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(54) **Title**: A FIELD EMISSION SYSTEM AND METHOD

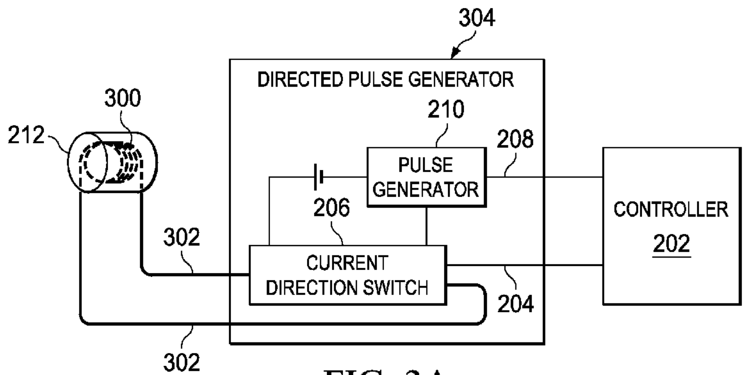

FIG. 3A

(57) **Abstract**: An improved field emission system and method is provided that involves field emission structures having electric or magnetic field sources. The magnitudes, polarities, and positions of the magnetic or electric field sources are configured to have desirable correlation properties, which may be in accordance with a code. The correlation properties correspond to a desired spatial force function where spatial forces between field emission structures correspond to relative alignment, separation distance, and the spatial force function.

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A Field Emission System and Method

Field of the Invention

[0001] The present invention relates generally to a field emission system and method. More particularly, the present invention relates to a system and method where correlated magnetic and/or electric field structures create spatial forces in accordance with the relative alignment of the field emission structures and a spatial force function.

Background of the Invention

[0002] Alignment characteristics of magnetic fields have been used to achieve precision movement and positioning of objects. A key principle of operation of an alternating-current (AC) motor is that a permanent magnet will rotate so as to maintain its alignment within an external rotating magnetic field. This effect is the basis for the early AC motors including the "Electro Magnetic Motor" for which Nikola Tesla received United States Patent 381,968 on May 1, 1888. On January 19, 1938, Marius Lavet received French Patent 823,395 for the stepper motor which he first used in quartz watches. Stepper motors divide a motor's full rotation into a discrete number of steps. By controlling the times during which electromagnets around the motor are activated and deactivated, a motor's position can be controlled precisely. Computer-controlled stepper motors are one of the most versatile forms of positioning systems. They are typically digitally controlled as part of an open loop system, and are simpler and more rugged than closed loop servo systems. They are used in industrial high speed pick and place equipment and multi-axis computer numerical control (CNC) machines. In the field of lasers and optics they are frequently used in precision positioning equipment such as linear actuators, linear stages, rotation stages, goniometers, and mirror mounts. They are used in packaging machinery, and positioning of valve pilot stages for fluid control systems. They are also used in many commercial products including floppy disk drives, flatbed scanners, printers, plotters and the like.

[0003] Although alignment characteristics of magnetic fields are used in certain specialized industrial environments and in a relatively limited number of commercial products, their use for precision alignment purposes is generally limited in scope. For the majority of processes where alignment of objects is important, e.g., residential construction, comparatively primitive alignment techniques and tools such as a carpenter's square and a level are more commonly employed. Moreover, long trusted tools and mechanisms for attaching objects together such as hammers and nails; screw drivers and screws; wrenches and nuts and bolts; and the like, when used with primitive alignment techniques result in far less than precise residential construction, which commonly leads to death and injury when homes collapse, roofs are blown off in storms, etc. Generally, there is considerable amount of waste of time and energy in most of the processes to which the average person has grown accustomed that are a direct result of imprecision of alignment of assembled objects. Machined parts wear out sooner, engines are less efficient resulting in higher pollution, buildings and bridges collapse due to improper construction, and so on.

[0004] It has been discovered that various field emission properties can be put in use in a wide range of applications.

Summary of the Invention

[0005] Briefly, the present invention is an improved field emission system and method. The invention pertains to field emission structures comprising electric or magnetic field sources having magnitudes, polarities, and positions corresponding to a desired spatial force function where a spatial force is created based upon the relative alignment of the field emission structures and the spatial force function. The invention herein is sometimes referred to as correlated magnetism, correlated field emissions, correlated magnets, coded magnets, coded magnetism, or coded field emissions. Structures of magnets arranged in accordance with the invention are sometimes referred to as coded magnet structures, coded structures, field emission structures, magnetic field emission structures, and coded magnetic structures. Structures of magnets arranged conventionally (or 'naturally') where their interacting poles alternate are referred to herein as non-correlated magnetism, non-correlated magnets, non-coded magnetism, non-coded magnets, non-coded structures, or non-coded field emissions.

[0006] In accordance with one embodiment of the invention, a field emission system comprises a first field emission structure and a second field emission structure. The first and second field emission structures each comprise an array of field emission sources each having positions and polarities relating to a desired spatial force function that corresponds to the relative alignment of the first and second field emission structures within a field domain. The positions and polarities of each field emission source of each array of field emission sources can be determined in accordance with at least one correlation function. The at least one correlation function can be in accordance with at least one code. The at least one code can be at least one of a pseudorandom code, a deterministic code, or a designed code. The at least one code can be a one dimensional code, a two dimensional code, a three dimensional code, or a four dimensional code.

[0007] Each field emission source of each array of field emission sources has a corresponding field emission amplitude and vector direction determined in accordance with the desired spatial force function, where a separation distance between the first and second field emission structures and the relative alignment of the first and second field emission structures creates a spatial force in accordance with the desired spatial force function. The spatial force comprises at least one of an attractive spatial force or a repellant spatial force. The spatial force corresponds to a peak spatial force of said desired spatial force function when said first and second field emission structures are substantially aligned such that each field emission source of said first field emission structure substantially aligns with a corresponding field emission source of said second field emission structure. The spatial force can be used to produce energy, transfer energy, move an object, affix an object, automate a function, control a tool, make a sound, heat an environment, cool an environment, affect pressure of an environment, control flow of a fluid, control flow of a gas, and control centrifugal forces.

[0008] Under one arrangement, the spatial force is typically about an order of magnitude less than the peak spatial force when the first and second field emission structures are not substantially aligned such that field emission source of the first field emission structure substantially aligns with a corresponding field emission source of said second field emission structure.

[0009] A field domain corresponds to field emissions from the array of first field emission sources of the first field emission structure interacting with field emissions from the array of second field emission sources of the second field emission structure.

[0010] The relative alignment of the first and second field emission structures can result from a respective movement path function of at least one of the first and second field emission structures where the respective movement path function is one of a one-dimensional movement path function, a two-dimensional movement path function or a three-dimensional movement path function. A respective movement path function can be at least one of a linear movement path function, a non-linear movement path function, a rotational movement path function, a cylindrical movement path function, or a spherical movement path function. A respective movement path function defines movement versus time for at least one of the first and second field emission structures, where the movement can be at least one of forward movement, backward movement, upward movement, downward movement, left movement, right movement, yaw, pitch, and or roll. Under one arrangement, a movement path function would define a movement vector having a direction and amplitude that varies over time.

[0011] Each array of field emission sources can be one of a one-dimensional array, a two-dimensional array, or a three-dimensional array. The polarities of the field emission sources can be at least one of North-South polarities or positive-negative polarities. At least one of the field emission sources comprises a magnetic field emission source or an electric field emission source. At least one of the field emission sources can be a permanent magnet, an electromagnet, an electro-permanent magnet, an electret, a magnetized ferromagnetic material, a portion of a magnetized ferromagnetic material, a soft magnetic material, or a superconductive magnetic material. At least one of the first and second field emission structures can be at least one of a back keeper layer, a front saturable layer, an active intermediate element, a passive intermediate element, a lever, a latch, a swivel, a heat source, a heat sink, an inductive loop, a plating nichrome wire, an embedded wire, or a kill mechanism. At least one of the first and second field emission structures can be a planer structure, a conical structure, a cylindrical structure, a curve surface, or a stepped surface.

[0012] In accordance with another embodiment of the invention, a method of controlling field emissions comprises defining a desired spatial force function corresponding to the relative alignment of a first field emission structure and a second field emission structure within a field domain and establishing, in accordance with the desired spatial force function, a position and polarity of each field emission source of a first array of field emission sources corresponding to the first field emission structure and of each field emission source of a second array of field emission sources corresponding to the second field emission structure.

[0013] In accordance with a further embodiment of the invention, a field emission system comprises a first field emission structure comprising a plurality of first field emission sources having positions and polarities in accordance with a first correlation function and a second field emission structure comprising a plurality of second field emission source having positions and polarities in accordance with a second correlation function, the first and second correlation functions corresponding to a desired spatial force function, the first correlation function complementing the second correlation function such that each field emission source of said plurality of first field emission sources has a corresponding counterpart field emission source of the plurality of second field emission sources and the first and second field emission structures will substantially correlate when each of the field emission source counterparts are substantially aligned.

Brief Description of the Drawings

[0014] The present invention is described with reference to the accompanying drawings. In the drawings, like reference numbers indicate identical or functionally similar elements. Additionally, the left-most digit(s) of a reference number identifies the drawing in which the reference number first appears.

[0100] FIG. 1 depicts a table having beneath its surface a two-dimensional electromagnetic array where an exemplary movement platform having contact members with magnetic field emission structures can be moved by varying the states of the individual electromagnets of the electromagnetic array;

[0101] FIGS. 2A-2E depict five states of an electro-permanent magnet apparatus in accordance with the present invention;

[0102] FIG. 3A depicts an alternative electro-permanent magnet apparatus in accordance with the present invention; and

[0103] FIG. 3B depicts a permanent magnetic material having seven embedded coils arranged linearly.

Detailed Description of the Invention

[0104] The present invention will now be described more fully in detail with reference to the accompanying drawings, in which the preferred embodiments of the invention are shown. This invention should not, however, be construed as limited to the embodiments set forth herein; rather, they are provided so that this disclosure will be thorough and complete and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

[0105] In accordance with the present invention, combinations of magnet (or electric) field emission sources, referred to herein as magnetic field emission structures, can be created in accordance with codes having desirable correlation properties. When a magnetic field emission structure is brought into alignment with a complementary, or mirror image, magnetic field emission structure the various magnetic field emission sources all align causing a peak spatial attraction force to be produced whereby misalignment of the magnetic field emission structures causes the various magnetic field emission sources to substantially cancel each other out as function of the code used to design the structures. Similarly, when a magnetic field emission structure is brought into alignment with a duplicate magnetic field emission structure the various magnetic field emission sources all align causing a peak spatial repelling force to be produced whereby misalignment of the magnetic field emission structures causes the various magnetic field emission sources to substantially cancel each other out. As such, spatial forces are produced in accordance with the relative alignment of the field emission structures and a spatial force function. As described herein, these spatial force functions can be used to achieve precision alignment and precision positioning. Moreover, these spatial force functions enable the precise control of magnetic fields and associated spatial forces thereby enabling new forms of attachment devices for attaching objects with precise alignment and new systems and methods for controlling precision movement of objects. Generally, a spatial force has a magnitude that is a function of the relative alignment of two magnetic field emission structures and their corresponding spatial force (or correlation) function, the spacing (or distance) between the two magnetic field emission structures, and the magnetic field strengths and polarities of the sources making up the two magnetic field emission structures.

[0106] The characteristic of the present invention whereby the various magnetic field sources making up two magnetic field emission structures can effectively cancel out each other when they are brought out of alignment can be described as a release force (or a release mechanism). This release force or release mechanism is a direct result of the correlation coding used to produce the magnetic field emission structures and, depending on the code employed, can be present regardless of whether the alignment of the magnetic field emission structures corresponds to a repelling force or an attraction force.

[0107] One skilled in the art of coding theory will recognize that there are many different types of codes having different correlation properties that have been used in communications for channelization purposes, energy spreading, modulation, and other purposes. Many of the basic characteristics of such codes make them applicable for use in producing the magnetic field emission structures described herein. For example, Barker codes are known for their autocorrelation properties. Although, Barker codes are used herein for exemplary purposes, other forms of codes well known in the art because of their autocorrelation, cross-correlation, or other properties are also applicable to the present invention including, for example, Gold codes, Kasami sequences, hyperbolic congruential codes, quadratic congruential codes, linear congruential codes, Welch-Costas array codes, Golomb-Costas array codes, pseudorandom codes, chaotic codes, and Optimal Golomb Ruler codes. Generally, any code can be employed.

[0108] The correlation principles of the present invention may or may not require overcoming normal 'magnet orientation' behavior using a holding mechanism. For example, magnets of the same magnetic field emission structure can be sparsely separated from other magnets (e.g., in a sparse array) such that the magnetic forces of the individual magnets do not substantially interact, in which case the polarity of individual magnets can be varied in accordance with a code without requiring a substantial holding force to prevent magnetic forces from 'flipping' a magnet. Magnets that are close enough such that their magnetic forces substantially interact such that their magnetic forces would normally cause one of them to 'flip' so that their moment vectors align can be made to remain in a desired orientation by use of a holding mechanism such as an adhesive, a screw, a bolt & nut, etc.

[0109] Fig. 1 depicts a table 102 having a two-dimensional electromagnetic array 104 beneath its surface as seen via a cutout. On the table 102 is a movement platform 106 comprising at least one table contact member 108. The movement platform 106 is shown having four table contact members 108 each having a magnetic field emission structure 110a that would be attracted by the electromagnet array 104. Computerized control of the states of individual electromagnets of the electromagnet array 104 determines whether they are on or off and determines their polarity. A first example 110 depicts states of the electromagnetic array 104 configured to cause one of the table contact members 108 to attract to a subset of the electromagnets corresponding to the magnetic field emission structure 110b. A second example 112 depicts different states of the electromagnetic array 104 configured to cause the table contact member 108 to be attracted (i.e., move) to a different subset of the electromagnets corresponding to the magnetic field emission structure 110b. Per the two examples, one skilled in the art can recognize that the table contact member(s) can be moved about table 102 by varying the states of the electromagnets of the electromagnetic array 104.

[0200] As previously described, electromagnets can be used to produce magnetic field emission structures whereby the states of the electromagnets can be varied to change a spatial force function as defined by a code. As described below, electro-permanent magnets can also be used to produce such magnetic field emission structures. Generally, a magnetic field emission structure may include an array of magnetic field emission sources (e.g., electromagnets and/or electro-permanent magnets) each having positions and polarities relating to a spatial force function where at least one current source associated with at least one of the magnetic field emission sources can be used to generate an electric current to change the spatial force function.

[0201] Figs. 2a through 2e depict five states of an electro-permanent magnet apparatus in accordance with the present invention. Referring to Fig. 2a, the electro-permanent magnet apparatus includes a controller 202 that outputs a current direction control signal 204 to current direction switch 206, and a pulse trigger signal 208 to pulse generator 210. When it receives a pulse trigger signal 208, pulse generator 210 produces a pulse 216 that travels about a permanent magnet material 212 via at least one coil 214 in a direction determined by current direction control signal 204. Permanent magnet material 212 can have three states: non-magnetized, magnetized with South-North polarity, or magnetized with North-South polarity. Permanent magnet material 212 is referred to as such since it will retain its magnetic properties until they are changed by receiving a pulse 216. In Fig. 2a, the permanent magnetic material is in its non-magnetized state. In Fig. 2b, a pulse 216 is generated in a first direction that causes the permanent magnet material 212 to attain its South-North polarity state (a notation selected based on viewing the figure). In Fig. 2c, a second pulse 216 is generated in the opposite direction that causes the permanent magnet to again attain its non-magnetized state. In Fig. 2d, a third pulse 216 is generated in the same direction as the second pulse causing the permanent magnet material 212 to become to attains its North-South polarity state. In Fig. 2e, a fourth pulse 216 is generated in the same direction as the first pulse 216 causing the permanent magnet material 212 to once again become non-magnetized. As such, one skilled in the art will recognized that the controller 202 can control the timing and direction of pulses to control the state of the permanent magnetic material 212 between the three states, where directed pulses either magnetize the permanent magnetic material 212 with a desired polarity or cause the permanent magnetic material 212 to be demagnetized.

[0202] Fig. 3a depicts an alternative electro-permanent magnet apparatus in accordance with the present invention. Referring to Fig. 3a, the alternative electro-permanent magnet apparatus is the same as that shown in Figs. 2a-2e except the permanent magnetic material includes an embedded coil 300. As shown in the figure, the embedded coil is attached to two leads 302 that connect to the current direction switch 206. The pulse generator 210 and current direction switch 206 are grouped together as a directed pulse generator 304 that received current direction control signal 204 and pulse trigger signal 208 from controller 202.

[0203] Fig. 3b depicts and permanent magnetic material 212 having seven embedded coils 300a-300g arranged linearly. The embedded coils 300a-300g have corresponding leads 302a-302g connected to seven directed pulse generators 304a-304g that are controlled by controller 202 via seven current direction control signals 204a-204g and seven pulse trigger signals 208a-208g. One skilled in the art will recognize that various arrangements of such embedded coils can be employed including two-dimensional arrangements and three-dimensional arrangements. One exemplary two-dimensional arrangement could be employed with a table like the table depicted in Fig. 1.

[0204] Exemplary applications of the invention include:

- Position based function control.
- Gyroscope, Linear motor, Fan motor.
- Precision measurement, precision timing.
- Computer numerical control machines.
- Linear actuators, linear stages, rotation stages, goniometers, mirror mounts.
- Cylinders, turbines, engines (no heat allows lightweight materials).
- Seals for food storage.
- Scaffolding.
- Structural beams, trusses, cross-bracing.
- Bridge construction materials (trusses).
- Wall structures (studs, panels, etc.), floors, ceilings, roofs.
- Magnetic shingles for roofs.
- Furniture (assembly and positioning).
- Picture frames, picture hangers.
- Child safety seats.
- Seat belts, harnesses, trapping.
- Wheelchairs, hospital beds.
- Toys – self assembling toys, puzzles, construction sets (e.g., Legos, magnetic logs).
- Hand tools – cutting, nail driving, drilling, sawing, etc.
- Precision machine tools – drill press, lathes, mills, machine press.
- Robotic movement control.
- Assembly lines - object movement control, automated parts assembly.
- Packaging machinery.
- Wall hangers – for tools, brooms, ladders, etc.
- Pressure control systems, Precision hydraulics.
- Traction devices (e.g., window cleaner that climbs building).
- Gas/Liquid flow rate control systems, ductwork, ventilation control systems.

- Door/window seal, boat/ship/submarine/space craft hatch seal.
- Hurricane/storm shutters, quick assembly home tornado shelters/snow window covers/vacant building covers for windows and doors (e.g., cabins).
- Gate Latch – outdoor gate (dog proof), Child safety gate latch (child proof).
- Clothing buttons, Shoe/boot clasps.
- Drawer/cabinet door fasteners.
- Child safety devices – lock mechanisms for appliances, toilets, etc.
- Safes, safe prescription drug storage.
- Quick capture/release commercial fishing nets, crab cages.
- Energy conversion – wind, falling water, wave movement.
- Energy scavenging – from wheels, etc.
- Microphone, speaker.
- Applications in space (e.g., seals, gripping places for astronauts to hold/stand).
- Analog-to-digital (and vice versa) conversion via magnetic field control.
- Use of correlation codes to affect circuit characteristics in silicon chips.
- Use of correlation codes to effect attributes of nanomachines (force, torque, rotation, and translations).
- Ball joints for prosthetic knees, shoulders, hips, ankles, wrists, etc.
- Ball joints for robotic arms.
- Robots that move along correlated magnetic field tracks.
- Correlated gloves, shoes.
- Correlated robotic "hands" (all sorts of mechanisms used to move, place, lift, direct, etc. objects could use invention).
- Communications/symbology.
- Snow skis/skateboards/cycling shoes/ski board/water ski/boots
- Keys, locking mechanisms.
- Cargo containers (how they are made and how they are moved).
- Credit, debit, and ATM cards.
- Magnetic data storage, floppy disks, hard drives, CDs, DVDs.
- Scanners, printers, plotters.
- Televisions and computer monitors.
- Electric motors, generators, transformers.
- Chucks, fastening devices, clamps.
- Secure Identification Tags.
- Door hinges.
- Jewelry, watches.
- Vehicle braking systems.
- Maglev trains and other vehicles.

- Magnetic Resonance Imaging and Nuclear Magnetic Resonance Spectroscopy.
- Bearings (wheels), axles.
- Particle accelerators.
- Mounts between a measurement device and a subject (xyz controller and a magnetic probe)/ mounts for tribrachs and associated devices (e.g., survey instruments, cameras, telescopes, detachable sensors, TV cameras, antennas, etc.)
- Mounts for lighting, sound systems, props, walls, objects, etc. – e.g., for a movie set, plays, concerts, etc. whereby objects are aligned once, detached, and reattached where they have prior alignment.
- Equipment used in crime scene investigation having standardized look angles, lighting, etc. – enables reproducibility, authentication, etc. for evidentiary purposes.
- Detachable nozzles such as paint gun nozzle, cake frosting nozzle, welding heads, plasma cutters, acetylene cutters, laser cutters, and the like where rapid removable/replacement having desired alignment provides for time savings.
- Lamp shades attachment device including decorative figurines having correlated magnets on bottom that would hold lamp shade in place as well as the decoration.
- Tow chain/rope.
- Parachute harness.
- Web belt for soldiers, handyman, maintenance, telephone repairman, scuba divers, etc.
- Attachment for extremely sharp objects moving at high rate of speed to include lawnmower blades, edgers, propellers for boats, fans, propellers for aircraft, table saw blades, circular saw blades, etc.
- Seal for body part transfer system, blood transfer, etc.
- Light globes, jars, wood, plastic, ceramic, glass or metal containers.
- Bottle seal for wine bottle, carbonated drinks etc. allowing one to reseal a bottle to include putting a vacuum or a pressure on the liquid.
- Seals for cooking instruments.
- Musical instruments.
- Attach points for objects in cars, for beer cans, GPS device, phone, etc.
- Restraint devices, hand cuffs, leg cuffs.
- Leashes, collars for animals.
- Elevator, escalators.
- Large storage containers used on railroads, ships, planes.
- Floor mat clasps.

- Luggage rack/bicycle rack/canoe rack/cargo rack.
- Trailer hitch cargo rack for bicycles, wheelchairs.
- Trailer hitch.
- Trailer with easily deployable ramp/lockable ramp for cargo trailers, car haulers, etc.
- Devices for holding lawnmowers, other equipment on trailers.
- 18 wheeler applications for speeding up cargo handling for transport.
- Attachment device for battery compartment covers.
- Connectors for attachment of ear buds to iPod or iPhone.

[0205] While particular embodiments of the invention have been described, it will be understood, however, that the invention is not limited thereto, since modifications may be made by those skilled in the art, particularly in light of the foregoing teachings.

Claims

1. A magnetic field emission structure, comprising:

an array of magnetic field emission sources each having positions and polarities relating to a spatial force function; and

at least one current source associated with at least one of said array of magnetic field emission sources, said at least one current source generating an electric current to change said spatial force function.

2. The structure of claim 1, wherein said at least one magnetic field emission source comprises an electro-permanent magnet.

3. The structure of claim 1, wherein said at least one magnetic field emission source is associated with a conductive element coupled to said at least one current source, said conductive element carrying an amount of current sufficient to change the magnetic state of said at least one of said array of magnetic field emission sources.

4. The structure of claim 3, wherein said conductive element comprises at least one winding.

5. The structure of claim 1, wherein said at least one current source is associated with at least one of a row of said array of magnetic field emission sources or a column of said array of magnetic field emission sources.

6. The structure of claim 5, wherein said at least one of a row of said array of magnetic field emission sources or a column of said array of magnetic field emission sources corresponds to one magnetic field emission source of said array of magnetic field emission sources.

7. The structure of claim 1, wherein said electric current comprises an electric pulse.

8. A method of producing a magnetic field emission structure, comprising the steps of:

associating at least one current source with at least one magnetic field emission source of an array of magnetic field emission sources, each of said magnetic field emission sources having a corresponding position and polarity corresponding to a spatial force function; and

generating an electric current associated with said at least one magnetic field emission source of said array of magnetic field emission sources to change said spatial force function.

9. The method of claim 8, wherein said at least one magnetic field emission source comprises an electro-permanent magnet.

10. The method of claim 8, further comprising the steps of:

associating said at least one magnetic field emission source with a conductive element coupled to said at least one current source, said conductive element carrying an amount of current sufficient to change the magnetic state of said at least one of said array of magnetic field emission sources.

11. The method of claim 10, wherein said conductive element comprises at least one winding.

12. The method of claim 8, further comprising:

associating said at least one current source with at least one of a row of said array of magnetic field emission sources or a column of said array of magnetic field emission sources.

13. The method of claim 12, wherein said at least one of a row of said array of magnetic field emission sources or a column of said array of magnetic field emission sources corresponds to one magnetic field emission source of said array of magnetic field emission sources.

14. The method of claim 1, wherein said electric current comprises an electric pulse.

15. A magnetic field emission structure, comprising:

an array of magnetic field emission sources each having positions and polarities relating to a spatial force function, each of said array of magnetic field emission sources having a corresponding conductive element of a plurality of conductive elements; and

at least one current source associated with said plurality of conductive elements, said at least one current source generating an electric current, each said corresponding conductive element of said plurality of conductive elements carrying an amount of current sufficient to change the magnetic state of said at least one of said array of magnetic field emission sources to change said spatial force function.

16. The structure of claim 15, wherein said at least one magnetic field emission source comprises an electro-permanent magnet.

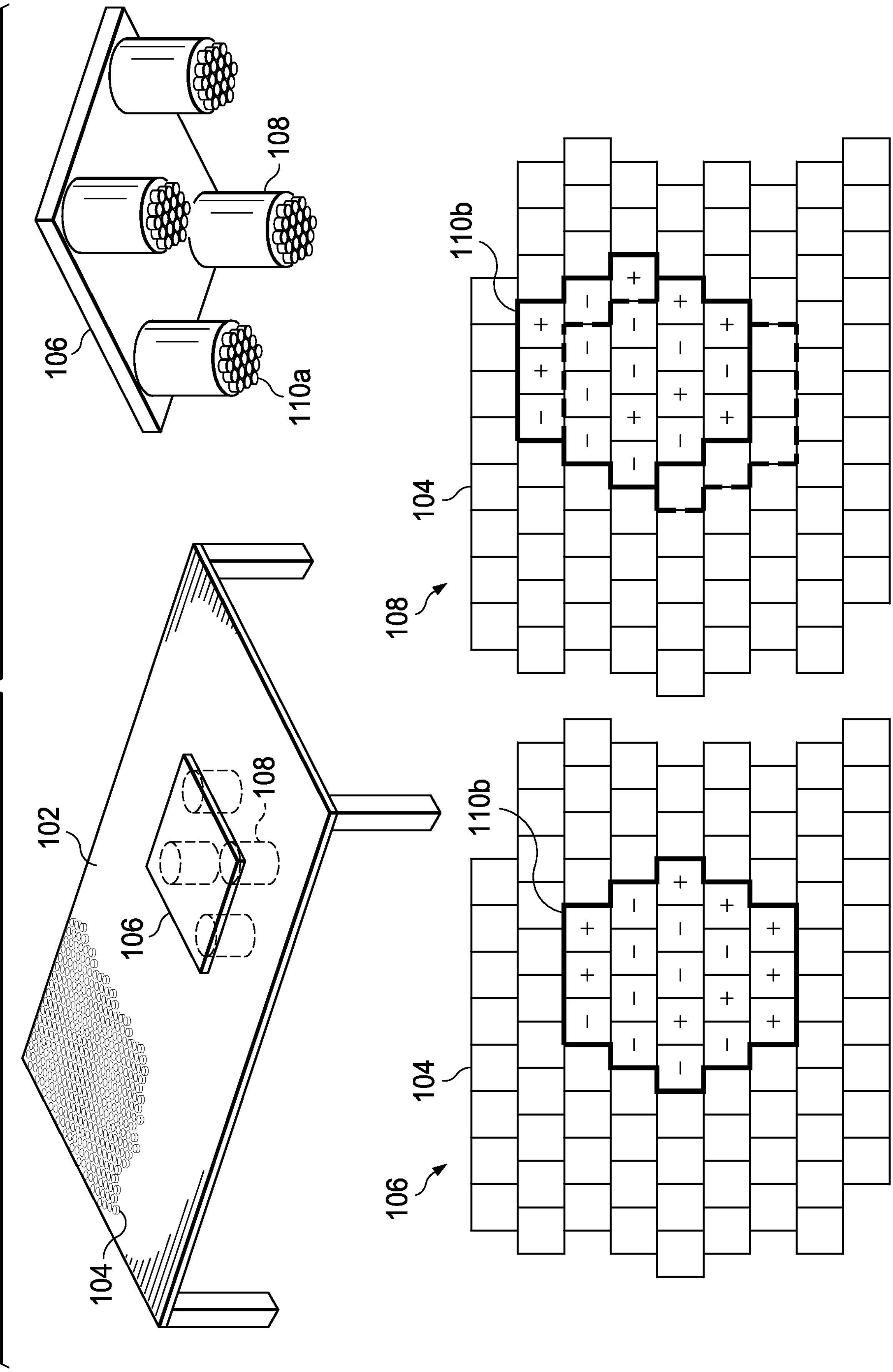
17. The structure of claim 15, wherein said at least one conductive element of said plurality of conductive elements comprises at least one winding.

18. The structure of claim 15, wherein said at least one current source is associated with at least one of a row of said array of magnetic field emission sources or a column of said array of magnetic field emission sources.

19. The structure of claim 18, wherein said at least one of a row of said array of magnetic field emission sources or a column of said array of magnetic field emission sources corresponds to one magnetic field emission source of said array of magnetic field emission sources.

20. The structure of claim 15, wherein said electric current comprises an electric pulse.

FIG. 1



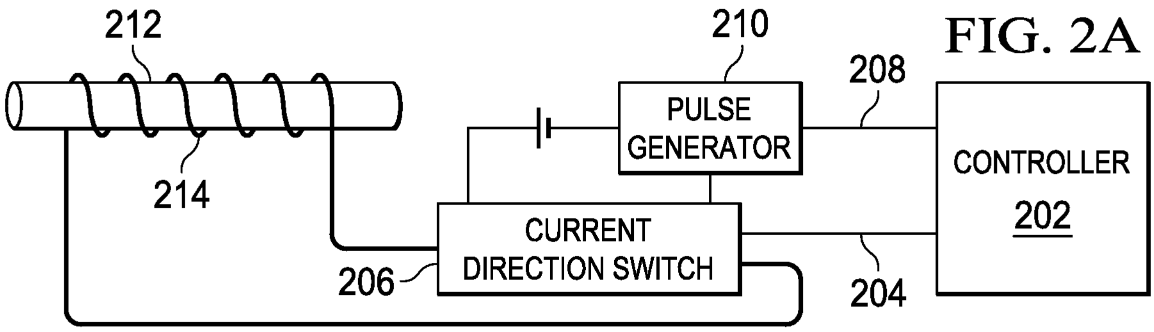


FIG. 2A

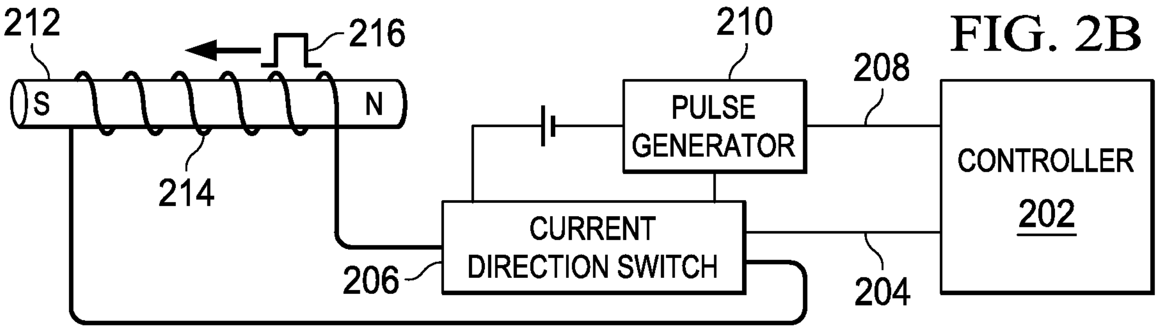


FIG. 2B

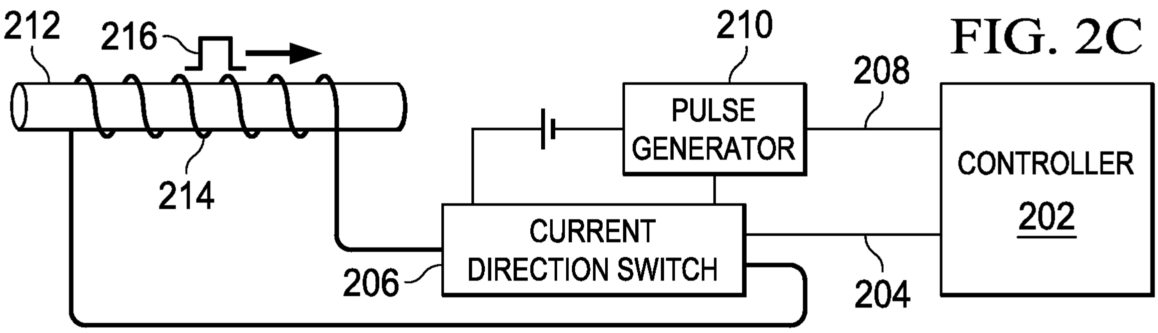


FIG. 2C

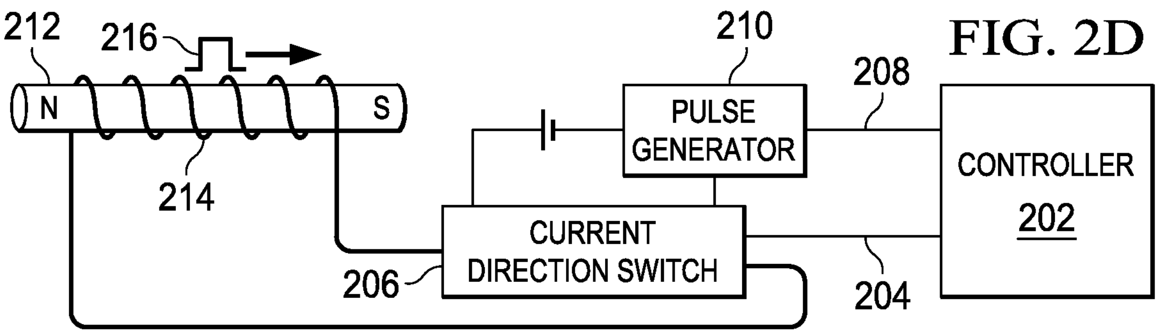


FIG. 2D

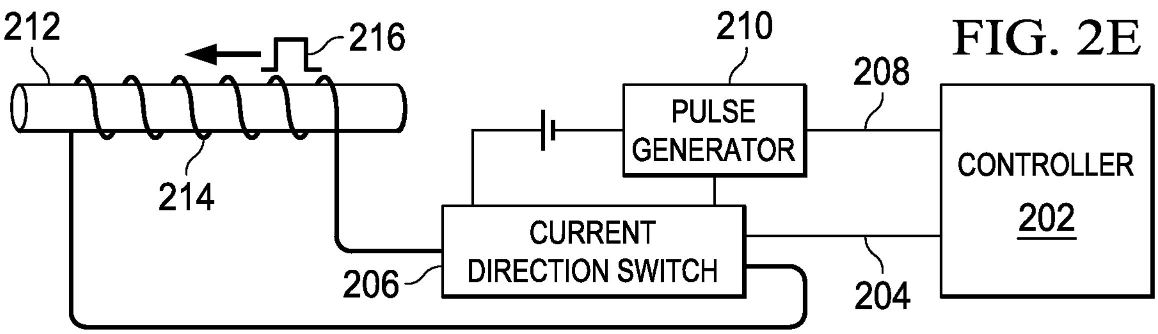


FIG. 2E

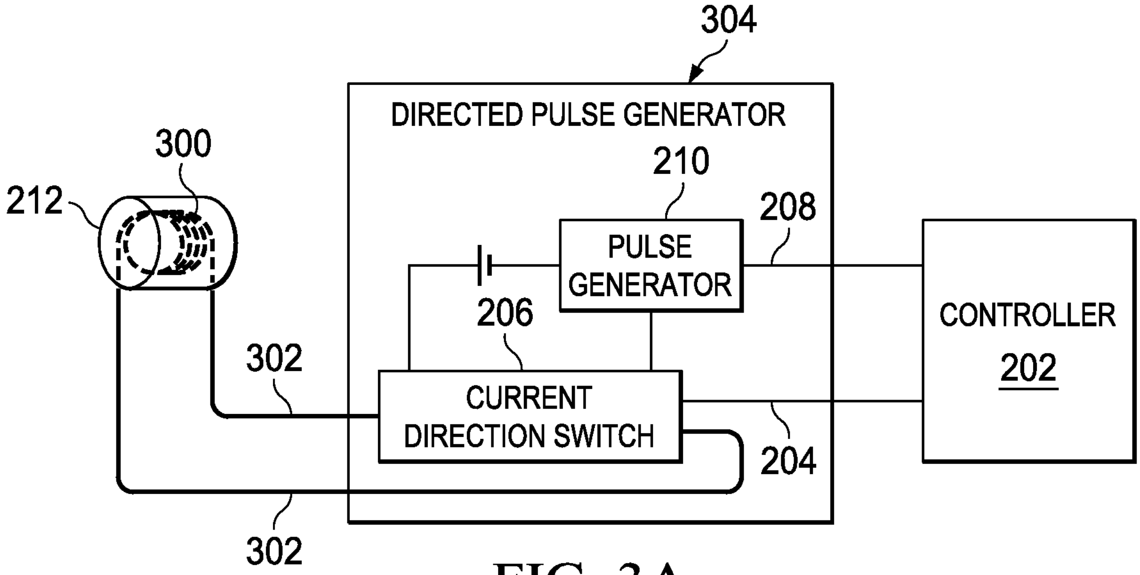
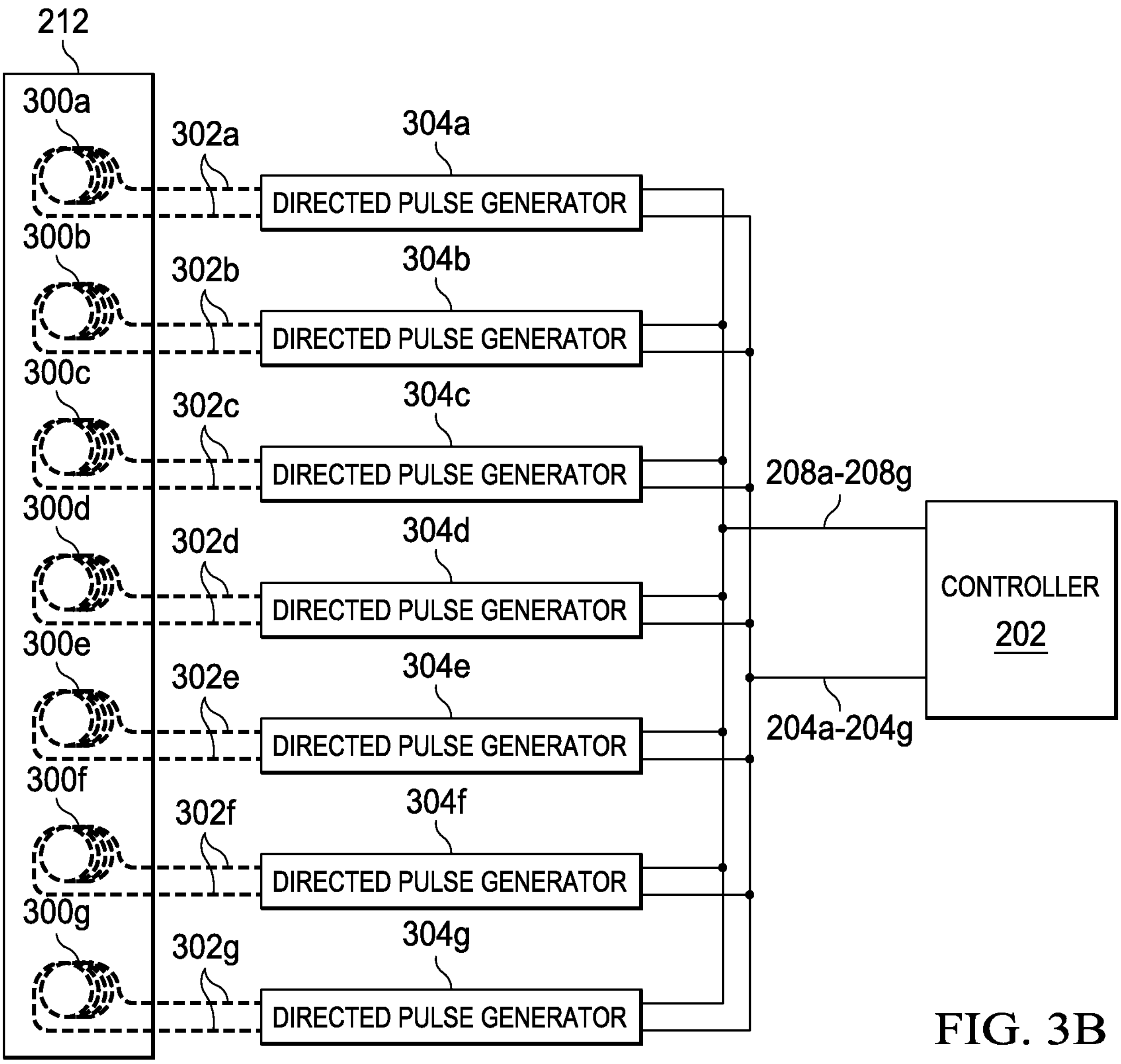

304
DIRECTED PULSE GENERATOR
300
210
212
208
PULSE GENERATOR
CONTROLLER
202
206
302
CURRENT DIRECTION SWITCH
204
302

FIG. 3A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302a
304a
DIRECTED PULSE GENERATOR
300b
302b
304b
DIRECTED PULSE GENERATOR
300c
302c
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DIRECTED PULSE GENERATOR
208a-208g
300d
302d
304d
DIRECTED PULSE GENERATOR
CONTROLLER
202
300e
302e
304e
204a-204g
DIRECTED PULSE GENERATOR
300f
302f
304f
DIRECTED PULSE GENERATOR
300g
302g
304g
DIRECTED PULSE GENERATOR

FIG. 3B

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/021612

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01F7/02 H01F7/06 H01F13/00
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)
H01F H02K

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)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	WO 2009/124030 A1 (CEDAR RIDGE RES LLC [US]; FULLERTON LARRY W [US]; ROBERTS MARK D [US]) 8 October 2009 (2009-10-08) paragraphs [0007], [0008], [0127]; figure 22	1,3,4,8, 10,11, 15,17
X	EP 0 345 554 A1 (TECNOMAGNETE SPA [IT]) 13 December 1989 (1989-12-13) column 3, line 13 - column 4, line 31; figures 1,2	1-20
X	WO 02/31945 A2 (CLARITY LLC [US]; ERTEN GAMZE [US]) 18 April 2002 (2002-04-18) page 12, line 25 - page 14, line 15; figures 9-13	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means
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"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
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"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	Date of mailing of the international search report
2 July 2010	13/07/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Sedlmeyer, Rafael

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2010/021612

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