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(54) Title: TORSION SPRING SPECKLE DIFFUSER

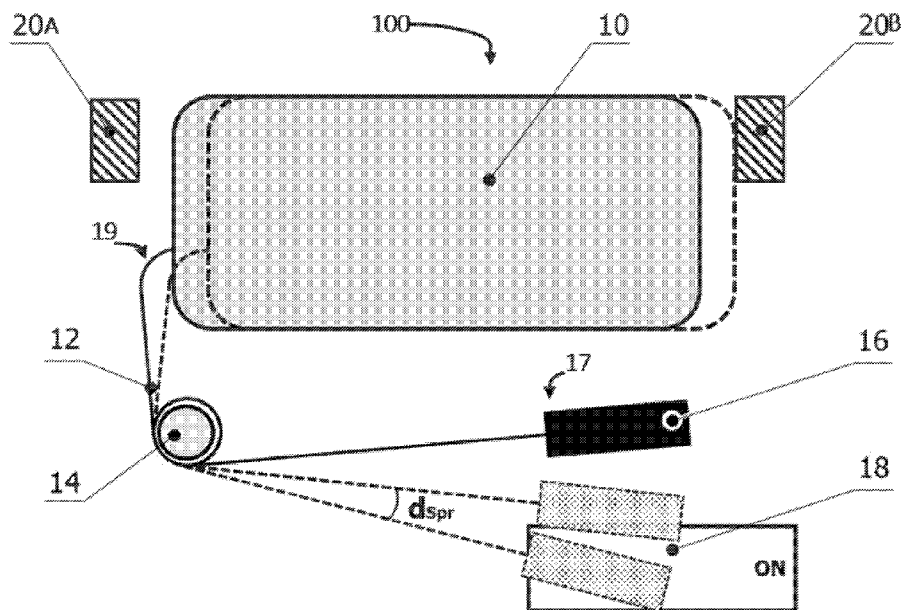


Figure 1

(57) Abstract: Devices for applying vibration and/or sliding motion to speckle diffusers are provided. A speckle diffusion device comprises at least one speckle diffuser element, one free form torsion spring with an axis of rotation, and at least one actuator. One end of the torsion spring includes an interaction element to interact with the actuator. The actuator actuates motion of the speckle diffusion element via the interaction element attached to the spring. The spring may also limit motion of the speckle diffuser element. The speckle diffusion device may be implemented or employed in various optical systems/devices. The speckle diffusion device may be easily adapted to accommodate various systems with various dimensions and geometry. Other embodiments may be disclosed and/or claimed.



GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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- *with international search report (Art. 21(3))*
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**(88) Date of publication of the international search report:**

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**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/IB2018/001099

A. CLASSIFICATION OF SUBJECT MATTER  
INV. G02B5/02 G02B27/48 G02B27/01  
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)  
G02B

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 A	US 2009/185251 A1 (CHEN GANG [US] ET AL) 23 July 2009 (2009-07-23) figure 5a paragraph [0039] paragraph [0035] paragraph [0037]	1,11-15  2-10, 16-20
X	----- US 2014/043589 A1 (CHIFU HIROKO [JP] ET AL) 13 February 2014 (2014-02-13) paragraph [0046] paragraph [0048] paragraph [0049] paragraph [0042] paragraph [0043] paragraph [0045] -----	21-25

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 application or patent 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

16 April 2019

Date of mailing of the international search report

26/04/2019

Name and mailing address of the ISA/  
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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IB2018/001099

## 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: 1-20

Independent claims 1, 11 and 16 and dependent claims 2 - 10, 12 - 15 and 17 - 20, directed to a speckle diffuser apparatus, a method for operating a speckle diffuser apparatus and an optical system, respectively, the special technical feature alleged to make a contribution over the prior art being a torsion spring. This special technical feature solves the problem of allowing for a greater variation of the amplitude of the current supplied to the actuator and causes the effect of making the configuration more reliable.

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2. claims: 21-25

Independent claim 21 and dependent claims 22 - 25, directed to a speckle diffusing subassembly, the technical feature alleged to make a contribution over the prior art being interacting means. This special technical feature solves the problem of increasing the efficiency of power transmission between the actuator and the movement means and causes the effect of saving battery power.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2018/001099

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009185251 A1	23-07-2009	NONE	
US 2014043589 A1	13-02-2014	US 2014043589 A1	13-02-2014
		WO 2012143990 A1	26-10-2012