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(54) **ACOUSTIC GENERATOR AND ASSOCIATED METHODS AND WELL SYSTEMS**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,072,982 A 3/1937 Dale
3,754,598 A 8/1973 Holloway, Jr.

(Continued)

FOREIGN PATENT DOCUMENTS

EP 2491357 8/2012
WO 2009073475 A2 6/2009

OTHER PUBLICATIONS

3M, 3M Glass Bubbles, HGS Series, dated Apr. 2009, 4 pages.

(Continued)

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(57) **ABSTRACT**

A well system and associated method can include an acoustic generator which can be used to excite a formation with acoustic waves transmitted from the acoustic generator. Another well system and associated method can include an acoustic generator which can transmit acoustic waves into cement surrounding a casing. Another well system and associated method can include an acoustic generator which can be used to transmit acoustic waves into an annulus surrounding a well screen during or after a gravel packing operation. Another well system and associated method can include an acoustic generator which can be connected in a drill string in close proximity to a drill bit, with the acoustic generator transmitting acoustic waves into a formation ahead of the bit.

16 Claims, 13 Drawing Sheets

