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Marchitto et al.

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(54) **INDUCTIVE HEATING OF TISSUES USING ALTERNATING MAGNETIC FIELDS AND USES THEREOF**

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A61B 18/14 (2006.01)
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CPC ***A61B 18/18*** (2013.01); ***A61B 18/14*** (2013.01); ***A61N 2/002*** (2013.01); ***A61N 2/004*** (2013.01);
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(58) **Field of Classification Search**
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(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,889,120 A 12/1989 Gordon
5,057,106 A 10/1991 Kasevich et al.
(Continued)

OTHER PUBLICATIONS

"Electromagnetic radiation." Collins Dictionary of Astronomy. London: Collins, 2006. Credo Reference. Web. May 24, 2012.*
(Continued)

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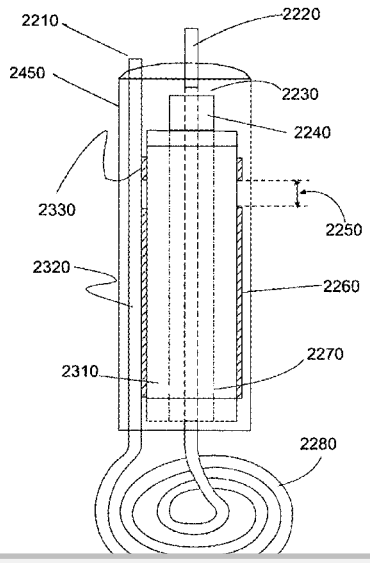
(57) **ABSTRACT**

The present invention improves the cosmetic appearance of skin by controllably heating a superficial layer of skin thereby inducing acute tissue contraction or shrinkage and a wound response leading to the production of biomolecules, all of which result in improved cosmesis. The invention incorporates a source of radiofrequency electrical energy coupled to coil, with requisite impedance matching network, thereby resulting in the production of an alternating magnetic field. When tissue is brought into proximity of the alternating magnetic field, inductive heating of the tissue results as a consequence of either or both of dipole formation and oscillation, and eddy current formation. Optionally, cooling is provided to remove heat from the coil, the source of radiofrequency electrical energy, or the surface of the skin alone or in combination. The invention exhibits the significant benefits of, among other things, being non-invasive, not requiring electrical contact with the body of the subject, and providing controllable heating only to a thin layer of tissue.

16 Claims, 10 Drawing Sheets



(51) **Int. Cl.**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

5,366,443	A	11/1994	Eggers et al.	
5,412,182	A	5/1995	Chan et al.	219/635
5,429,583	A	7/1995	Paulus et al.	
5,824,015	A	10/1998	Sawyer	
5,897,495	A	4/1999	Aida et al.	
6,074,385	A *	6/2000	Klopotek	606/27
6,148,236	A	11/2000	Dann	
6,171,321	B1	1/2001	Gifford et al.	
6,208,903	B1 *	3/2001	Richards et al.	607/101
6,241,753	B1 *	6/2001	Knowlton	607/99
6,350,274	B1	2/2002	Li	
6,451,044	B1	9/2002	Naghavi et al.	
6,458,109	B1	10/2002	Henley et al.	
6,656,174	B1	12/2003	Hegde et al.	
6,814,712	B1	11/2004	Edwards et al.	
7,189,230	B2	3/2007	Knowlton	
7,463,251	B2	12/2008	Giraldo	
7,967,839	B2	6/2011	Flock et al.	
2003/0032950	A1 *	2/2003	Altshuler et al.	606/9
2004/0122494	A1 *	6/2004	Eggers et al.	607/103
2004/0127895	A1 *	7/2004	Flock et al.	606/41
2004/0210214	A1 *	10/2004	Knowlton	606/41
2011/0077451	A1	3/2011	Marchitto et al.	

OTHER PUBLICATIONS

Anderson, "Fire and ice," Arch Dermatol., 139(6):787-788, Jun. 2003.

Cameron, editor. "Diathermy," Physical Agents in Rehabilitation, 4th Edition, Chapter 10, pp. 202-222, published 2012, originally published 1999.

Cameron, editor. "Pain," Physical Agents in Rehabilitation, 4th Edition, Chapter 4, pp. 46-71, published 2012, originally published 1999.

Cameron, editor. "Physical Agents in Clinical Practice," Physical Agents in Rehabilitation, 4th Edition, Chapter 2, pp. 15-22, published 2012, originally published 1999.

Cameron, editor. "Superficial Cold and Heat," Physical Agents in Rehabilitation, 4th Edition, Chapter 8, pp. 129-172, published 2012, originally published 1999.

Cameron, editor. "The Physiology of Physical Agents," Physical Agents in Rehabilitation, 4th Edition, Chapter 1, pp. 1-14, published 2012, originally published 1999.

Cameron, editor. "Tone Abnormalities," Physical Agents in Rehabilitation, 4th Edition, Chapter 5, pp. 72-105, published 2012, originally published 1999.

Franco et al., "Hyperthermic injury to adipocyte cells by selective heating of subcutaneous fat with a novel radiofrequency device: feasibility studies," Lasers Surg Med., 42(5):361-370, Jul. 2010.

Klein, "Deep Heat," emedicine.medscape.com [online] dated Sep. 25, 2008. Retrieved from the Internet <URL: http://emedicine.medscape.com/article/325046-print>, retrieved on Jan. 27, 2010, 8 pages.

Leitgeb, "Exposure of non-target tissues in medical diathermy," Bioelectromagnetics, 31(1):12-19, Jan. 2010.

* cited by examiner

Fig 1

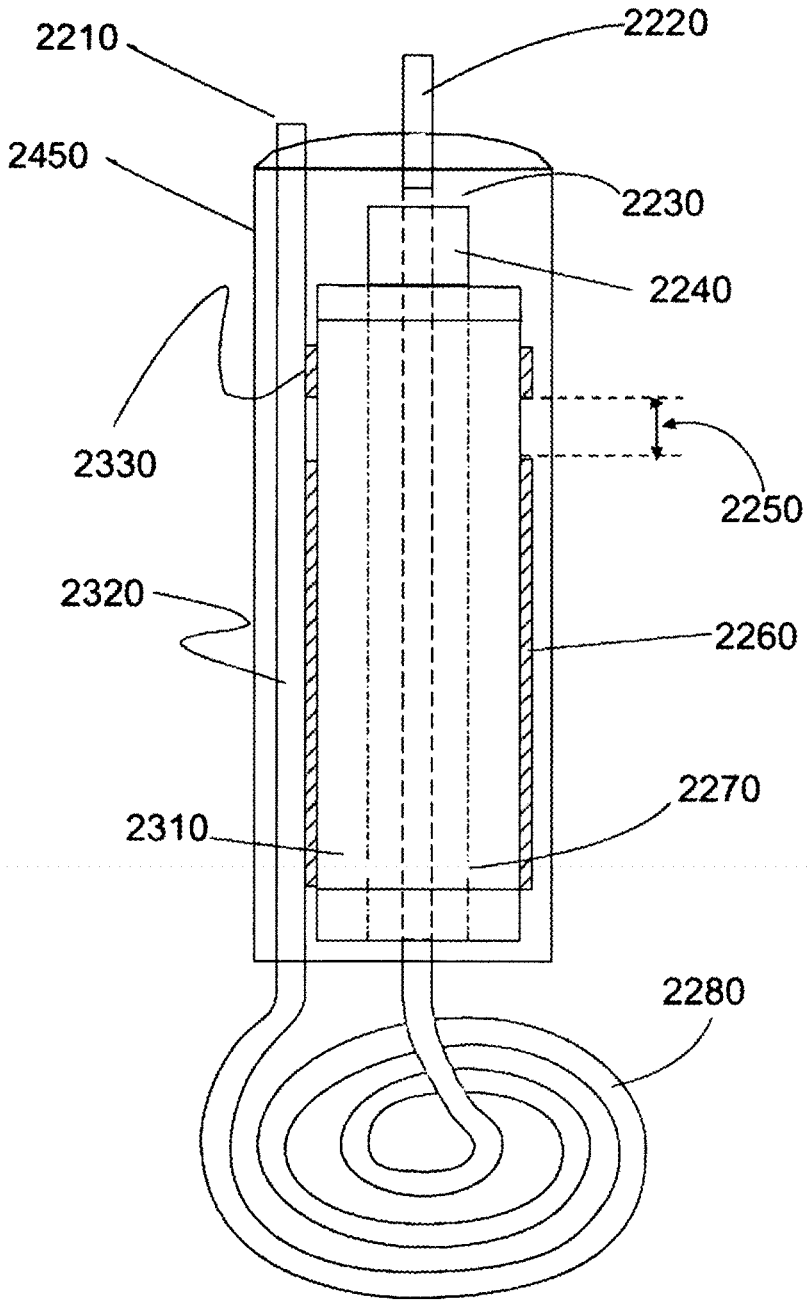


Fig 2

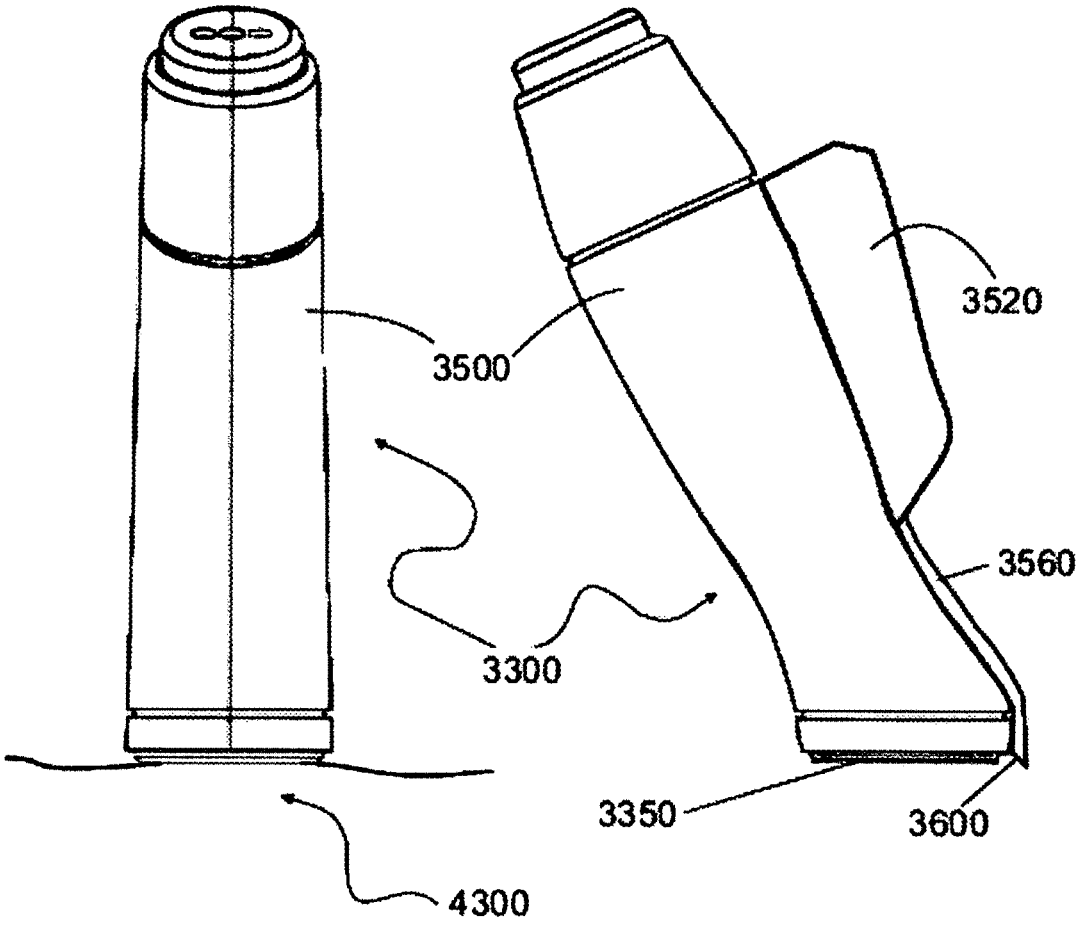
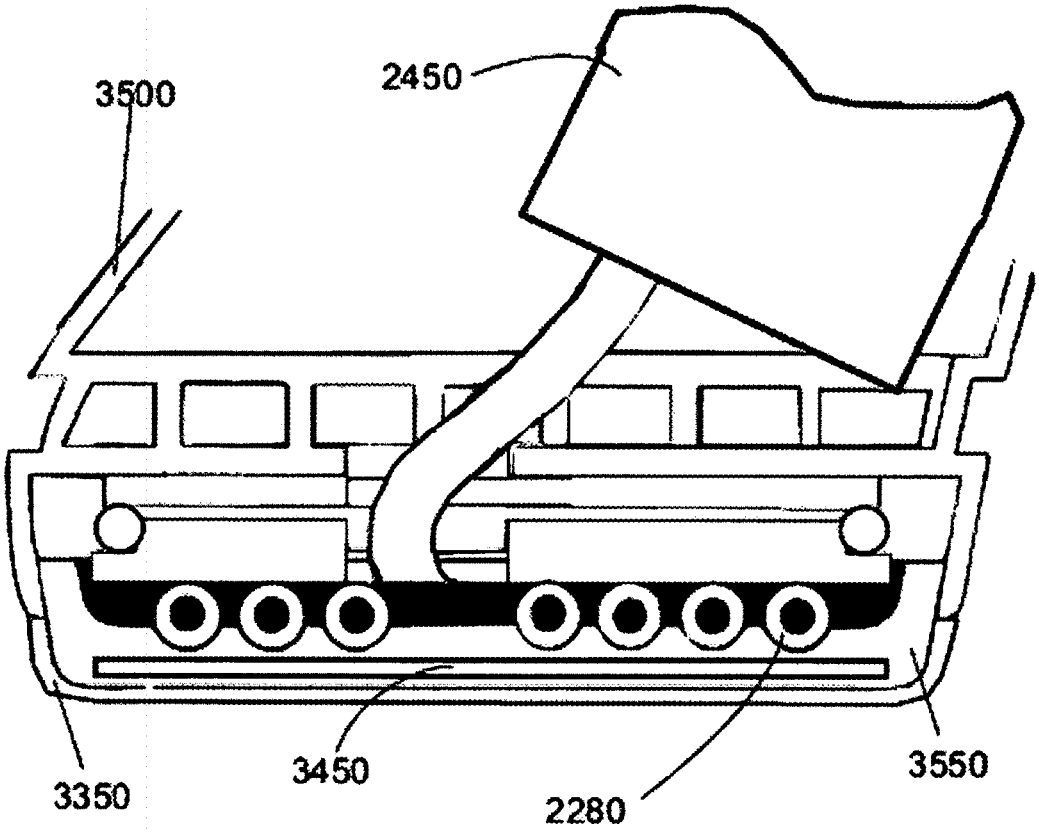


Fig 3



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