is open.

5 According to a preferred design practice, particles 7 are dimensioned to occupy no more than 90% in volume of cavity 8 so that they are free to move in the cavity itself. Furthermore, the material of particles 7 can be chosen upon the intended application, for example it is
10 possible to use steel spheres. Alternative to the later described preferred solution to have the particles 7 in the cavity during sintering, particles can be filled into the cavity after the sintering process of the friction layer is completed, then only normal operation temperatures have to
15 be considered for selection of the particle material.

Advantageously, the position of cavity 8 can be identified according to the following steps:

- performing a free-free analysis of back plate 2 without damping device 4 to obtain a frequency
20 response function;
- identifying at least the highest peak of amplitude and the relative vibration mode;
- locating cavity/cavities 8 far from nodes and close to the points having the highest vibration
25 amplitude of the selected vibration mode/modes. Preferably, the point/points of highest vibration amplitude shall fall within the perimeter of cavity/cavities 8.

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The brake plate 1 comprises a plurality of fixing portions for connection with known supporting elements to be actuated against the brake disk of the braking system. Therefore, it might happen that the points having the highest vibration amplitude lie close to such fixing portions (not shown), which are unsuitable for locating a cavity 8. In this case it is possible to locate cavity 8 close to such points without any interference with the fixing portions of brake pad 1.

According to a preferred embodiment of the present invention, cavity 8 is a recess of surface 6 and can be closed by a shim 9 normally used on a brake plate 1 facing to the actuation elements.

According to one embodiment, particles 7 are assembled in cavity 8 as follows. Particles 7 are packed in a package housed in cavity 8. The package is made of a material that burns/melts after cavity 8 is closed, e.g. of cellulose, at a temperature that preserves the functionality of all the other components of brake plate 1, i.e. the burning temperature of cellulose is far lower than the sintering temperature of the friction layer 3 and/or of annealing temperature of steel of the support plate 2 and/or particles 7. According to a preferred embodiment of the present invention, burning/melting temperature of the package is below the temperature at which friction layer 3 is sintered on support plate 2.

Figure 2 shows a comparison of a brake plate 1 with a particle damping device 4 according to the present

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invention and a back plate having a conventional antinoise shim.

Spectra are similar which means that the dimension of the cavity is small compared to the overall mass of the
5 brake plate. In particular the little shift at low frequency is the result of the weight difference.

A good damping of high frequencies, i.e. the noisy frequencies, is evident.

A brake plate according to the present invention has
10 the following advantages.

Noise attenuation is up to 80% with almost no impact on the manufacturing process and manufacturing costs. In particular, it is possible to manufacture cavity 8 before the heat treatment of friction layer 3 and afterwards close
15 the same with a plate equivalent to shim 9 that is normally used to assemble brake plate to supporting elements. Therefore, the interface of the breaking system shall not be adapted to the improved brake plate.

Furthermore, cavity 8 is defined by the back plate so
20 that it is possible to deposit any kind of friction material with no impact on the manufacturing steps relating to the friction plate. Therefore, the braking pad according to the present invention is suitable for any friction material, including sintering ones.

25 Furthermore, the damping is temperature independent because energy is dissipated in collisions and temperature has little influence on this kind of process.

When the burning/melting temperature of the package of

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the granular material is lower than a sintering temperature of friction layer 3, a single manufacturing phase is necessary without any impact on the manufacturing process.

It is finally apparent that modifications and variants
5 can be made to brake plate 1 disclosed and illustrated herein without departing from the scope of protection of the present invention, as defined in the appended claims.

In particular, depending on the mix of compounds constituting the friction layer, the latter can be fixed to
10 the back plate by hot pressing instead of sintering.

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CLAIMS

1. Brake plate (1) for a braking system of a motor vehicle, comprising a back plate (2), a friction layer (3) constituted by a braking friction material sintered on and supported by said back plate (2), and a particle damping device (4) defining a cavity (8), characterized in that said cavity (8) is defined by said back plate (2) on a surface (5) that is opposite to that facing said friction layer (3).
2. Brake plate as claimed in claim 1, characterized by comprising a shim (9) and in that said cavity (8) is closed by said shim (9).
3. Brake plate according to claim 1 or 2, characterized in that said particle damping device (4) comprises a granular material (7) free to move in at least a cavity (8).
4. Brake plate as claimed in claim 3, characterized in that said granular material (7) has a volume up to 90% of said cavity (8).
5. Brake plate as claimed in any of the preceding claims, characterized in that said particle damping device (4) is positioned at least close to the points of maximum vibration amplitude of a vibration mode of said back plate (2).
6. Brake plate as claimed in any of the preceding claims, characterized in that said points of maximum vibration amplitude lies within the perimeter of said cavity (8).
7. Brake plate as claimed in any of the preceding claims, characterized in that said friction layer comprises a mix

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of powders having inorganic and organic compounds.

8. Method of manufacturing of a brake plate (1) as claimed in any of the preceding claims comprising the phases of:

- housing in said cavity (8) a package containing said

5 granular material;

- closing said cavity (8);

- heating said brake plate (1) at a temperature that is higher than the burning/melting temperature of the material of said package.

10 9. Method as claimed in claim 8, characterized in that said burning/melting temperature is lower than a sintering / hot pressing temperature of said friction layer (3).

FIG. 1

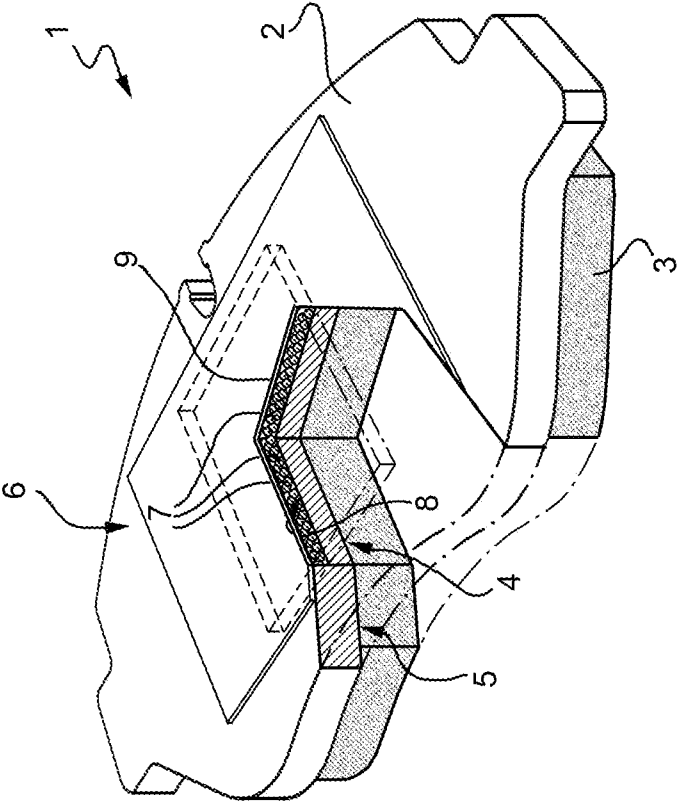
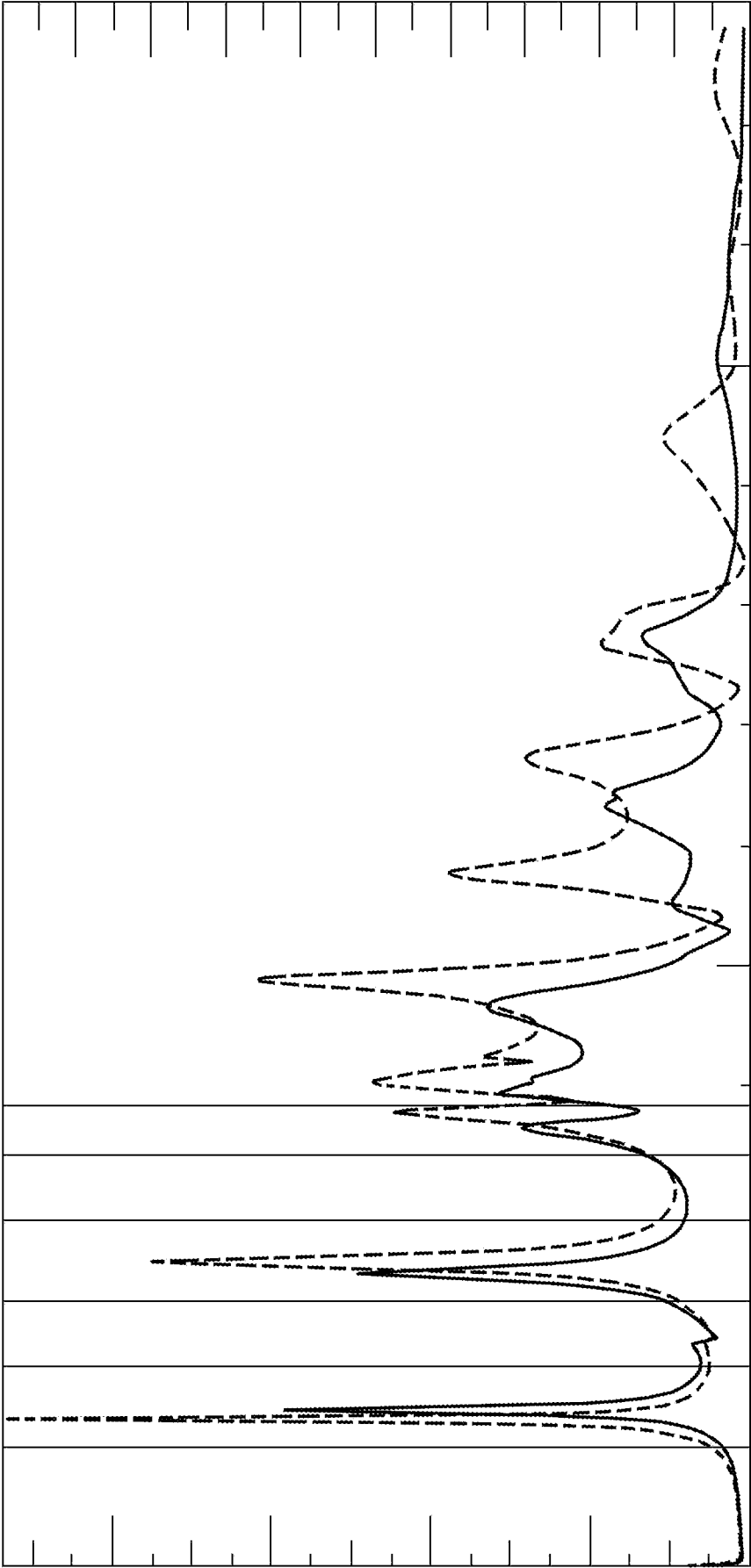


FIG. 2



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/058380

A. CLASSIFICATION OF SUBJECT MATTER INV. F16D65/092 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) F16D F16F		
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 practical, search terms used) EP0-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/091595 A (TMD FRICTION EUROP GMBH [DE]; BRECHT JOERG [DE]; FIEDLER CARSTEN [DE];) 6 November 2003 (2003-11-06) page 5, line 13 - line 23 page 6, line 31 - page 7, line 11; figures 1,11	1-7
A	----- WO 00/14425 A (MESSIER BUGATTI [FR]; MAURIGE OLIVIER [FR]; MAGAND FRANCOIS [FR]; GARC) 16 March 2000 (2000-03-16) page 5, line 1 - page 9, line 29; figures	1-7
A	----- US 3 378 115 A (STEPHENS III JOHN F) 16 April 1968 (1968-04-16) column 1, line 66 - column 2, line 28; figures	1-7
----- -/--		
☒ Further documents are listed in the continuation of Box C. ☒ 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 "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
Date of the actual completion of the international search 15 November 2010		Date of mailing of the international search report 19/11/2010
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer van Koten, Gert

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/058380

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 03/019036 A (BOSCH GMBH ROBERT [DE]; HOFFMANN NORBERT [DE]; FISCHER MICHAEL [DE]) 6 March 2003 (2003-03-06) the whole document -----	1-7
A	DE 197 16 569 A1 (PORSCHE AG [DE]) 22 October 1998 (1998-10-22) the whole document -----	1-7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2010/058380

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-7

a brake plate including a cavity

2. claims: 8, 9

method of manufacturing a brake plate in which a cavity
includes granular material in the form of a package

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2010/058380

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 03091595	A	06-11-2003	AT 329176 T 15-06-2006
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