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(54) **PSEUDO-RANDOM STEGANOGRAPHIC CAMOUFLAGE**

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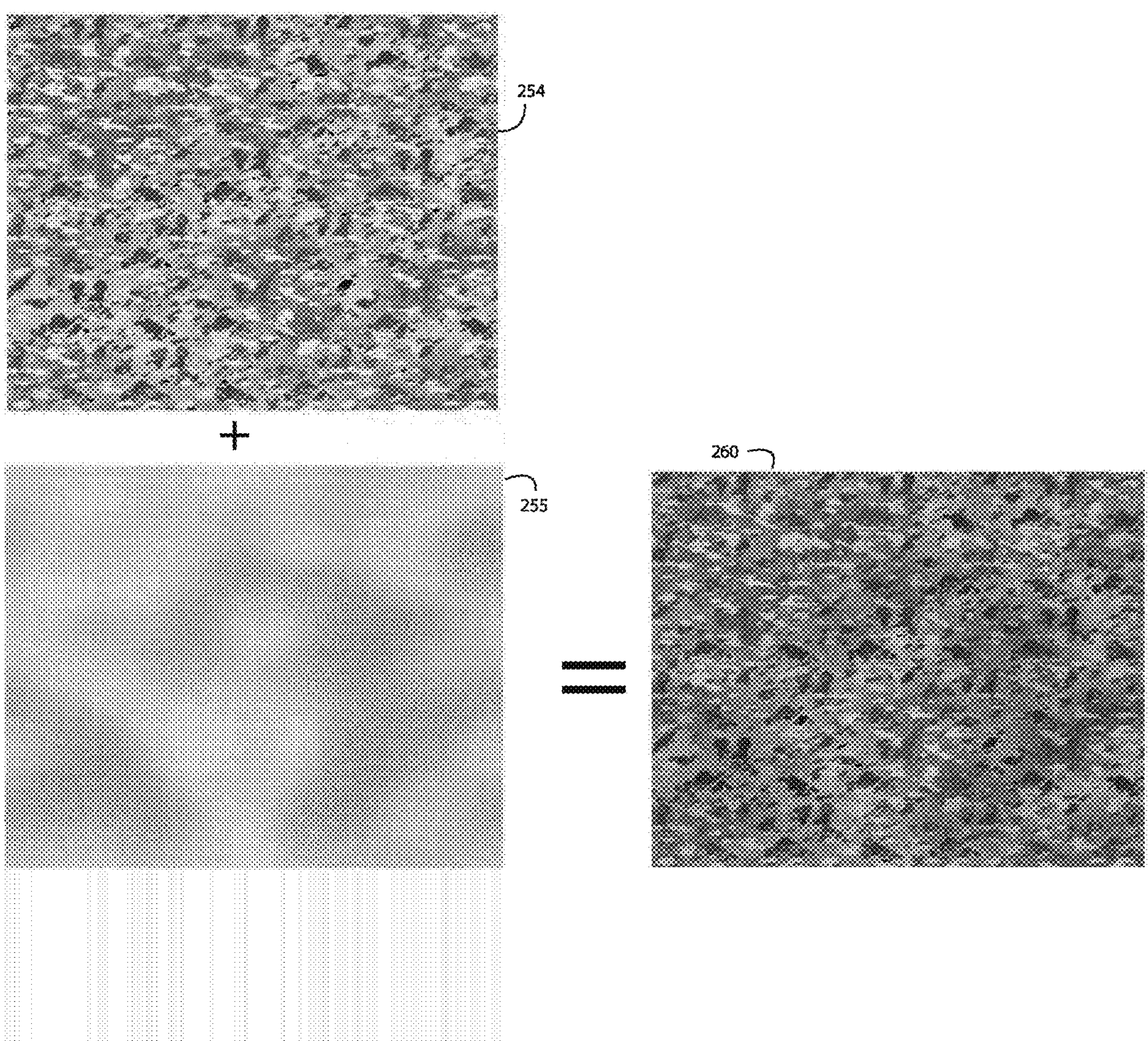
(57) **ABSTRACT**

A pseudo-random steganographic camouflage includes a graphic design printed or painted as camouflage on an outer side of a substrate like Mylar thermal blanket sheets, uniforms, and adhesive tapes. The graphic design is uniquely generated from pseudo-random noise in four overlaying colors that each begin as a raster of randomly generated noise CDMA encoded with a PRN and a message in a standardized tile size. E.g., gray, green, tan, and brown colors natural for concealment applications are each masked by two-tone image contrast rasters. The four results are mixed in groups together with a monochrome mixing mask to produce a whole tile of concealment camouflage that will conjoin seamlessly within arrays of such tiles. A further refinement visually adds a distorted-grid mesh-texture to the pseudo-random steganographic camouflage, and even faint "watermarks" of commercial trademarks.



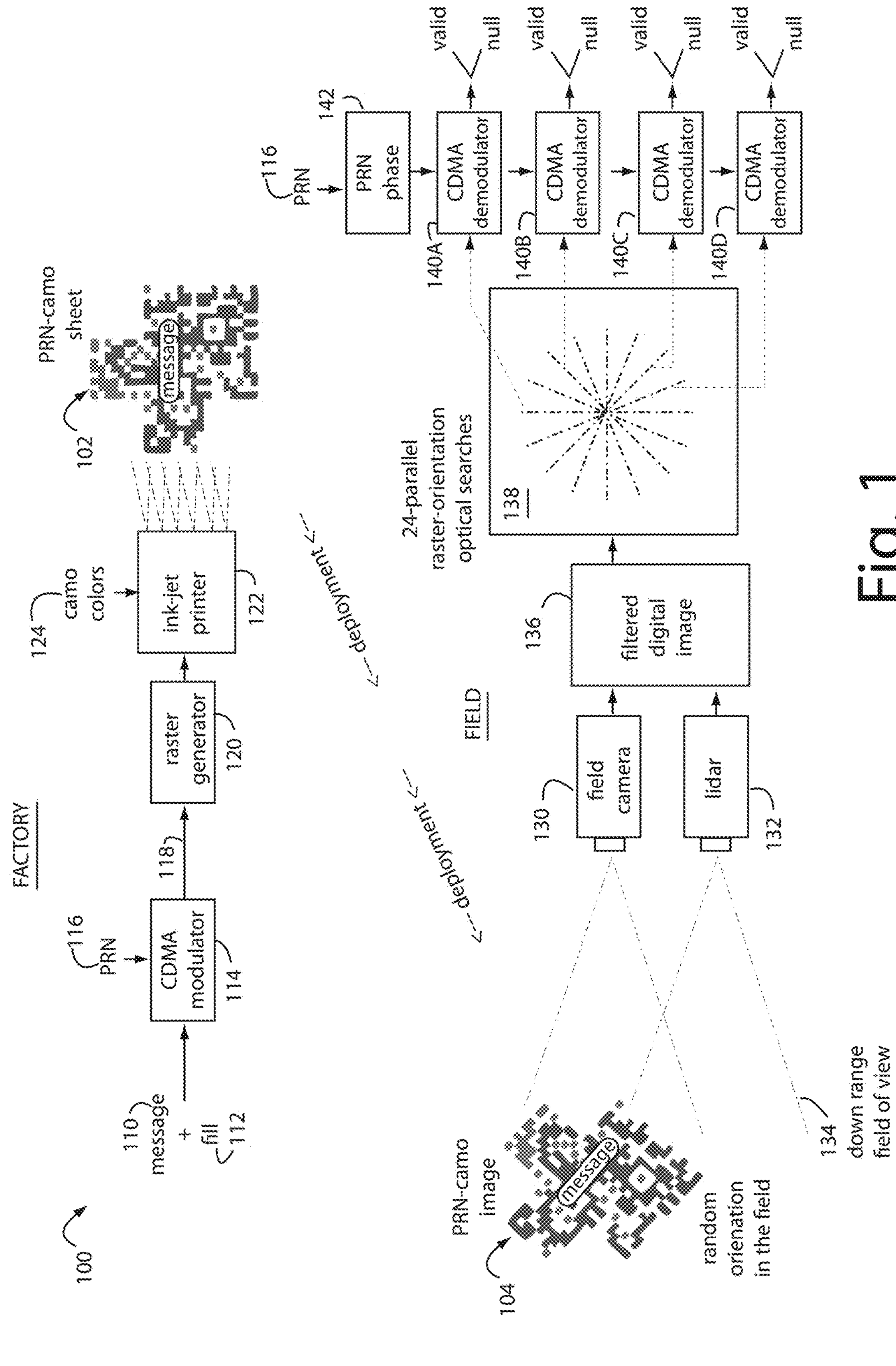

100
FACTORY
110 message
+
fill 112
116 PRN
CDMA modulator
114
118
raster generator
120
124 camo colors
ink-jet printer
122
102
PRN-camo sheet
message
deployment
deployment
FIELD
104
PRN-camo image
message
random orienation in the field
134
down range field of view
field camera
130
lidar
132
filtered digital image
136
24-parallel raster-orientation optical searches
138
116 PRN
PRN phase
142
CDMA demodulator
140A
140B
140C
140D
valid
null

Fig. 1

Fig. 2A

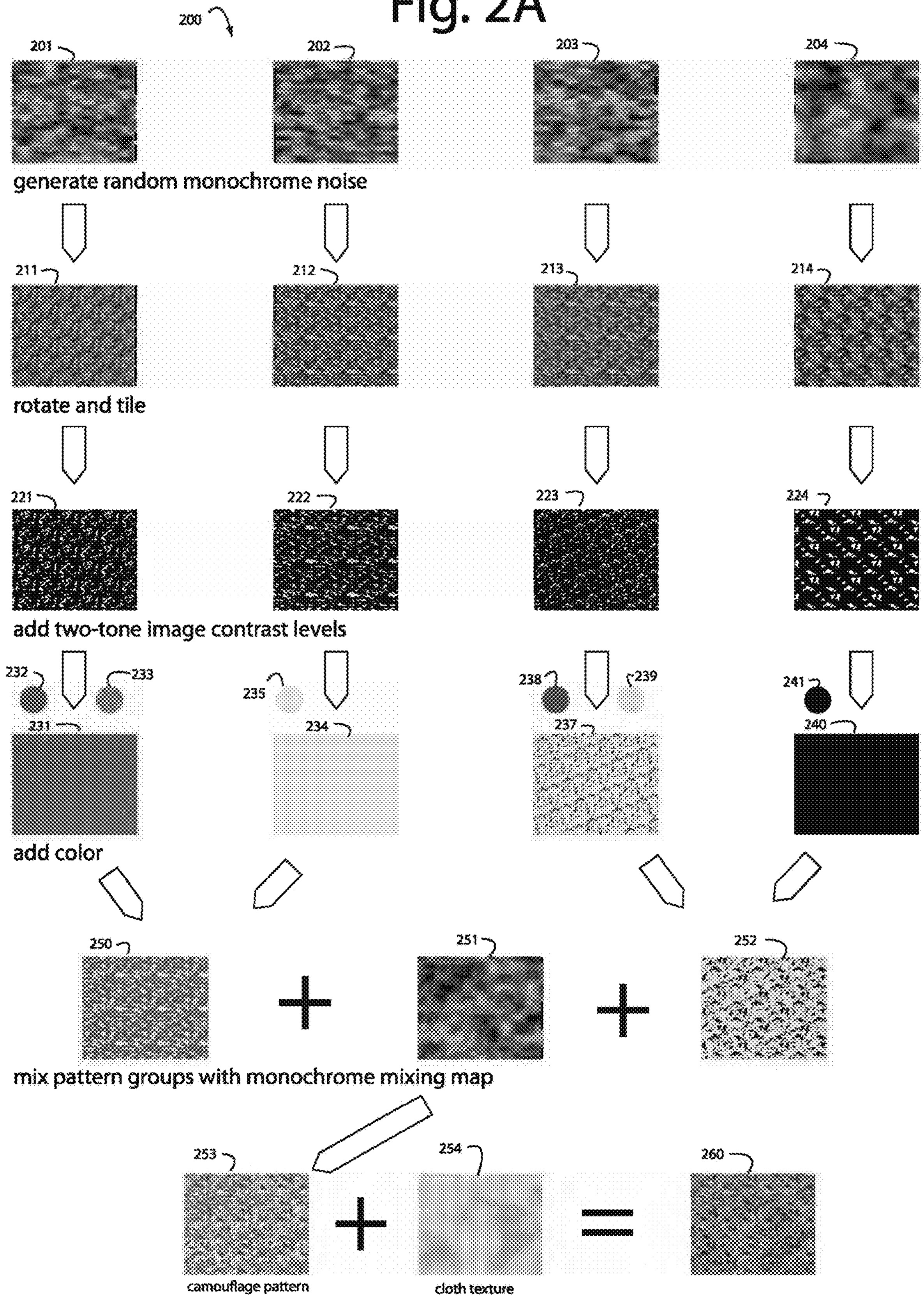

200
201
202
203
204
generate random monochrome noise
211
212
213
214
rotate and tile
221
222
223
224
add two-tone image contrast levels
232
233
235
238
239
241
231
234
237
240
add color
250
251
252
mix pattern groups with monochrome mixing map
253
254
260
camouflage pattern
cloth texture

Fig. 2B

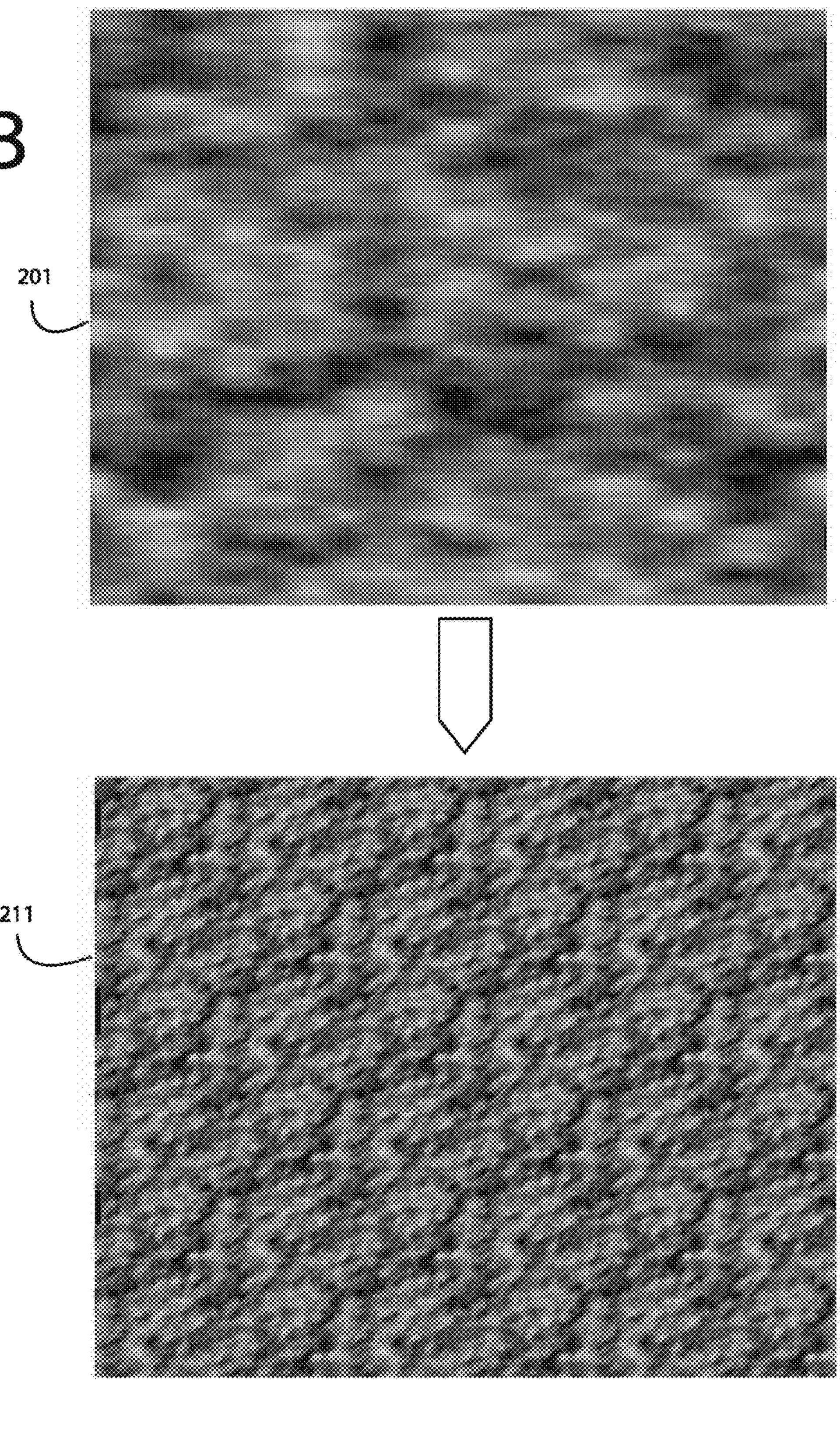


Fig. 2C

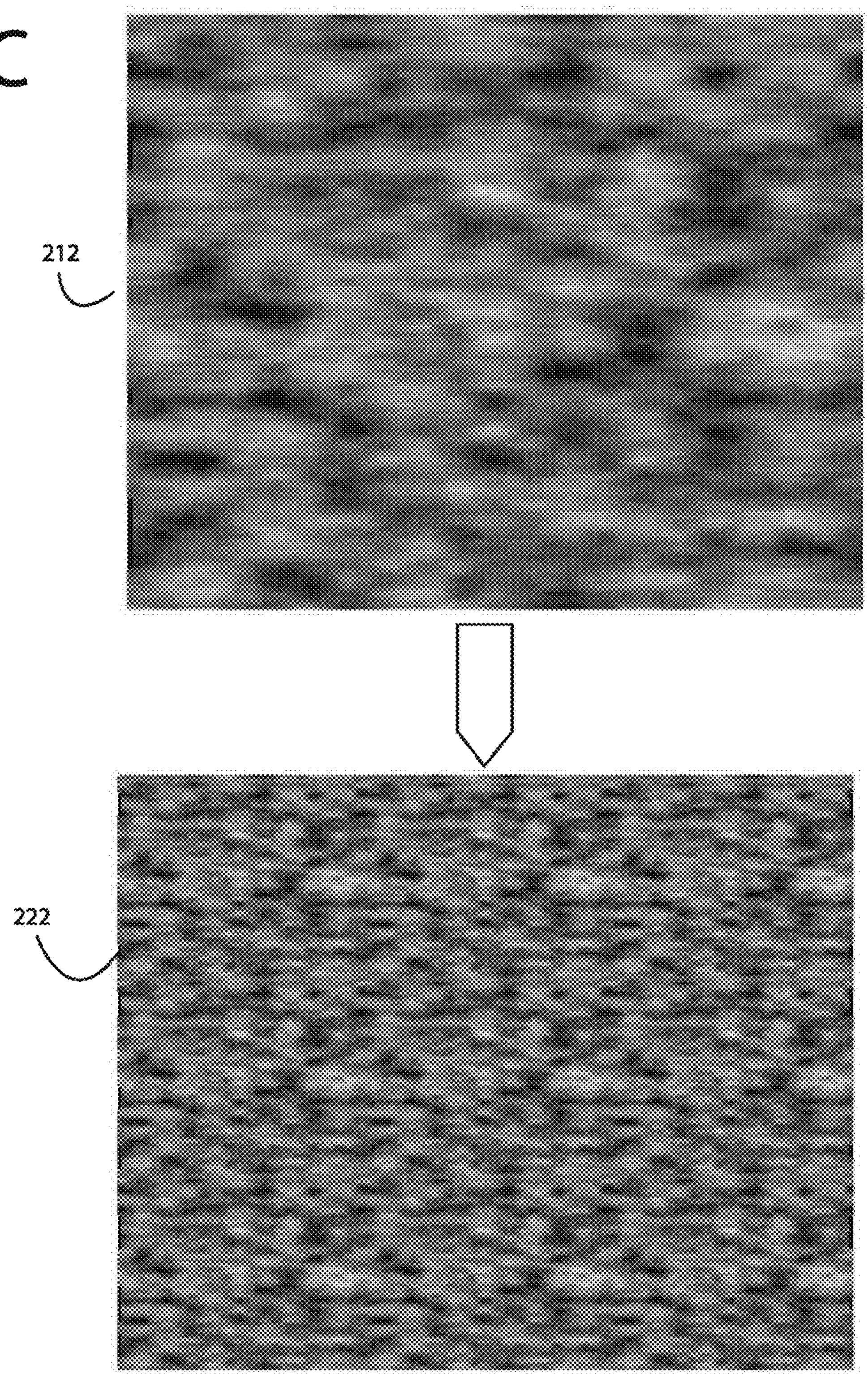


Fig. 2D

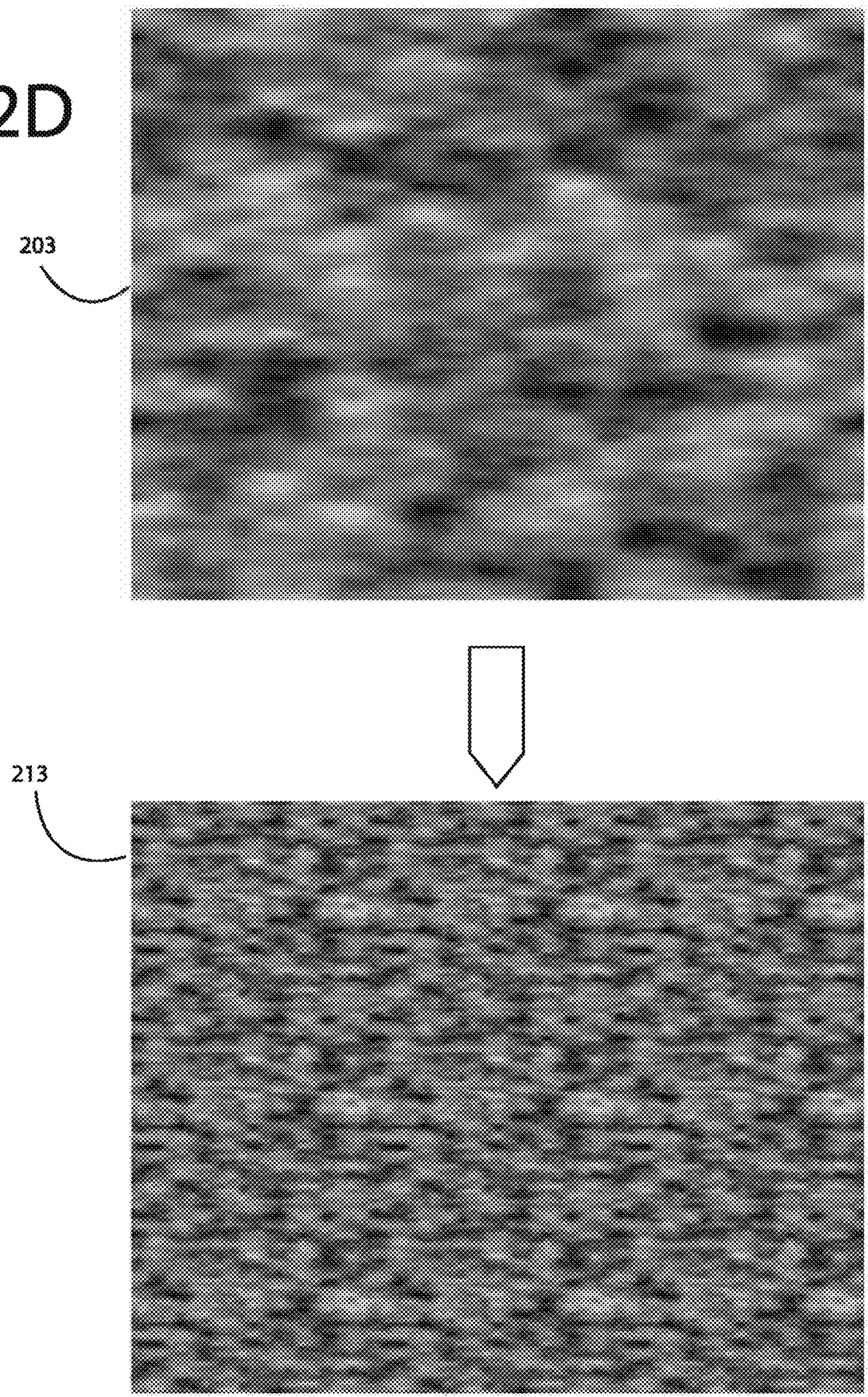


Fig. 2E

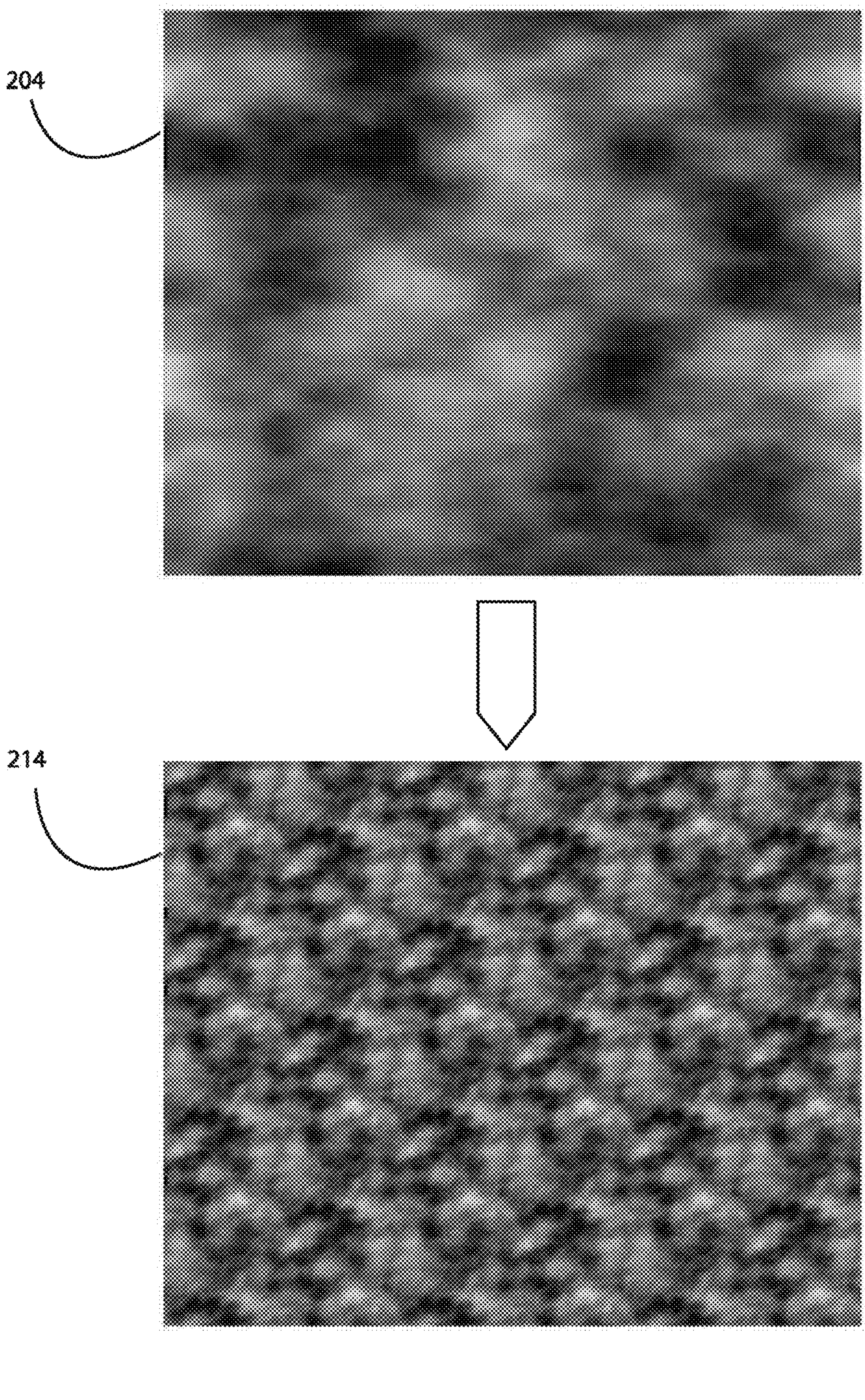


Fig. 2F

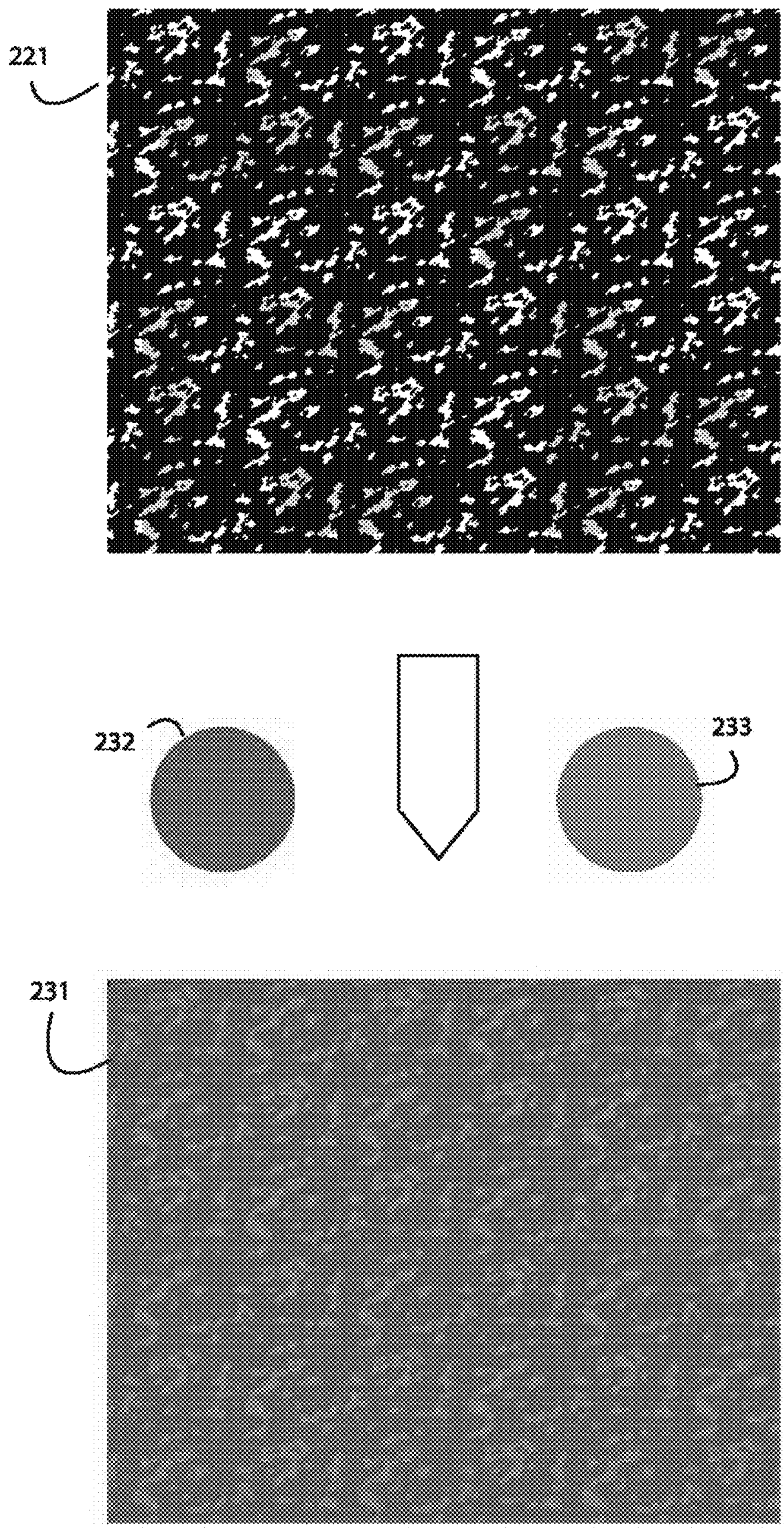
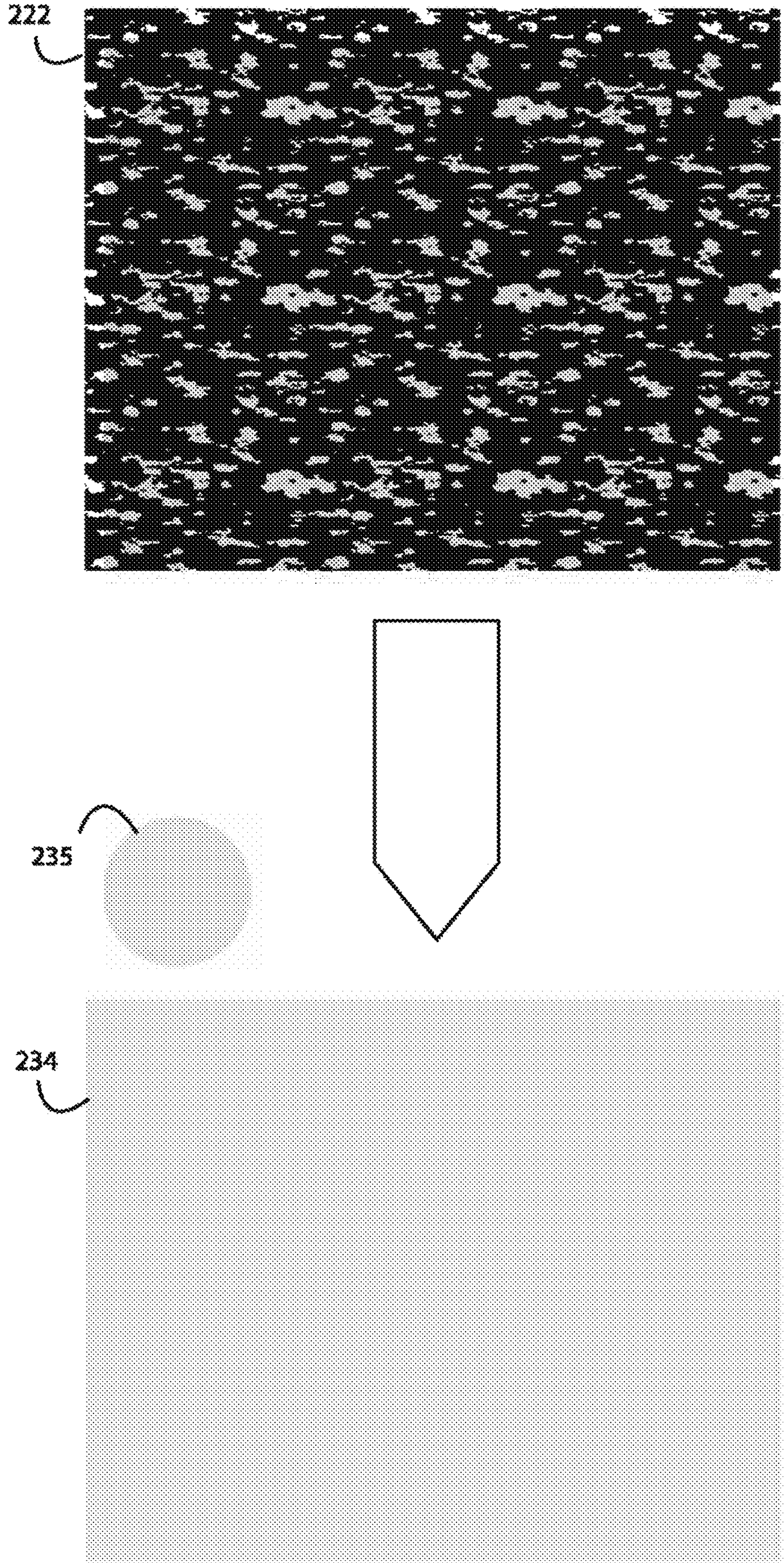


Fig. 2G



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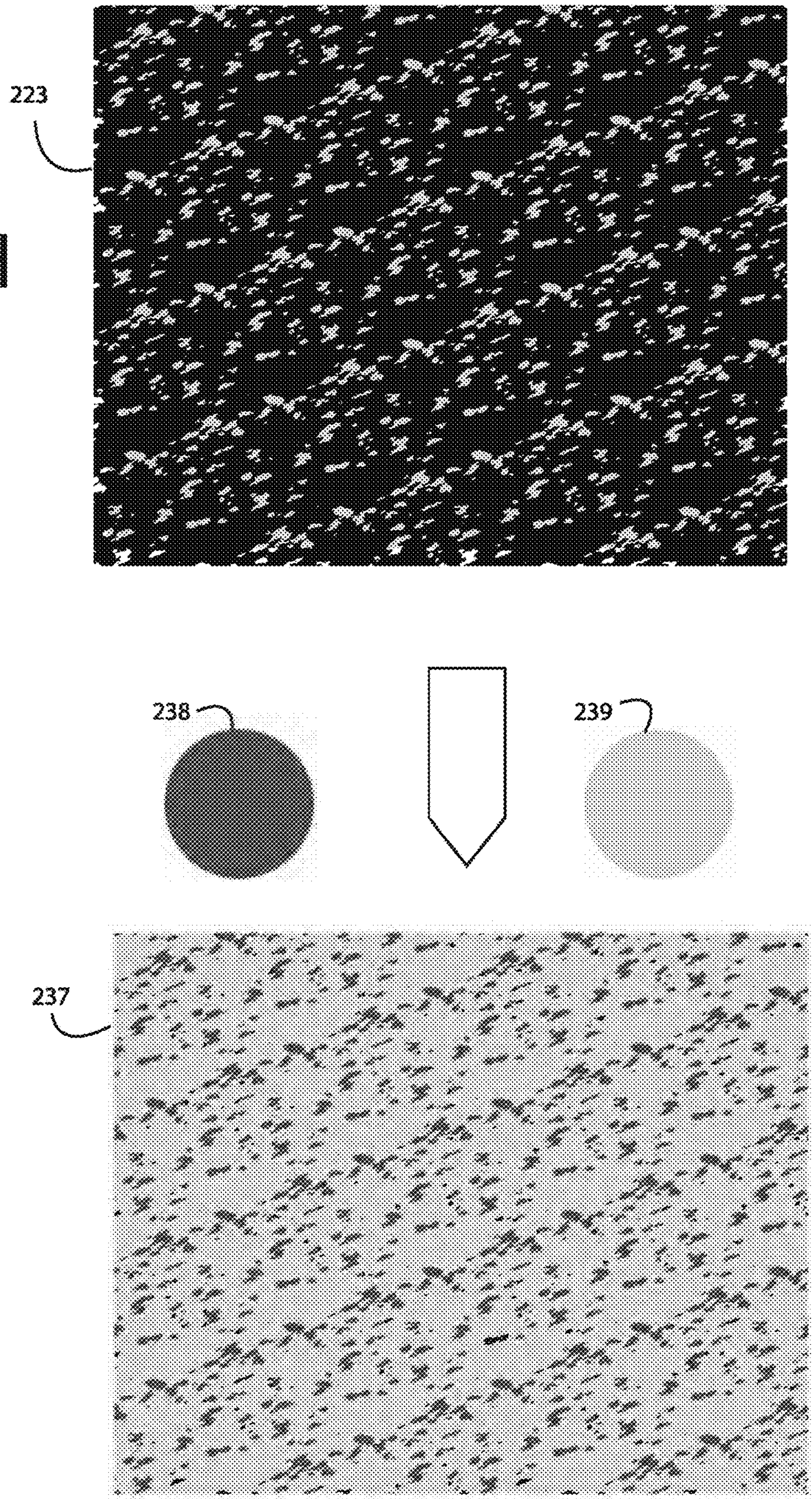
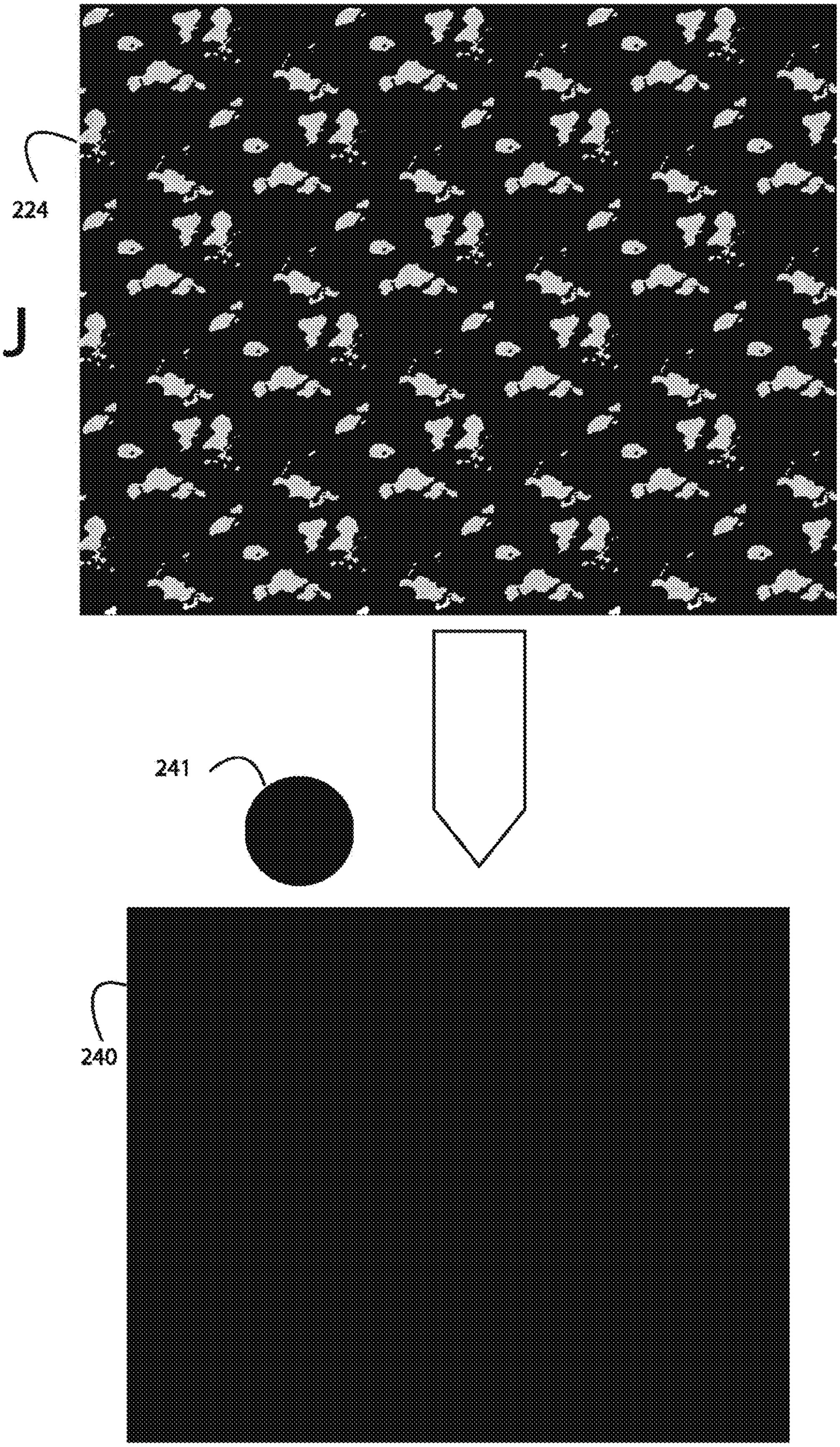


Fig. 2J



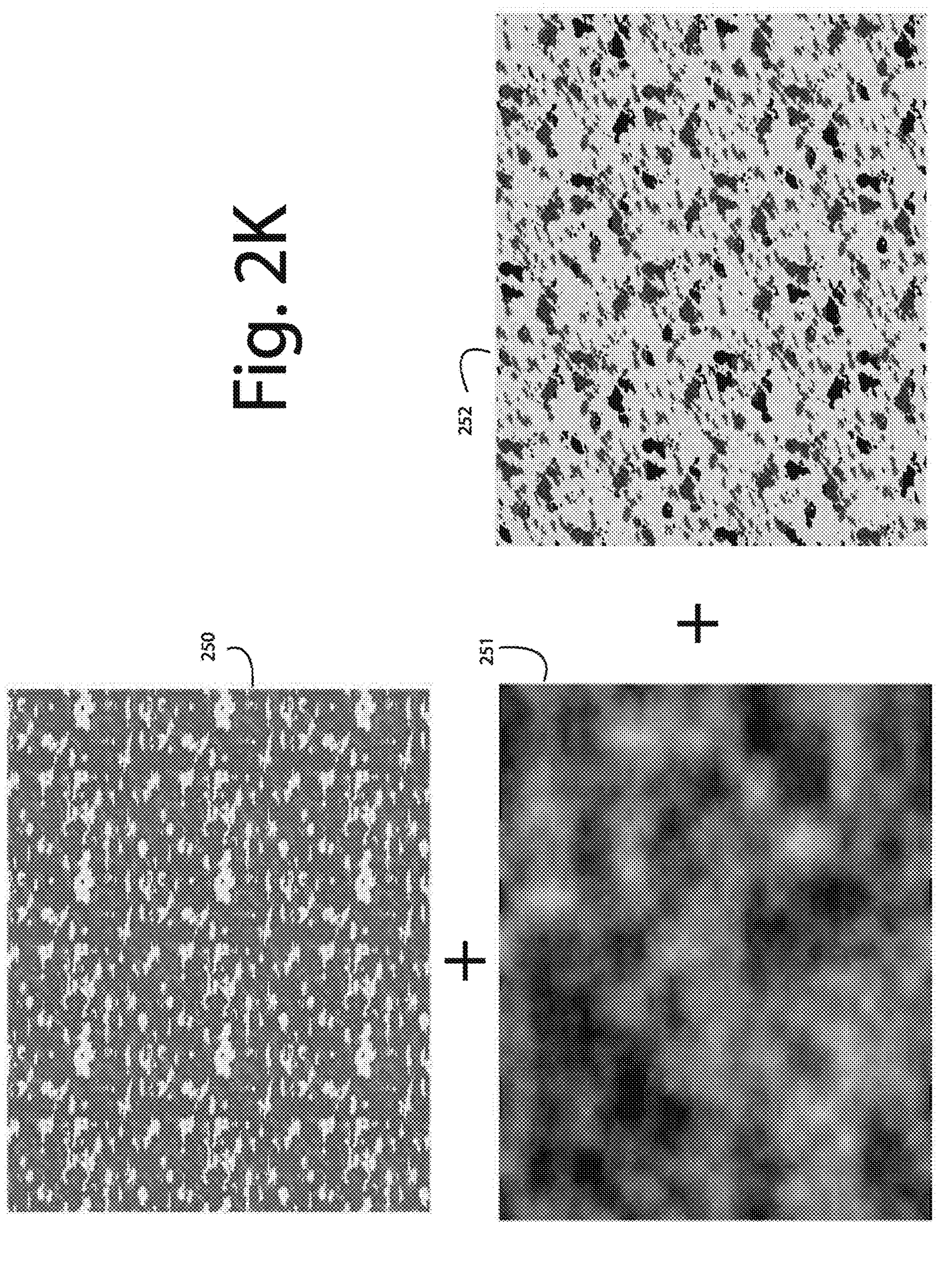


Fig. 2K

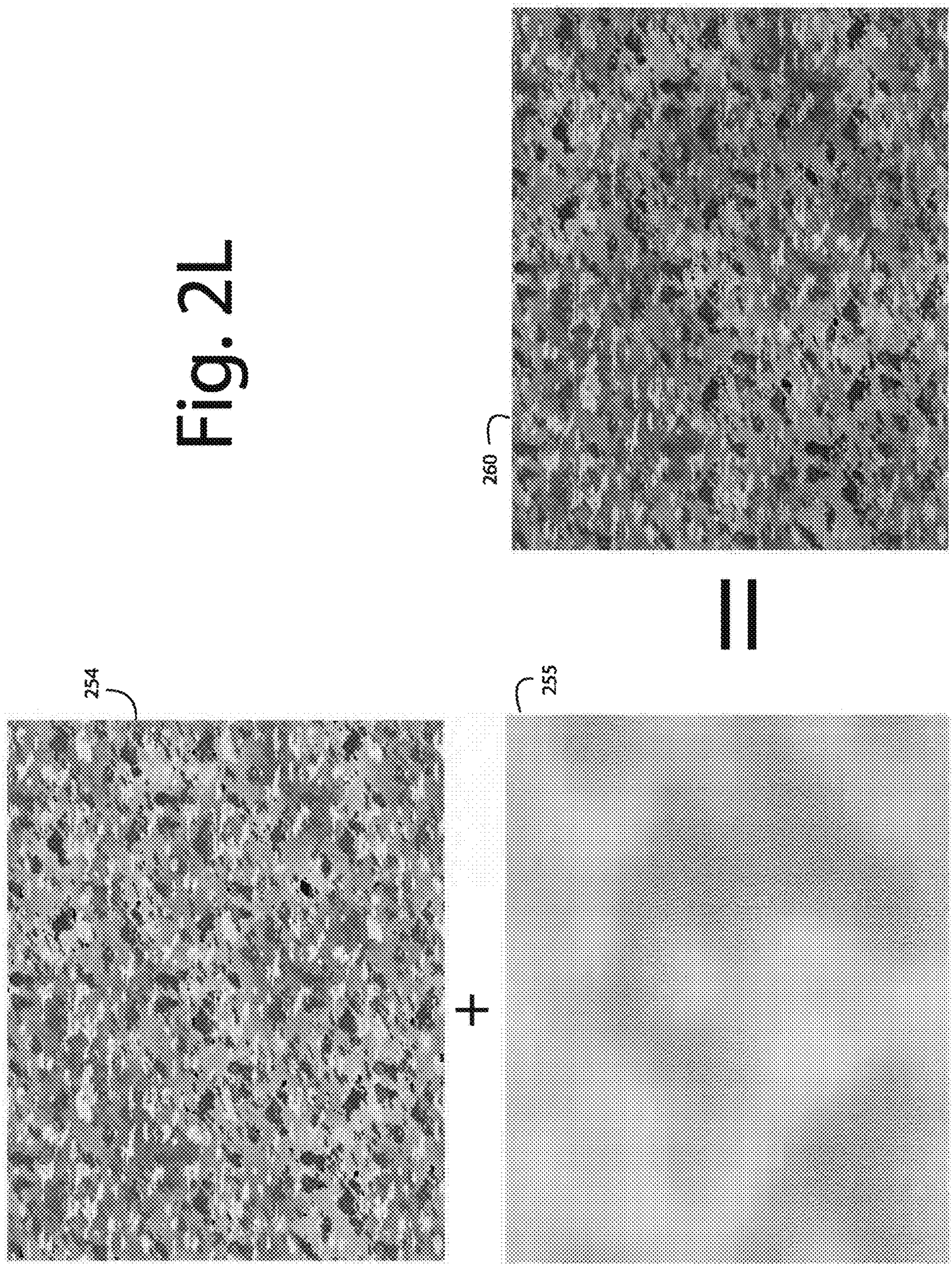
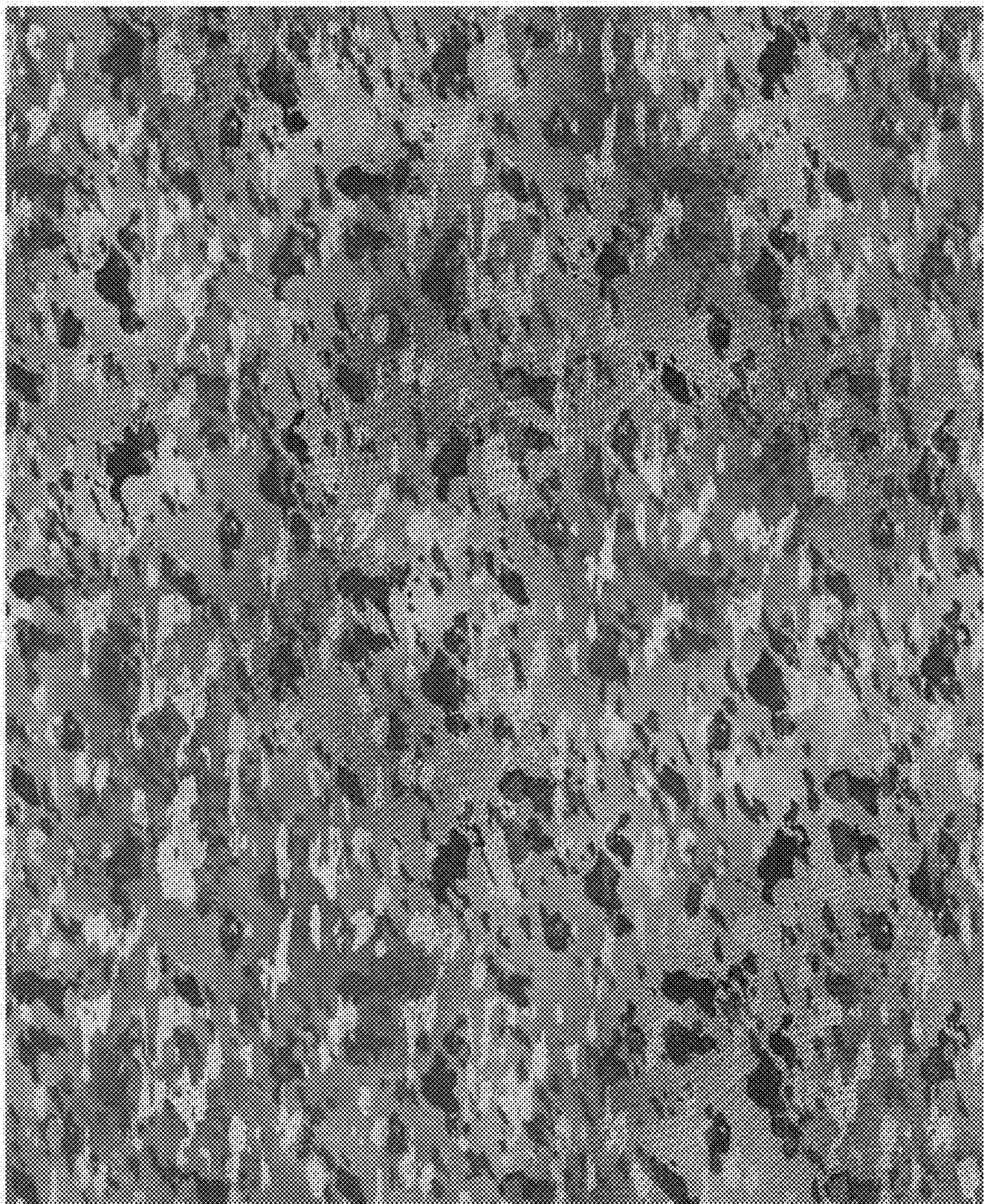


Fig. 2L

Fig. 2M



260

Fig. 2N

Fig. 2P

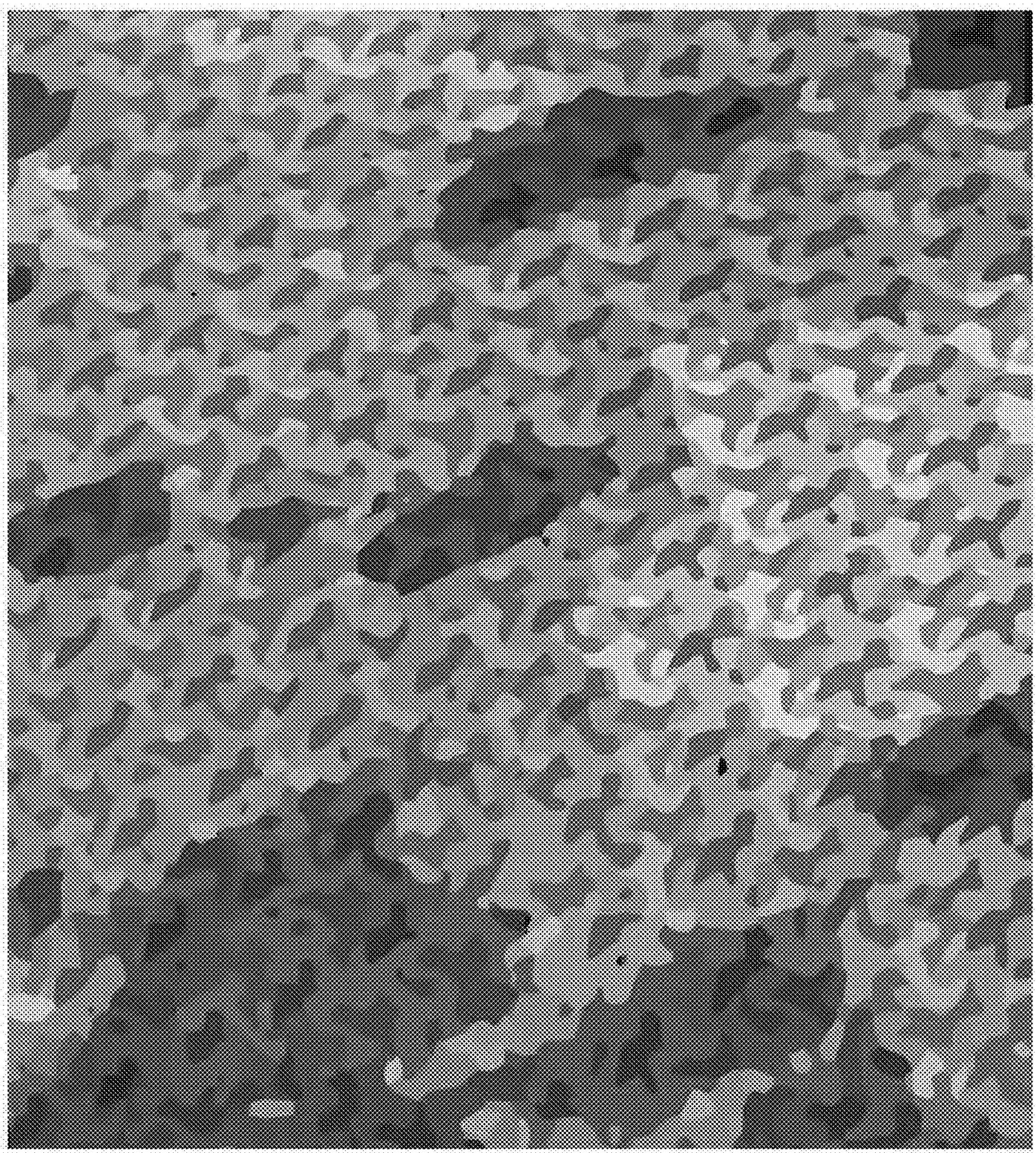


Fig. 4

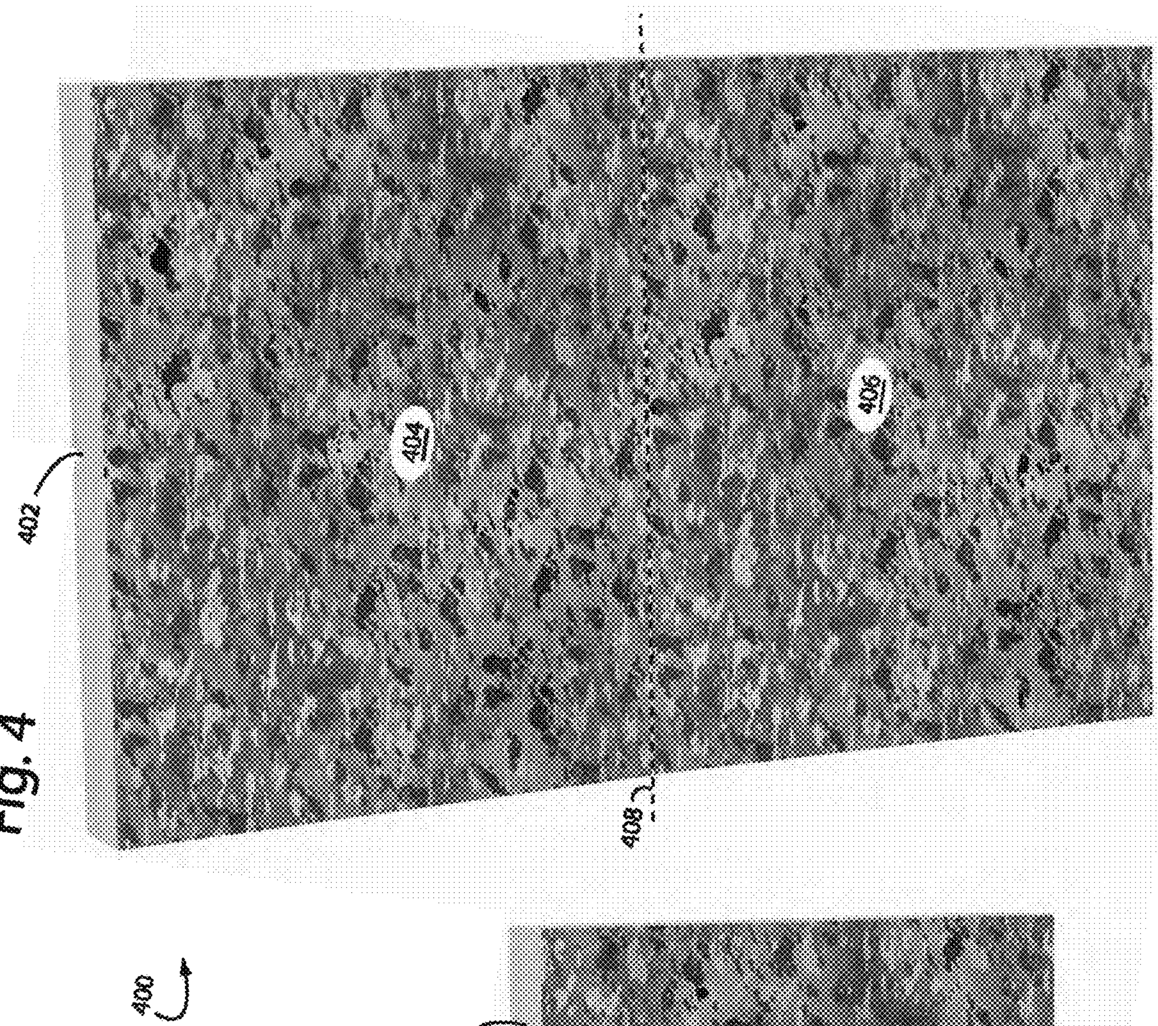


Fig. 3

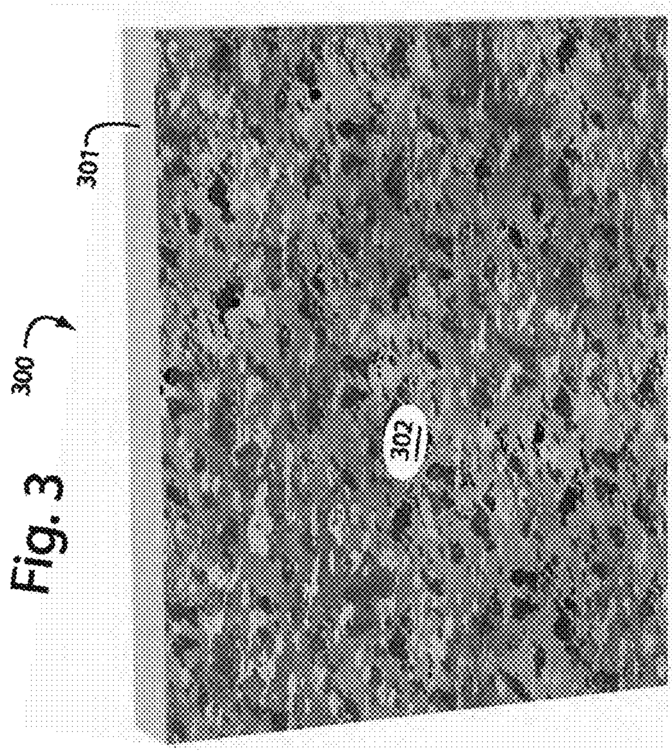


Fig. 5

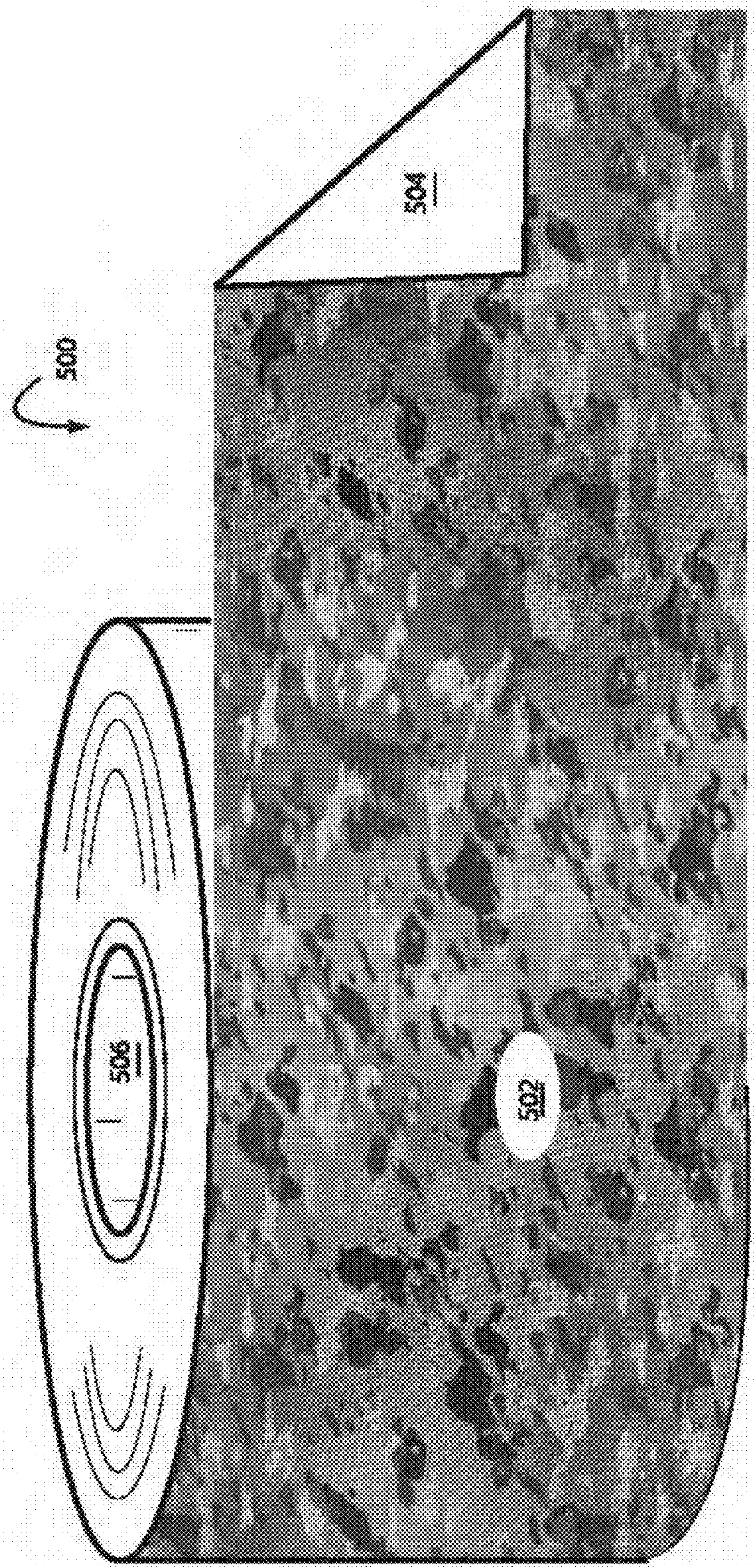


Fig. 6

600

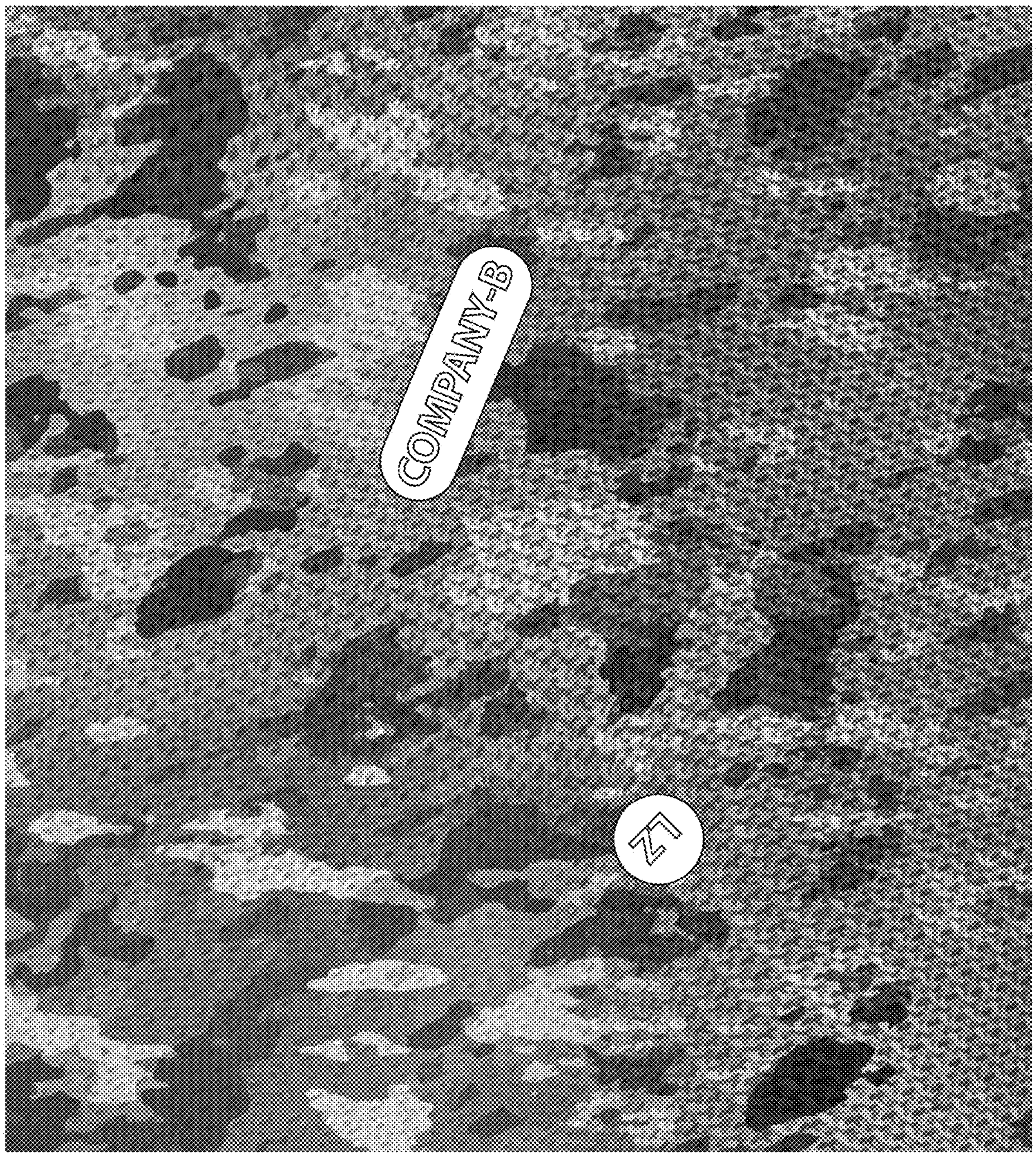
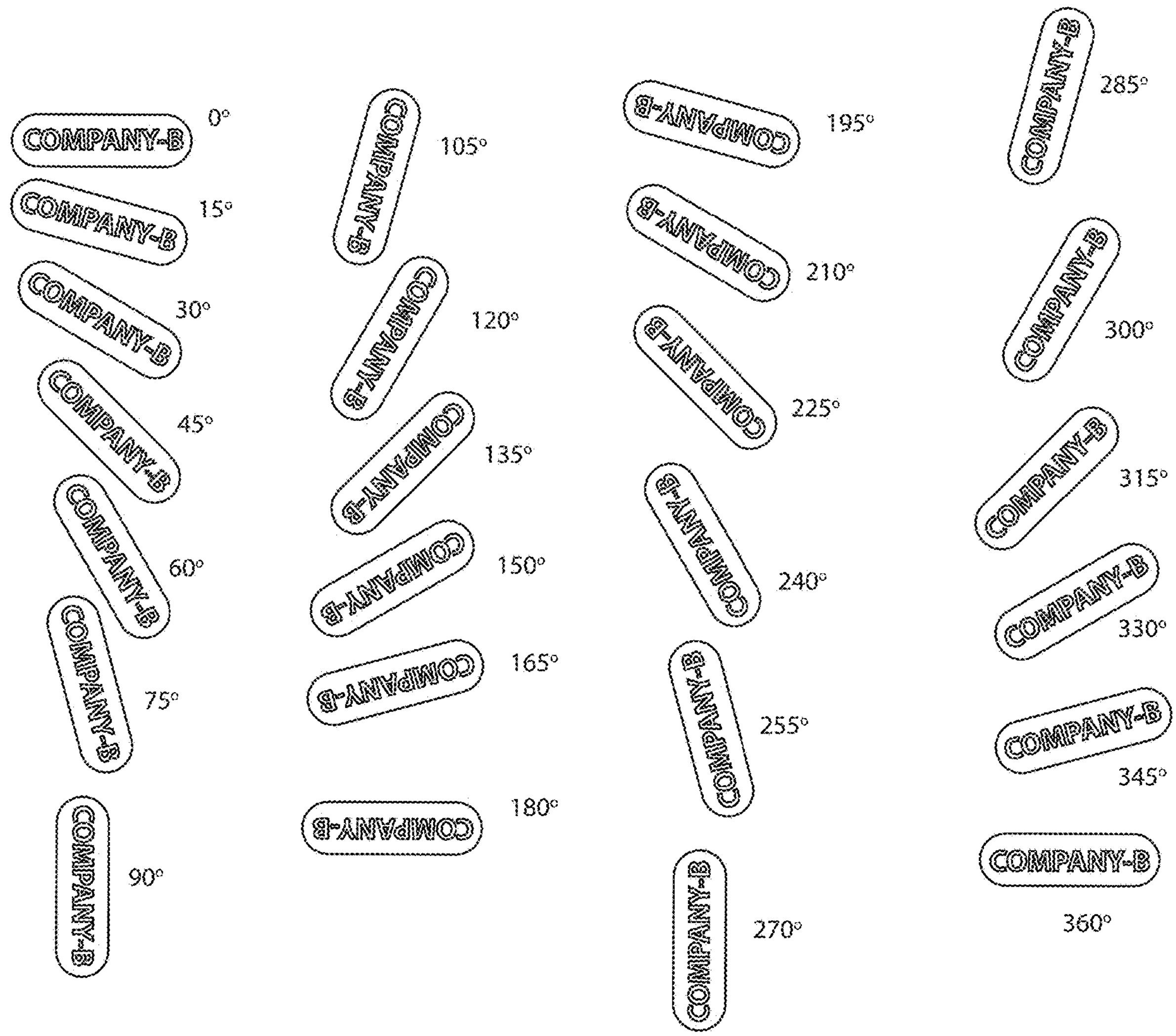


Fig. 7


COMPANY-B
0°
15°
30°
45°
60°
75°
90°
105°
120°
135°
150°
165°
180°
195°
210°
225°
240°
255°
270°
285°
300°
315°
330°
345°
360°

PSEUDO-RANDOM STEGANOGRAPHIC CAMOUFLAGE

FIELD OF THE INVENTION

[0001] The present invention relates to concealment-type survivalist gear, and more particularly to a tiled and mesh-textured camouflage-pattern graphic designs with encoded steganographic messages applied to a substrate like plastic films, adhesive tapes, clothing, tents, blankets, vehicles, etc.

DESCRIPTION OF THE PRIOR ART

[0002] Camouflage can use any combination of materials, coloration, or illumination for concealment, either by making people or equipment hard to discern by sight, or by masquerading as something else more expected. Examples include jungle cover, desert sands, blue sky, grasses and tree litter, soils, leaves, and snow. Gilly suits actually cover a sniper with an overall decorated with fake mosses, twigs, grasses, dirt, leaves, etc. Natural clutter on an optical level to natural vision or cameras will resolve as stills or video rasters of noise. In videos, waves through the noise can appear to be wind in the grasses or trees, waves in the water, and clouds in the skies.

[0003] One object of camouflage is to be able to hide personnel and equipment behind cover from easy visual detection in the field by adversaries or prey. The basic method used is to match the colors and patterns on the camouflage to the immediate surrounds so that at a distance there are no sharp, recognizable silhouettes or outlines. Camouflage effective in contrast to one background or environment may stand out and yell loudly in another. The chameleon has been able to overcome this limitation, but manmade camouflage is not near as adaptable or as good at adapting and blending in.

[0004] Warships and combat aircraft are routinely painted with desert, woodland, artic, blue sky, open sea, and other colors and patterns to help conceal such equipment out in the open. Some warships and combat aircraft will, of course, be "friendlies" and some will be foes. Conventional camouflage conceals both the same. And so a misidentification caused by the concealment can be costly or deadly.

[0005] In 2005 the US Army adopted the Universal Camouflage Pattern as the standard camouflage pattern for all environments. When soldiers started to complain about it completely underperforming in every environment the Army issued a Solicitation for a better pattern.

[0006] "The US Army Contracting Center, Aberdeen Proving Ground (Soldier, Chemical, Research & Test), Natick Contracting Division (NCD) on behalf of the US Army Soldier System Center, Natick, Mass. (Product Manager Soldier Clothing and Individual Equipment), intends to issue a solicitation under Authority of FAR Part 15, for a research and development effort to work with multiple vendors to develop a family of camouflage patterns. The family is comprised of three patterns/color palettes for the uniforms (i.e., wooded, arid and transitional), which have the same or similar geometry, and one pattern for the personal protective equipment (PPE)/organizational clothing and individual equipment (OCIE), which may or may not be one of the uniform patterns. The uniform patterns/palettes must be compatible with the PPE/OCIE pattern/palette. The first objective of this effort is to develop for the US Army a family of camouflage patterns that offers improved concealment and reduced detection capability over current patterns. The second objective is to acquire the data rights for a portion or all of the best performing camouflage pattern families. The Government anticipates that this requirement will be competed full and open; however, the Government reserves the right to change the solicitation procedure. Firms shall not be reimbursed for any costs associated with proposals. The Government envisions multiple awards, to a Business under North American Industry Classification System code 541712, and Federal Supply Code 8731. When released, the solicitation, including all amendments and applicable documents, will be available in electronic substrate, on or about Mar. 18, 2011, at the US Army Contracting Center, Aberdeen Proving Ground (SCRT), Natick Contracting Division website, https://www3.natick.army.mil

[0007] On May 23, 2014, the US Army announced that the Scorpion pattern, a predecessor to Crye Precision's MultiCam, was selected to replace UCP as the Army's standard camouflage pattern, despite the fact that it was dropped from the trials for being too similar to MultiCam.

[0008] Crye Precision's MultiCam pattern also forms a basis for the British MTP pattern then replacing the DPM and the new (2013) AMP (Australian Multicam Pattern) which will replace the DPCU. Polish special forces are using a version of the Multicam called Suez. MultiCam is a single camouflage pattern that helps a wearer hide in varied environments, seasons, elevations, and light conditions. It tries to address a real-world need for concealment in different environments, with one basic kit of gear. While there are many location-specific patterns, MultiCam work across a very broad range of environmental conditions when observed in both the visual and near infrared (night vision) spectrums. The pattern reflects some of the surrounding colors of the environment. It takes on an overall green appearance when under a green forest canopy, and an overall tan look when in the open desert. By adapting to varying local lighting conditions, it blends with many environments, elevations, seasons, weather conditions, and times of the day. The design is based on the way the human eye and brain perceive shapes, volumes, and colors. Only a very small portion of the human eye can perceive color, so the brain does a lot of interpolating. MultiCam uses this principle to help observers "see" the pattern as part of the background. MultiCam relies on a blending effect, rather than a contrast effect to mask the wearer. This effect allows it to perform in a wide range of environments, and keeps the pattern effective even at close distances where pixelated or "blocky" patterns will often stand out against natural, non-blocky environments.

[0009] What would be very useful in the field of camouflage would be camouflage that visually flashed a marker identifying the "friendly" and yet maintained the concealment to foes or unauthorized spotters. Not directly of course, but with "authorized" digital imaging cameras. For example, the Marker could be something that resolved after decryption to "USA", "Company-B", "Press", "FIELD HOSPITAL", "Battery-C", "Deer Hunters", "Tunnel Entrance", etc.

SUMMARY OF THE INVENTION

[0010] Briefly, a concealment substrate embodiment of the present invention comprises a graphic design printed or painted as camouflage on substrates like mesh-textured uniforms, military equipment, Mylar thermal blanket sheets, adhesive tapes, etc. The graphic design is uniquely generated from pseudo-random noise in four overlaying colors that each begin as a raster of randomly generated noise in a standardized tile size. E.g., gray, green, tan, and brown colors natural for concealment applications are each masked by two-tone image contrast rasters. The four results are mixed in groups together with a monochrome mixing mask to produce a whole tile of concealment camouflage that will conjoin seamlessly within arrays of such tiles. A further refinement visually adds a distorted-grid mesh-texture overly texture to the concealment camouflage, and even faint "watermarks" of commercial trademarks.

[0011] These and other objects and advantages of the present invention no doubt become obvious to those of ordinary skill in the art after having read the following detailed description of the preferred embodiments which are illustrated in the various drawing figures.

IN THE DRAWINGS

[0012] FIG. **1** is a functional block diagram of a pseudo-random camouflage system in an embodiment of the present invention. The pseudo-random camouflage system has a factory to produce a sheet of pseudo-random camouflage comprising a pseudo-randomly generated and positioned collection of blobs, splotches, drops, spots, globules, and blotches. A second field-deployed part can then optically resolve and read encrypted messages in a pseudo-random camouflage captured image obtained in any orientation and practically at any distance;

[0013] FIG. **2**A is a flowchart diagram of a graphics design method embodiment of the present invention for rendering a pseudo-random concealment pattern that is printed, painted, or otherwise permanently deposited as color pigments on a substrate;

[0014] FIGS. **2**B-**2**H and **2**J-**2**M are detailed views of the various patterns included in FIG. **2**A;

[0015] FIGS. **2**N and **2**P are four-times and twenty-six times magnifications of small portions of the distorted-grid mesh-texture concealment four-color camouflage pattern in FIG. **2**M. These are presented herein to show how the regular placement of consistently sized, but darker-than-average, blobs and splotches of color, in conjunction with the mesh-textured overlay, give the appearance of natural blending at stand-off distances;

[0016] FIG. **3** is a perspective view diagram of a substrate printed on one side with a whole single tile of the repeatable concealment pattern produced by the Method of FIG. **2**A, e.g., the pattern of FIG. **2**M;

[0017] FIG. **4** is a perspective view diagram of a flexible blanket-sized Mylar substrate printed on one side with two whole single tiles of the repeatable concealment pattern seamlessly joined together along the dashed line;

[0018] FIG. **5** is a perspective view diagram of a roll of adhesive backed duct tape printed on one side with partial tiles of the repeatable concealment pattern seamlessly joined heel-to-toe along its longitudinal run;

[0019] FIG. **6** is a cartoon diagram representing what a user would see on an LCD monitor screen when camera is imaging a video raster of a natural jungle terrain from a kilometer away; and

[0020] FIG. **7** is a diagram representing twenty-four 15° relative visual orientations, 0°-360°, that a message such as COMPANY-B could appear as in the field-of-view of a level camera. If a COMPANY-B message is present, and the PRN used is correct, one of the decoding shift registers of FIG. **1** will produce a message output, "COMPANY-B".

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0021] FIG. **1** represents a pseudo-random camouflage system **100** in an embodiment of the present invention. The pseudo-random camouflage system **100** can factory produce a sheet of pseudo-random camouflage **102** comprising a visible surface of a pseudo-randomly generated and positioned mixed-collection of blobs, splotches, drops, spots, globules, and blotches.

[0022] A second field-deployed part can then optically resolve and read the messages encrypted in a pseudo-random camouflage captured image **104**. These images can be obtained in any orientation and at practical distances. The sheet of pseudo-random camouflage **102** can be produced in an ink-jet printer, silkscreen process, or other method that can faithfully produce a computed pseudo-random camouflage pattern on any tangible object. One extreme would be light projection on a reflective surface.

[0023] More generally, the pseudo-random camouflage need not be limited to sheets of material, but could be applied to any tangible substrate like military armor, vehicles, etc.

[0024] Herein, blobs, splotches, drops, spots, globules, and blotches are words in ordinary usage meant herein to describe the variety of ways inks, paints, and other contrasts applied to tangible materials will appear to observers and have no predefined or predictable borders, perimeters, shapes, or shadings.

[0025] As an example of what is meant by a "mixed-collection of blobs, splotches, drops, spots, globules, and blotches", see *How To Create a Repeating Camo Pattern in Illustrator*, by Chris Spooner, https://blog.spoongraphics.co.uk/, 29 Nov. 2010.

[0026] A message **110** (e.g., COMPANY-B) and surrounding pattern fill **112** are applied to a code division multiplex access (CDMA) modulator **114** that uses a PRN code **116** to produce what appears to be digital noise **118**. A raster generator **120** places the message **110** and pattern fill **112** into a two-dimensional (2D) image raster representing the size of the tangible object to be printed or otherwise painted like sheet **102**. Multiple image rasters can be tiled onto the tangible object to make the application more practical. An ink-jet printer **122** is an example of a device that can permanently apply the image raster to a sheet substrate. A palette of camo-colors **124** are selected to produce the best concealment given a selected use environment, e.g., jungle, desert, sky, sea, etc.

[0027] Sheets of pseudo-random camouflage **102** are stockpiled, warehoused, transported, distributed and otherwise deployed to the field for use.

[0028] Once in the field, individual sheets of pseudo-random camouflage **102** are used to cover, blanket, or other conceal people, equipment, and installations from view of detection by adversaries and otherwise unauthorized spotters. But, command and other authorized actors will be enabled to "see" exactly where in the field the people, equipment, and installations hidden from view are exactly positioned. That is, if PRN **116** is known to them. Otherwise, the individual sheets of pseudo-random camouflage **102** will operate as conventional camouflage.

[0029] A printable and displayable message **110** is chosen according to how and where the particular pseudo-random steganographic camouflage on the substrate is intended to be deployed. The printable and displayable message **110** is typically able to identify people, equipment, assets, hazards, and installations concealable by the pseudo-random steganographic camouflage printed on the substrate. It can also be used to hide or secret a trademark, copyright notice, security or counterfeiting countermeasure, etc.

[0030] A fill pattern **112** is needed to visibly submerge the message **110** when it's printed or displayed. The particular camouflage theme for the fill pattern includes conventional desert, jungle, woodland, sky, and sea palettes of colors and patterns.

[0031] A pseudo-random number (PRN) set **116** is needed for encoding a code in a code-division multiple access (CDMA) modulator **114**. The modulator **114** controls a digital serialization **118** of the message **110** and the fill pattern **112** with the PRN **116** into component colors, saturations, and light levels adhering to a particular camouflage theme, e.g., camo colors **124**. A two-dimensional raster generator **120** converts a serialization of the message and the fill pattern with the PRN code into a raster of horizontal scanning lines for color printing. A color printer, silkscreen, paint sprayer or other similar device (all represented by ink jet printer **122**) applies paints, inks, and other colored materials to a substrate according to the serialization of the message and the fill pattern with the PRN into component colors, saturations, and light levels.

[0032] The challenge here is not unlike a global positioning system (GPS) navigation receiver which must first replicate the PRN code that is transmitted by the satellite vehicle (SV) being acquired by the receiver; then it must shift the phase of the replica code until it correlates with the SV PRN code. When cross-correlating the transmitted PRN code with a replica code, the same correlation properties occur that occurs for the mathematical autocorrelation process for a given PRN code. Receiver correlation processes are very different from autocorrelation processes because only selected points of the correlation envelope are found and examined by the receiver. When the phase of the GPS receiver replica code matches the phase of the incoming SV code, there is maximum correlation. When the phase of the replica code is offset by more than one "chip" (serial bit) on either side of the incoming SV code, there is minimum correlation. This is how GPS receivers detect the SV signals when acquiring or tracking the SV signals in the code phase dimension. GPS receivers must also detect the SV in the carrier phase dimension by replicating the carrier frequency to obtain carrier phase lock with the SV signal. So, GPS signal acquisition and tracking process is a two-dimensional, code and carrier, signal replication process. See, Ward, Betz, and Hegarty, *Satellite Signal Acquisition, Tracking, and Data Demodulation*. UNDERSTANDING GPS PRINCIPLES AND APPLICATIONS 2nd Ed., ISBN 1580538940,© 2006.

[0033] Here, "carrier phase" is not an uncertainty, but the relative visual orientation of a camera to the lay of image **104** deployed in the field is uncertain. The uncertainty as to range and zoom can be mitigated by measuring the range, e.g., with LIDAR.

[0034] The PRN code **116** will repeat many times in each raster. How the chips shift and wiggle represents the modulation data of the message **110**.

[0035] The message **110** is visually submerged into pseudo-random steganographic camouflage **102** and is discernable from the fill **112** and readable as to the content to only cameras equipped with a CDMA demodulator and a correct PRN. Typical substrates include tangible sheet and bulk materials that can receive and retain inks, paints, and decorations on their surfaces from the printer. The raster generator **120** sends a serial stream of digital data to the printer **122** as a series of progressive scan lines that are recoverable by a digital camera employing raster scanning and a matching serial output.

[0036] The second, field deployable part of pseudo-random camouflage system **100** has a camera **130** that is positioned and focused such that it can capture PRN-camo image **104**. A light detection and ranging (LIDAR) device **132** measures the distance and obtains a range. This is important to ascertain the degree of zoom necessary for camera **130** to produce a raster of a digital image that can be read for the message **110**.

[0037] Alternatively, camera **130** could be mounted coaxially on an axle to rotate with a step motor in one degree increments, searching for the correct relative orientation. That is if time permits.

[0038] A filtered digital image **136** produced by an image processor represents PRN-camo image **104** in the relative orientation that camera **130** finds itself at the moment in the field. The PRN-camo image **104** could have the message **110** upside down or sideways, and thus frustrate simple PRN code searches and CDMA demodulation.

[0039] So in a splitter **138**, twenty-four 15° twists of digital image **136** are distributed in parallel to twenty-four serial shift registers that can each independently match to PRN **116**. Unauthorized field units will not have PRN **116**. If, it turns out empirically, that 15° twists of digital image **136** are too large to reliably decode message **116**, then finer twists and more PRN serial shift decoders will be necessary. This example is merely intended to describe the basic technique.

[0040] CDMA demodulators **140**A-**140**D are intended to represent however many serial shift registers are necessary. Each is fed with a trial phasing of PRN **116** by a phase generator **142**. If the PRN phase gets lucky, and if message **110** is present in PRN-camo image **104**, one of the CDMA demodulators **140**A-**140**D will spit out a valid character string. The others will produce noise.

[0041] The valid character string is easy enough to present in a user display in a visual display position and orientation derived from its processing.

[0042] Serialized and rasterized digital image streams here are not unlike what a GPS receiver would sense from a GPS satellite that transmits CDMA messages encoded with the satellite almanac and system time. CDMA demodulation based on a fixed known set of PRNs is conventional and highly developed in the navigation satellite receiver art. For example, see *Satellite Signal Acquisition, Tracking, and Data Demodulation*, by Phillip W. Ward NAVWARD GPS Consulting, and John W. Betz and Christopher J. Hegarty, The MITRE Corporation, pp. 153-241, UNDERSTANDING GPS PRINCIPLES AND APPLICATIONS 2nd Ed., ISBN 1580538940, © 2006, https://pdfs.semanticscholar.org/9897/aecb6eb1d23430480cb915df769 cd93dfd9a.pdf

[0043] FIGS. **2**A-**2**M represent a graphics design method **200** in an embodiment of the present invention for rendering, e.g., a concealment pattern that is printed or painted on substrates like Mylar blankets and adhesive waterproof tapes in rolls. A first set of patterns **201**-**204** are generated from a mix mix of pseudo-random monochrome noise using a graphics design software like Adobe Illustrator. The pseudo-random part is a code division multiplex access (CDMA) modulation of a "Message". E.g., COMPANY-B.

[0044] These are individually rotated and tiled to produce a next set of patterns **211**-**214**. Individual two-tone image contrast levels **221**-**224** are used to fix color transitions in each of the four pattern sets. A drab green color **231** is shifted by contrast level **221** between a darker-than-average drab green color **232** and a lighter-than-average drab green color **233**. A grey color **234** is filtered by contrast level **222** to turn on or off grey color **235**. A tan color **237** is shifted by contrast level **223** between a darker-than-average tan color **238** and a lighter-than-average tan color **239**. A brown color **240** is filtered by contrast level **224** to turn on or off brown color **241**.

[0045] Patterns **201** and **211** can be seen in much finer detail in FIG. **2**B. Patterns **202** and **212** can be seen in much finer detail in FIG. **2**C. Patterns **203** and **213** can be seen in much finer detail in FIG. **2**D. Patterns **204** and **214** can be seen in much finer detail in FIG. **2**E. Resulting pattern **231** that shifts between drab green colors **232** and **233** according to pattern **221** is presented in much finer detail in FIG. **2**F. Color **234** that is filtered by pattern **222** is presented in much finer detail in FIG. **2**G. Resulting pattern **237** that shifts between tan colors **238** and **239** according to pattern **223** is presented in much finer detail in FIG. **2**H. Color **240** that is filtered by pattern **224** is presented in much finer detail in FIG. **2**J.

[0046] A first color pattern group **250** results from adding together **221**, **231**, **222**, and **234**. A monochrome mixing map **251** is added with a second color pattern group **252** that is the sum of **223**, **237**, **224**, and **240**. See FIG. **2**K. The three added together form a final four-color camouflage pattern **253**. See FIG. **2**L. Such can be the final step in this process, and printed on a substrate.

[0047] A distorted-grid mesh-texture pattern **254** is added to four-color camouflage pattern **253** to further distort the repeatable patterns, as well as provide an appearance of mesh-textured for printing on some Mylar blankets, duct tape, and other products. See FIG. **2**L for finer details of the patterns. Such mesh-textured is an option. A distorted-grid mesh-texture concealment four-color camouflage pattern **260** is the final product of these steps and can be seen in finer detail in FIG. **2**M.

[0048] In one embodiment of the invention, the graphic design is repeated in 230-cm×205-cm rectangular virtual tiles that visually blend seamlessly with identical neighbor tiles top-bottom and left-right sides. The graphic design includes two main elements throughout, a mesh-texture using fine grid shadowing and a color of woodland color splotches and blobs that mimic natural, unoccupied woodland settings and scenery.

[0049] A further refinement visually adds a distorted-grid mesh-texture to the concealment camouflage, and even faint "watermarks" of commercial trademarks plain to see or encrypted signatures and messages hidden in plain sight.

[0050] As a consequence of method **200**, and for one forest concealment embodiment only, all the colors used cluster around shades of gray, green, brown, and drab green, olive drab, and army green, no two blobs seem to have exactly the same Cyan-Magenta-Yellow-Black (CMYK) color values. And so it could be said thousands of color shades are being used. And, because of the random noise generated rasters, no two blobs seem to have the same exact shapes, as all appear unique.

[0051] There are, however, general consistencies in blob sizes, about a dozen blob size groups. The mesh-texturing occurs parallel wave lines and each virtual intersecting thread occurs at regular period longitudinal and lateral positions represented by consistently sized blobs that are a few shades darker-than-average than the larger blobs that they overlay.

[0052] FIGS. **2**N and **2**P are four-times and twenty-six times magnifications of small portions of the distorted-grid mesh-textured concealment four-color camouflage pattern **260** in FIG. **2**M. These show how the regular placement of consistently sized, but darker-than-average, blobs and splotches of color give the appearance of mesh-textured at stand-off distances.

[0053] Method **200** is one way of making a concealment substrate embodiment of the present invention. A first step generates a monochrome raster (**201**-**204**) of random noise for each of four colors (**232**, **235**, **238**, and **241**) in a camouflage color palette. A next step rotates and equally tiles each of the four random-noise monochrome rasters as four individual tiles (**211**-**214**). A further step adds to each of the four random-noise monochrome rasters (**211**-**214**) a corresponding two-tone contrast level (**221**-**224**) to the four individual tiles. A next step adds to each of the four random-noise monochrome rasters a corresponding green, grey, tan, and brown color according to its respective two-tone contrast level. A next step mixes together a pair of color pattern groups (**250**, **252**) of the above according to a monochrome mixing map (**251**) to obtain a unique camouflage pattern (**253**). A further step prints a substrate (**201**, **302**) with whole and partial tiles (**304**, **306**) of the unique camouflage pattern repeated as necessary to join seamlessly along each edge (**308**) with a neighboring tile.

[0054] In one embodiment, an optional step adds to the unique camouflage pattern (**253**) a visual mesh-textured raster (**254**), followed by printing of the combination (**260**). Other embodiments comprise graphics depicting the visual mesh-texture.

[0055] A first plurality of overlapping and unsystematically positioned blobs, splotches, drops, spots, globules, and blotches are such that each constituent comprises a unique proportioned combination within any one rectangular shaped tile area of, e.g., cyan-magenta-yellow-black (CMYK) color pigments in a limited range of cyan, a limited range of magenta, a limited range of yellow, and a limited range of black. Others can use RGB or Pantone instead of CMYK. These overlapping and unsystematically positioned blobs, splotches, drops, spots, globules, and blotches are such that each constituent comprises a unique shape within any one rectangular shaped tile area, and each constituent has an area size in the range of 2% to 20% of the area size of any one whole rectangular shaped tile area.

[0056] FIG. **3** represents a woodlands concealment product **300** with a base substrate **301** printed on one side with a whole single tile of the repeatable concealment pattern **202** produced by the Method of FIG. **2**A, e.g., the pattern of FIG. **2**M. Commercial materials that can be used for the base substrate **301** include paper, vinyl, tarps, spread cloths, foils, and stickers.

[0057] The foregoing example is not intended to be limiting nor exclude desert, artic, and other color pallets.

[0058] FIG. **4** represents a woodlands concealment emergency blanket **400** of a flexible blanket-sized Mylar substrate **302** printed on one side with two whole single tiles **404** and **406** of the repeatable concealment pattern **260** (FIG. **2**M) seamlessly joined together along the dashed line **408**. Of course however many whole or partial tiles can be seamlessly assembled as tiles to suit whatever product size is commercially necessary. A typical tile will be 230-cm by 205-cm. A typical heat-reflective emergency survival blanket will be 52" by 84" (232-cm by 214-cm).

[0059] A similar flexible blanket-sized Mylar substrate **302** was developed by NASA in 1964 for the US space program. That material was a thin sheet of polyethylene terephthalate (PET) plastic, and deposition coated with a metallized reflector, usually gold or silver in color, and that reflects up to 97% of radiated heat.

[0060] For use in space, polyimide substrate, e.g., KAPTON, UPILEX®, is preferred due to its resistance to the hostile space environment, large temperature range (cryogenic to −260° C. and for short excursions up to over 480° C.), low outgassing (making it suitable for vacuum use) and resistance to ultraviolet radiation. Aluminized kapton, with foil thickness of 50 and 225 μm, was used on the Apollo Lunar Module. The polyimide gives the foils their distinctive amber-gold color. Space blankets are made by vaporizing pure aluminum and vacuum depositing micron thick films onto very thin, durable plastic substrates.

[0061] FIG. **5** is a perspective view diagram of a roll of waterproof-adhesive backed duct tape **500** printed on an outer side **502** with partial tiles of the repeatable concealment pattern **260** (FIG. **2**M). Such tiles are seamlessly joined heel-to-toe along its longitudinal run. The inner side **504** has a waterproof adhesive and the tape material itself is a fabric. For example, a polyethylene-coated textile fabric cut into linear strips and coiled onto rolls **506**. The tape **500** can be used to join together blankets **300** without disrupting the camouflage benefits.

[0062] The "printing" of pattern **260** (FIG. **2**M) onto a base substrate includes conventional ink stamping, ink rolling, ink jet, silk screening, digital printing, laser xerography printing, spray painting, and other color pigment transfer and dye technologies.

[0063] The unique camouflage pattern **260** (FIG. **2**M) can have at multiple variants, e.g., what we will trademark as HUNTER'S SHROWD, and WOODLAND SHROWD, which is the same design but uses a greener color pallet for the woodland shroud variant. Such designs are mostly aesthetic, as its usefulness has not been proven in the field yet. Since this particular pattern has never been seen before, it is still aesthetically pleasing, and it creates a value in the eyes of buyers. One objective of the present invention is to create patterns that never have been seen before. These here can't be recreated because the baseline monochrome random noise element produces a different result each time it's executed in the method **200**. An adversary's knowing what to look for when searching for a camouflaged individual befuddles easy discovery.

[0064] Duct tape **500** is similarly improved by unique camouflage pattern **260** (FIG. **2**M). The many useful properties and functions of standard silver-colored duct tape are maintained, while not creating obvious unnatural reflective delineations on the material it is used on. In addition, duct tape **400** can be used to cover monotone color painted equipment such as weapons and battle helmets in situations where better concealment is preferred.

[0065] The top half of FIG. **1** represents a factory portion of a pseudo-random camouflage system **100** that can produce a pseudo-random camouflage on a substrate. Such pseudo-random camouflage appears on a visible surface as a pseudo-randomly generated and positioned mixed-collection of blobs, splotches, drops, spots, globules, and blotches.

[0066] The bottom half of FIG. **1** represents a field deployable portion of pseudo-random camouflage system **100** that can, at practical distances, optically resolve and read encrypted messages visually appearing on the surface of a substrate with pseudo-random camouflage in an image captured in any orientation.

[0067] FIG. **6** represents a cartoon **600** of what a user would see on an LCD monitor screen when camera **130** is imaging a video raster of a natural jungle terrain from a kilometer away. At least one of our concealment substrates **102** is captured inside this field-of-view and each occupies, for example, ten percent of the raster area. Camera **130** would see these portions patched with PRN-camo image **104**, and not see what is being concealed. Before any authorized message decoding, the concealment of the camouflage is as effective, as any conventional camouflage for this environment would ordinarily be. The object is our "friendlies" can be revealed to us but not to them because we hold the key, PRN **116**. We can then take steps to assist, and not harm the friendlies, and they can remain passive and quiet because we don't need them to tell us anything.

[0068] In essence, it's a form of Steganography. See, *Hiding Images in Plain Sight: Deep Steganography*, by Shumeet Baluja Google Research Google, Inc. shumeet@google.com. Steganography is the practice of concealing a secret message within another, ordinary, message. Commonly, steganography is used to unobtrusively hide a small message within the noisy regions of a larger image. We are putting a concealment substrate **102** with pseudo-random noise in a natural field-of-view that a camera **130** will image as only a small part **104**. Shumeet Baluja created deep neural networks that were simultaneously trained to create hiding and revealing processes and were designed to specifically work as a team. The system was trained on images drawn randomly from an ImageNet database, and worked well on natural images from a wide variety of sources. Beyond demonstrating the successful application of deep learning to hiding images, he examines how the result was achieved and explores extensions. Popular steganographic methods encode the secret message within the least significant bits of a carrier image, his approach compresses and distributes the secret image's representation across all of the available bits.

[0069] But COMPANY-B has concealed themselves under a concealment substrate **102** that was generated with PRN **116**. A message, "COMPANY-B" was modulated into the camouflage printing. Camera **130** is not naturally squared with the message in the field, in fact, the relative orientations are never known to begin with. So all orientations 0°-360° must be expected as possible and every one tried. Best if all tries are accomplished in parallel. But one at a time is practical and could be attempted by mechanically rotating camera **130**. In FIG. **1** we chose to electronically resolve the orientations to 15° sets of twenty-four. CDMA demodulators

140A-**140**D represented all of these. More than twenty-four may be needed, at this point the correct number is unknown due to a lack of test data.

[0070] In FIG. **6** we assume a practical distance of about a kilometer, but better can be obtained with advanced optics fitted to camera **130**. The degree of zoom or magnification employed in each instant will determine the clock rates needed in the decoding shift registers to yield message outputs.

[0071] FIG. **7** represents the twenty-four 15° orientations, 0°-360°, that COMPANY-B could appear as in the field-of-view of camera **130**. If COMPANY-B is present, one of the decoding shift registers will produce a message output, "COMPANY-B". How it was oriented would be useful to mimic in the user display screen cartoon **600**. A landing zone (LZ) might also have been concealed by and near COMPANY-B.

[0072] Although the present invention has been described in terms of the presently preferred embodiments, it is to be understood that the disclosure is not to be interpreted as limiting. Various alterations and modifications no doubt become apparent to those skilled in the art after having read the above disclosure. Accordingly, it is intended that the appended claims be interpreted as covering all alterations and modifications as fall within the "true" spirit and scope of the invention.

1. A pseudo-random steganographic camouflage, comprising:

a base substrate;

a rectangular shaped tile area disposed in a tiled arrangement on the outer side of the base substrate, and each such rectangular shaped tile area having a pair of parallel top and bottom edges and a pair of parallel left and right edges; and

a first plurality of overlapping and pseudo-randomly generated and positioned mixed collection of blobs, splotches, drops, spots, globules, and blotches each comprising color pigments restricted to a theme, and each and all disposed on the outer side of the base substrate;

a message encoded and encrypted and affecting a pseudo-random generated and positioned collection of blobs, splotches, drops, spots, globules, and blotches such that the message is demodulateable, decryptable, decodable, and readable by an authorized digital imaging camera supplied with a pseudo-random number code used originally in the pseudo-random generation and positioning of the blobs, splotches, drops, spots, globules, and blotches;

wherein, the first plurality are identically repeated in the rectangular shaped tile area, and seamlessly blend each of their overlapping and unsystematically positioned blobs, splotches, drops, spots, globules, and blotches across borders of the top and bottom and left and right edges of any conjoining rectangular shaped tile area.

2. The pseudo-random steganographic camouflage of claim **1**, further comprising:

a second plurality of distorted-grid-grid positioned and consistently smaller sized blobs, splotches, drops, spots, globules, and blotches each comprising contrastingly darker-than-average color pigments restricted to muted flat earth tones of shades of gray, drab green, brown, and tans that together overlay a few larger areas of the first plurality and that faintly emulate a visual appearance of a fabric wave on which the first plurality is disposed on the outer side of the base substrate.

3. The pseudo-random steganographic camouflage of claim **1**, further comprising:

a pressure sensitive adhesive that covers the inner side of the base substrate opposite to the outer side on which the first plurality is disposed;

wherein, the base substrate includes a polyethylene-coated textile fabric cut into linear strips and coiled into rolls of tape.

4. The pseudo-random steganographic camouflage of claim **1**, wherein, the base substrate comprises Mylar plastic sheeting cut into blankets or tarps.

5. The pseudo-random steganographic camouflage of claim **1**, wherein the first plurality of overlapping and unsystematically positioned blobs, splotches, drops, spots, globules, and blotches are such that each constituent comprises a unique proportioned combination within any one rectangular shaped tile area of color pigments.

6. The pseudo-random steganographic camouflage of claim **1**, wherein the first plurality of overlapping and unsystematically positioned blobs, splotches, drops, spots, globules, and blotches are such that each constituent comprises a unique shape within any one rectangular shaped tile area.

7. The pseudo-random steganographic camouflage of claim **1**, wherein the first plurality of overlapping and unsystematically positioned blobs, splotches, drops, spots, globules, and blotches are such that each constituent has an area size in the range of 2% to 20% of the area size of any one rectangular shaped tile area.

8-13. (canceled)

14. A camouflage sheet, comprising:

a means for encoding a message on a sheet encoded and encrypted as a pseudo-random generated, positioned, and deposited as a variety of color pigments in a collection of blobs, splotches, drops, spots, globules, and blotches;

wherein, the message is demodulateable, decryptable, decodable, and readable by a digital imaging camera supplied with an authorizing pseudo-random number code;

wherein, the authorizing pseudo-random number code is used originally in the pseudo-random generation and positioning of the blobs, splotches, drops, spots, globules, and blotches.

15. The camouflage of claim **14**, wherein:

the variety of color pigments suit a particular camouflage scheme and function to visually obscure anything hidden behind the sheet.

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