



- (51) **International Patent Classification:**  
*H01F 41/16* (2006.01) *H01F 1/00* (2006.01)
- (21) **International Application Number:**  
PCT/US2015/019637
- (22) **International Filing Date:**  
10 March 2015 (10.03.2015)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
61/971,666 28 March 2014 (28.03.2014) US
- (71) **Applicant:** THINK SCIENTIFIC INNOVATIONS  
[US/US]; 5532 Douglas Rd., Toledo, Ohio 43613 (US).
- (72) **Inventors:** BOUDOURIS, Randall; 7348 Grenlock,  
Sylvania, Ohio 43560 (US). ALBRECHT, Donald E.;  
1769 North Lexington Ave., #311, Roseville, Minnesota  
55113 (US).
- (74) **Agent:** LINDQUIST, Lisa R.; Vidas, Arrett & Steinkraus,  
9531 West 78th Street, Suite 400, Eden Prairie, Minnesota  
55344 (US).

(81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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

**Published:**

— with international search report (Art. 21(3))

(54) **Title:** ROTARY PROCESS FOR APPLICATION OF MAGNETIC COMPOSITIONS

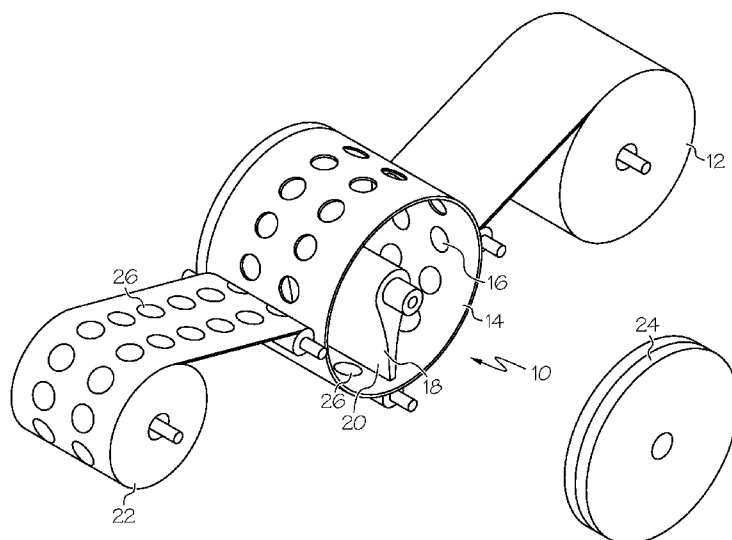


FIG. 1

(57) **Abstract:** A method of making a magnet, the method comprising providing a magnetizable composition comprising a thermoplastic polymer material and magnetizable particles, heating the magnetic composition to a temperature at which the magnetic composition is in a flowable state, providing the magnetic composition to a cavity of a rotating cylinder through a stationary flat nozzle, the rotating cylinder comprising a plurality of openings therethrough, providing a substrate in the form of a moving web or sheet and contacting the rotating cylinder with the substrate, wherein the flat nozzle forces the magnetic composition through the openings in the rotating cylinder and the magnetic composition adheres to the substrate.

## **ROTARY PROCESS FOR APPLICATION OF MAGNETIC COMPOSITIONS**

### **CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] The present application claims the benefit of U.S. Provisional Application 61/971,666, filed March 28, 2014.

### **BACKGROUND OF THE INVENTION**

[0002] The present invention relates to compositions and methods of making magnets that will self-adhere to a magnetically attracted surface.

[0003] Flexible permanent magnetic materials are often supplied in the form of sheets or rolls and have been commercially available for many years. These materials are typically prepared by mixing a powdered ferrite material with a suitable polymeric or plastic binder into a uniform mixture. The polymeric materials are often elastomers, and the process is therefore typically accomplished through the use of sheet extrusion or calendering. The mixture is converted into strip or sheet form, providing a permanent stable product that is usually somewhat flexible, and that can readily be handled and made into elements of any desired shape by cutting and/or stamping.

[0004] The magnets may take on any geometric shape including round, square, rectangular, triangular, etc., as well as any animal shape such as dog, cat, frog, camel, horse, etc., articles of manufacture such as tools, cars, snowmobiles, etc. Using the present method, the shape of the resultant magnet that may be selected is infinite.

[0005] The magnetic material is permanently magnetized so that the resulting elements can act individually as permanent magnets, the magnetic field being of sufficient strength that they will

adhere to a magnetically attracted surface, such as the surface of an iron or steel sheet, even through a sheet of paper or thin cardboard. Many magnetic materials and the resultant sheet materials are typically inherently dark in color and it is therefore usual to attach these magnets to a printable substrate such as paper or plastic by gluing.

[0006] These magnetic pieces may then be placed on a magnetically attracted surface such as a refrigerator, file cabinet, or other surface where they may be used as reminders and are often used to hold sheets of paper such as notes, recipes, lists, children's artwork, reminders, and so on.

[0007] In the usual manufacture of these items, multiple producers are involved in the process. For example, a printer produces the printed matter on wide web presses or individual sheets. If in web form, the web is cut into individual sheets and then shipped to a magnet manufacturer where the magnetic material and the printed matter are joined through the use of an adhesive layer.

Alternatively, the printer may purchase or otherwise obtain magnets and then join the printed matter to the magnets through the use of an adhesive layer, or may have both pieces shipped to a third party where the pieces may be joined through the use of an adhesive layer.

[0008] US Patent Nos. 7,128,798 and US 7,338,573 disclose methods of directly and continuously applying a magnetizable composition to a substrate.

[0009] There remains a need in the art for improved methods of making magnets.

## SUMMARY OF THE INVENTION

[0010] In one aspect, the present invention relates to a method of making a magnet comprising an indirect rotary printing or coating method.

[0011] In one embodiment, the present invention relates to a method of making a magnet comprising the method comprising providing a magnetic composition comprising a

thermoplastic polymer material and magnetizable particles, heating the magnetic composition to a temperature at which the magnetic composition is in a flowable state, providing said magnetic composition to a rotating cylinder through a stationary flat nozzle, the rotating cylinder comprising a series of openings therein, providing a substrate in the form of a moving web or sheet and contacting the rotating cylinder with the substrate, wherein the flat nozzle forces the magnetic composition through the openings in the rotating cylinder and the magnetic composition adheres to the substrate.

[0012] In another aspect, the present invention relates to A method of making an article comprising a magnetically receptive material comprising providing a composition comprising a thermoplastic polymer material and magnetite, heating the composition to a temperature at which the magnetic composition is in a flowable state, providing the composition to a cavity of a rotating cylinder through a stationary flat nozzle, the cavity of the rotating cylinder is defined by the cylinder wall, the cylinder wall of the rotating cylinder comprising a plurality of openings therethrough, providing a substrate in the form of a moving web or sheet and contacting the rotating cylinder with the substrate, wherein the flat nozzle forces the composition through the plurality of openings in the rotating cylinder and the composition adheres to the substrate in the shape of each of the plurality of openings.

[0013] In another aspect, the present invention relates to a method of making a magnet, the method comprising providing a magnetizable composition comprising at least one thermoset polymer material and magnetizable particles, providing the magnetic composition to a cavity of a rotating cylinder through a stationary flat nozzle, the cavity of the rotating cylinder is defined by the cylinder wall, the cylinder wall of the rotating cylinder comprising a plurality of openings therethrough, providing a substrate in the form of a moving web or sheet, contacting the rotating

cylinder with the substrate and facilitating curing of the thermoset polymer material , wherein the flat nozzle forces the magnetic composition through the plurality of openings in the rotating cylinder and the magnetic composition adheres to the substrate in the shape of each of the plurality of openings, prior to facilitating curing of the thermoset material.

[0014] The thermoset polymer composition and method may also be employed with magnetic receptive materials.

[0015] These and other aspects, embodiments and advantages of the present disclosure will become immediately apparent to those of ordinary skill in the art upon review of the Detailed Description and Claims to follow.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 illustrates an embodiment of a rotary cylinder that can be employed for forming individual magnets on a moving substrate according to the invention.

[0017] FIG. 2 is a perspective view of one embodiment of a package having a magnetic closure formed according to the process disclosed herein.

[0018] FIG. 3 is a perspective view of another embodiment of a package having a magnetic closure formed according to the process disclosed herein.

[0019] FIG. 4 is a perspective view of another embodiment of a package having a magnetic closure formed according to the process disclosed herein.

#### DETAILED DESCRIPTION OF THE INVENTION

[0020] While embodiments of the present disclosure may take many forms, there are described in detail herein specific embodiments of the present disclosure. This description is an

exemplification of the principles of the present disclosure and is not intended to limit the disclosure to the particular embodiments illustrated.

[0021] The present invention relates to a method of making a magnetic article using an indirect method of printing or coating a magnetizable composition using a rotary cylinder comprising holes therethrough for applying the magnetizable composition to a substrate in any shape desired or form.

[0022] The present method eliminates the need for cutting the magnetizable material into the desired shape and size. Magnetizable materials that can be subjected to a magnetic field and permanently magnetized have high loadings of magnetic particulates which causes rapid wear of cutting blades.

[0023] Suitably, the resultant magnet has a strength of at least about 100 g/inch when using an Imada DPS-1 force gauge and pulling the magnet from a 4 x 4" steel plate, and more suitably at least about 200 g/inch.

[0024] Turning now to the figures, FIG. 1 illustrates one embodiment of a rotary printing cylinder 14 used in a roll-to-roll or web coating line for indirect printing or coating of a magnetizable composition onto a moving substrate.

[0025] A web of substrate 12 is fed from a supply roll 12 to a roll 22 opposite of the coating station. Coating station 10 includes a rotary printing cylinder 14, having a plurality of holes 16 which extend through the cylinder wall. Magnetizable composition is fed through a flat nozzle 18 that includes a doctor blade or slot die 20 which scrapes the inner surface of the cylinder forcing magnetizable composition into the holes 16. The magnetizable composition contacts the moving substrate 12 and remains on the substrate 12 as it loses contact with rotating cylinder 14 at point 28, and a plurality of individual magnetizable articles 26 are formed thereon. Cover 24 can be placed on the rotary cylinder 14 to retain the magnetic composition therein.

[0026] The magnetizable composition suitably includes about 70 wt-% or more of the magnetic material as to have a sufficient attractive force for practical uses. However, it is usually impractical to employ more than 95 wt-% of the magnetic material because of production concerns, and also because of the difficulty of retaining more than this in the binder material. Furthermore, including more than about 95 wt-% of the magnetic material may lead to a rougher surface. The magnetic material is often supplied in a powder form.

[0027] Suitably, the magnetizable composition comprises about 70 wt-% to about 95 wt-% of the magnetizable particles and about 5 wt-% to about 30 wt-% of at least one polymer material.

[0028] In some embodiments, the magnetic composition comprises about 80 wt-% to about 90 wt-% of the magnetizable particles and about 10 wt-% to about 20 wt-% of at least one polymer material.

[0029] The magnetic strength of the finished product is a function of the amount of magnetic material or powder in the mix, the surface area, thickness, and method of magnetization (e.g. whether it is aligned or not).

[0030] Any magnetic material may be employed herein. Magnetic materials which are particularly suitable for use herein include the ferrites having the general formula  $(M^{2+}O_6Fe_2O_3)MFe_{12}O_{19}$  where M represents Ba or Sr.

[0031] Other examples of magnetic materials suitable for use herein include a rare earth-cobalt magnet of  $RCO_5$  where R is one or more of the rare earth elements such as Sm or Pr, yttrium (Y), lanthanum (La), cerium (Ce), and so forth.

[0032] Other specific examples of magnetic materials include, for instance, manganese-bismuth, manganese-aluminum, and so forth.

[0033] The method of the present invention is not limited to any particular magnetic material, and the scope of the invention is therefore not intended to be limited as such. While the above described materials find particular utility in the process of the present invention, other materials which are readily permanently magnetized may also find utility herein.

[0034] In some embodiments, the method employs a composition comprising a thermoplastic polymer and a magnetically receptive material. Suitable magnetically receptive materials include magnetite, which is one example of naturally occurring iron oxides having the chemical formula  $\text{Fe}_3\text{O}_4$ . Articles made from these compositions can be employed to adhere magnetic articles thereto.

[0035] The thermoplastic material, often referred to in the industry as a thermoplastic binder, suitable for use in the process of the present invention may include any polymeric material that is readily processable with the magnetic material on, for instance, the thermoplastic or hot melt processing equipment as described in detail below. Such thermoplastic materials include both thermoplastic elastomers and non-elastomers or any mixture thereof.

[0036] The thermoplastic composition may be selected based on, for one, the type of printable substrate which is being used, and the adhesion obtained between the thermoplastic composition and the printable substrate.

[0037] Examples of thermoplastic elastomers suitable for use herein include, but are not limited to, natural and synthetic rubbers and rubbery block copolymers, such as butyl rubber, neoprene, ethylene-propylene copolymers (EPM), ethylene-propylene-diene polymers (EPDM), polyisobutylene, polybutadiene, polyisoprene, styrene-butadiene (SBR), styrene-butadiene-styrene (SBS), styrene-ethylene-butylene-styrene (SEBS), styrene-isoprene-styrene (SIS), styrene-isoprene (SI), styrene-ethylene/propylene (SEP), polyester elastomers, polyurethane



elastomers, to mention only a few, and so forth and mixtures thereof. Where appropriate, included within the scope of this invention are any copolymers of the above described materials.

[0038] Examples of suitable commercially available thermoplastic elastomers such as SBS, SEBS, or SIS copolymers include KRATON<sup>®</sup> G (SEBS or SEP) and KRATON<sup>®</sup> D (SIS or SBS) block copolymers available from Kraton Polymers; VECTOR<sup>®</sup> (SIS or SBS) block copolymers available from Dexco Chemical Co.; and FINAPRENE<sup>®</sup> (SIS or SBS) block copolymers available from Atofina.

[0039] Some examples of non-elastomeric polymers include, but are not limited to, polyolefins including polyethylene, polypropylene, polybutylene and copolymers and terpolymers thereof such as ethylene vinyl acetate copolymers (EVA), ethylene n-butyl acrylates (EnBA), ethylene methyl (meth) acrylates including ethylene methyl acrylates (EMA), ethylene ethyl (meth) acrylates including ethylene ethyl acrylates (EEA), interpolymers of ethylene with at least one C<sub>3</sub> to C<sub>20</sub> alphaolefin, polyamides, polyesters, polyurethanes, to mention only a few, and so forth, and mixtures thereof. Where appropriate, copolymers of the above described materials also find utility herein.

[0040] Examples of polymers useful herein may be found in US 6262174 incorporated by reference herein in its entirety. Polymeric compositions exhibiting high hot tack have been found to be particularly suitable for use herein. Hot tack is a term of art known to those of ordinary skill.

[0041] Examples of commercially available non-elastomeric polymers include EnBA copolymers available from such companies as Atofina under the tradename of Lotryl<sup>®</sup> available from Arkema in the King of Prussia, PA, from ExxonMobil Chemical in Houston, TX under the tradename of Escorene<sup>™</sup>, from DuPont de Nemours & Co. in Wilmington, DE under the

tradename of Elvaloy®; EMA copolymers available from ExxonMobil Chemical under the tradename of Optema™; EVA copolymers are available from DuPont™ under the tradename of Elvax® and from Lyondell Blassell in Houston, TX under the tradename of Ultrathene® to name only a few.

[0042] Polyolefins or polyalphaolefins can be employed herein, or copolymers or terpolymers thereof. Examples of useful polyolefins include, but are not limited to, amorphous (i.e. atactic) polyalphaolefins (APAO) including amorphous propylene homopolymers, propylene/ethylene copolymers, propylene/butylene copolymers and propylene/ethylene/butylene terpolymers; isotactic polyalphaolefins; and linear or substantially linear interpolymers of ethylene and at least one alpha-olefin including, for instance, ethylene and 1-octene, ethylene and 1-butene, ethylene and 1-hexene, ethylene and 1-pentene, ethylene and 1-heptene, and ethylene and 4-methyl-1-pentene and so forth. In some embodiments, it may be preferable to employ a small amount of another polymer in combination with the polyalphaolefin such as maleic anhydride grafted polymers which have been used to improve wetting and adhesion. Other chemical grafting can be used, but maleic anhydride is by far the most common. Usually only a few percent in grafting (1-5%) are used and most tend to be ethylene or propylene copolymers.

[0043] Thermoset polymer materials may also be employed which are cured in a variety of manners such as moisture cure, radiation cure, two-part chemical reactions, heat, and so forth to form substantially insoluble or infusible materials. Such materials are well known in the art.

[0044] Thermoset polymers crosslink and/or polymerize by energy or by chemical means and by a wide variety of mechanisms including, but not limited to, moisture cure, thermal and radiation cure, condensation, free radical systems, oxidative cures, etc. as well as combinations thereof.

[0045] Some examples of suitable thermoset materials include, but are not limited to,

polyurethanes, polyureas, polyurethane/polyurea hybrids, epoxies, acrylics, polyesters, (meth)acrylates, cyanoacrylates, silicones (polysiloxanes), polyolefins and copolymers thereof such as ethylene vinyl acetate copolymers, rubbers including rubbery block copolymers, etc.

[0046] Each of class of thermoset material may come in a variety of different systems, including, for example, one and two part systems, and radiation curing systems such as radiation (e.g. UV) curing systems, moisture cure, etc.

[0047] In some preferred embodiments, the magnetic composition includes a multicomponent epoxy or urethane thermoset composition.

[0048] The thermoset polymer compositions may also be employed in combination with magnetic receptive particle materials.

[0049] In some embodiments, the thermoset polymer composition is cured using electron beam (e-beam) radiation. Crosslinking of polymer based products via e-beam radiation improves mechanical, thermal and chemical properties. Specifically, thermal resistance to temperature degradation and aging and low temperature impact resistance are improved.

[0050] Tensile strength, modulus, abrasion resistance, resistance to creep, stress crack resistance, resistance to high pressure, and so forth are increased.

[0051] Polymers which are commonly crosslinked using the electron beam irradiation process include polyvinyl chloride (PVC), thermoplastic polyurethanes and elastomers (TPUs), polybutylene terephthalate (PBT), polyamides/nylon (PA66, PA6, PA11, PA12), polyvinylidene fluoride (PVDF), (meth)acrylates, polymethylpentene (PMP), polyethylenes (LLDPE, LDPE, MDPE, HDPE, UHMWPE), and ethylene copolymers such as ethylene-vinyl acetate (EVA) and ethylene tetrafluoroethylene (ETFE). Some of the polymers utilize additives to make the polymer more readily irradiation crosslinkable.

[0052] The above thermoset materials may include monomers, dimers, oligomers and polymers, as well as combinations thereof as is known to those of ordinary skill in the art.

[0053] Other suitable additives can be employed in the magnetizable composition as well such as antioxidants and processing aids. One of ordinary skill in the art is knowledgeable as to hot melt additives.

[0054] The polymer material and the magnetizable particles can be added to and melted in mixer or an extruder, or can be supplied in the form of pre-made pellets.

[0055] The magnetizable composition is heated to a temperature at which it is molten or flowable using any suitable hot melt or thermoplastic equipment such as a heated mixer with counter rotating blades.

[0056] The mixture is then supplied to a melt pump or small extruder via any suitable means such as an auger.

[0057] The mixture is then pumped from the melt pump or extruder via a heated hose to the flat nozzle head 18 shown in FIG. 1 above.

[0058] The doctor blade 20 of the flat nozzle head 18 scrapes the magnetizable composition into the holes 16 of the rotating cylinder 14 and into contact with the moving substrate 12 wherein it preferentially adheres rather than to the rotating cylinder 14.

[0059] The cylinder may be formed of any suitable metal or metal alloy thereof including, but not limited to, stainless steel, titanium and alloys thereof, cobalt and alloys thereof, chromium and alloys thereof, and so forth.

[0060] The above list is intended for illustrative purposes only and not as a limitation on the scope of the present invention.

[0061] The metal or metal alloy can be reinforced with fibers or nanomaterials including, but not limited to, carbon or ceramic fibers or nanotubes or fullerene nanotubes. Many suitable materials can be employed for forming reinforcement fibers or nanofibers and these exemplary materials are not intended as a limitation on the scope of the present invention.

[0062] The compositions according to the invention can be applied to the moving substrate 12 at a high rate of line speed of from about 50 feet/minute to about 1000 feet/minute, suitable greater than about 80 feet/minute to about 500 feet/minute.

[0063] The present invention provides significant advantages over prior art methods including less waste, flexibility of design, elimination of wear and replacement of die cutting heads because there is no need to cut through the abrasive magnetizable composition, the ability to print to rolls or sheets, the ability to spot print any shape or form desired, and lower equipment costs due to the simplicity of design.

[0064] The present invention finds utility in making any magnetized substrate, particularly printed substrates.

[0065] The process according to the invention can be employed to make any printed substrate and finds particular utility for those substrates formed from paper, paper products or pasteboard. However, other materials can be employed as well including, but not limited to, plastic or polymeric materials, metal, release liners such as silicone release liner, textiles or fabrics, and so forth. Combinations of any of the substrates may also be employed.

[0066] In particular embodiments, the substrate is a layered or laminated substrate and includes paper, paper products or pasteboard and a foil wrap.

[0067] In some embodiments, the printed substrates are packages. The magnetically reclosable packages disclosed herein may find utility for any items, and particularly for reclosable packages

for consumable food items. In particular, the present invention finds utility for reclosable packages wherein it is desired that the contents not spill out of the package.

[0068] For example, magnetically reclosable packages for snack foods such as crackers and chips, breakfast foods such as cereal, tobacco products such as cigarette boxes, candy and chewing gum, and so forth.

[0069] FIG. 2 is a perspective view of one embodiment of a magnetically reclosable package 10 according to the invention, in this embodiment, package 10 has a basic box configuration with opposing sides 18 interconnected by opposing sides 16. Box 10 also has two opposing side flaps 26a, 26b which fold inward first to close box 10. Flap 20b is then be folded down at fold 22b. Flap 20b has a magnetic strip 12. Flap 20a has an opposing magnetic strip 14 which overlaps with magnetic strip 12 on flap 20b which when folded down at fold 22a magnetically secures the flaps 20a and 20b together.

[0070] FIG. 3 is an alternative embodiment of a box or carton 10 which can be formed of one or more foldable blanks. In this embodiment, box 10 includes a bottom portion having opposing sides 18 and opposing sides 16 and an inner foldable blank 20, is disposed within box 10. Inner blank 20 includes a magnetic strip 26. Box 10 includes a top portion 18 which opens and closes. On the inner surface of top 18 is a magnetic strip 24 which overlaps magnetic strip 26 when the top 18 is closed. Inner foldable blank 20 also includes a cut out portion 22 for more easily retrieving items when top 18 is open.

[0071] FIG. 4 is an alternative embodiment of a box or carton 10 which is formed of one or more foldable blanks. In this embodiment, one foldable blank is employed. Box 10 includes two opposing side portions 18 and a front portion 16 disposed therebetween. Back portion disposed between two opposing side portions is not seen in this view. Front portion 16 has a magnetic

portion 12 and a slit 30. Flap 20 has an upper portion 28 and is foldable at 22. Flap 20 also has a magnetic strip 14. When flap 20 is closed, magnetic strip 14 overlaps magnetic strip 12 and top portion 28 of flap 20 can be disposed within slit 30 of box 10, both the overlapping magnetic strips and the top portion 28 of flap 20 secure box 10 in a closed state.

[0072] The packages may be permanently sealed at all but one end wherein the package is opened and a reclosable seal is formed via the use of a magnetic region. The permanent seals may be formed using any conventional method known in the art including by folding or with an adhesive, for example.

[0073] Packages of this type are disclosed in US Patent Pub. No. 2014/0008425 and in WO 2014/096427, both of which are incorporated by reference herein in their entirety.

[0074] Other examples of printed material include, but are not limited to, promotional pieces, greeting cards, postcards, magnetic business cards, appointment reminder cards, announcements, advertisements, coupons, labels, calendars, picture frames, and so forth which have a magnetic surface joined to a printed surface which may be self-adhered or self-sticking to a metallic surface for display. Examples of this type of substrate can be found in commonly assigned US Patent Nos. 7,128,798 and 7,338,573, the entire content of which is incorporated by reference herein.

[0075] The thickness of the magnetic strips, whether one is employed or two as in the case of providing a seal for a package and such, is between about 100 microns and about 750 microns, suitably about 100 microns to about 600 microns and most suitably about 100 microns to about 400 microns.

[0076] The present method is advantageous because the substrate can be coated and printed in a single inline process.

[0077] Previous methods, in contrast, printed the coated substrates off-line which is less efficient and more costly.

[0078] One of ordinary skill in the art will recognize that these are only examples of numerous sizes and shapes of packages which can be employed herein without deterring from the scope of the present invention.

[0079] The description provided herein is not to be limited in scope by the specific embodiments described which are intended as single illustrations of individual aspects of certain embodiments. The methods, compositions and devices described herein can comprise any feature described herein either alone or in combination with any other feature(s) described herein. Indeed, various modifications, in addition to those shown and described herein, will become apparent to those skilled in the art from the foregoing description and accompanying drawings using no more than routine experimentation. Such modifications and equivalents are intended to fall within the scope of the appended claims.

[0080] All published documents, including all US patent documents and US patent publications, mentioned anywhere in this application are hereby expressly incorporated herein by reference in their entirety. Any copending patent applications, mentioned anywhere in this application are also hereby expressly incorporated herein by reference in their entirety. Citation or discussion of a reference herein shall not be construed as an admission that such is prior art.



## CLAIMS:

1. A method of making a magnet, the method comprising:
  - a) providing a magnetizable composition comprising at least one thermoset polymer material and magnetizable particles;
  - b) heating the magnetic composition to a temperature at which the magnetic composition is in a flowable state;
  - c) providing the magnetic composition to a cavity of a rotating cylinder through a stationary flat nozzle, the cavity of the rotating cylinder is defined by the cylinder wall, the cylinder wall of the rotating cylinder comprising a plurality of openings therethrough;
  - d) providing a substrate in the form of a moving web or sheet; and
  - e) contacting the rotating cylinder with the substrate;wherein the flat nozzle forces the magnetic composition through the plurality of openings in the rotating cylinder and the magnetic composition adheres to the substrate in the shape of each of the plurality of openings.
2. The method of claim 1 wherein the cylinder is defined by a wall thickness of about 100 microns to about 750 microns.
3. The method of claim 1 comprising heating the magnetic composition to a temperature of about 150° C to about 350° C.
4. The method of claim 1 wherein the magnetic composition comprises about 70% to about 95% magnetizable particles and about 5% to about 30% by weight polymer material.
5. The method of claim 1 wherein said polymer material comprises at least one member selected from the group consisting of homopolymers, copolymers and terpolymers of olefins, esters, ethers, urethanes, amides, and mixtures thereof.

6. The method of claim 5 wherein said polymer material comprises at least one homopolymer, copolymer or terpolymer of olefins.
7. The method of claim 6 wherein said polymer material comprises at least one copolymer of ethylene.
8. The method of claim 7 wherein said copolymer of ethylene comprises at least one member selected from the group consisting of vinyl acetate, n-butyl acrylate, methyl (meth)acrylate, ethyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, (meth)acrylate, (ethyl)acrylate, and acrylic acid.
9. The method of claim 1 comprising providing the magnetizable composition in pellet form.
10. The method of claim 1 comprising providing the magnetizable composition to a heated mixer comprising rotating blades.
11. The method of claim 10 further comprising the step of feeding the magnetizable composition to a melt pump or extruder with an auger.
12. The method of claim 11 further comprising pumping the magnetizable composition through a heated hose to the stationary flat nozzle in the cavity of the rotating cylinder.
13. The method of claim 1 wherein the openings are formed in any specified shape.
14. The method of claim 13 wherein the magnetizable composition adheres to the substrate in the specified shape.
15. The method of claim 1 comprising moving the substrate a rate of about 50 feet/minute to about 1000 feet/minute.
16. The method of claim 1 further comprising permanently magnetizing the magnetizable composition.

17. The method of claim 1 comprising neutralizing the magnetizable composition.

18. The method of claim 17 further comprising permanently magnetizing the magnetizable composition after neutralizing.

19. The method of claim 1 wherein the magnetic composition is adhered to the substrate as the substrate is no longer contacting the rotating cylinder.

20. The method of claim 1 further comprising smoothing the magnetizable composition, chilling the magnetizable composition or both.

21. A method of making an article comprising a magnetically receptive material, the method comprising:

a) providing a composition comprising a thermoplastic polymer material and magnetite;

b) heating the composition to a temperature at which the magnetic composition is in a flowable state;

c) providing the composition to a cavity of a rotating cylinder through a stationary flat nozzle, the cavity of the rotating cylinder is defined by the cylinder wall, the cylinder wall of the rotating cylinder comprising a plurality of openings therethrough;

d) providing a substrate in the form of a moving web or sheet; and

e) contacting the rotating cylinder with the substrate;

wherein the flat nozzle forces the composition through the plurality of openings in the rotating cylinder and the composition adheres to the substrate in the shape of each of the plurality of openings.

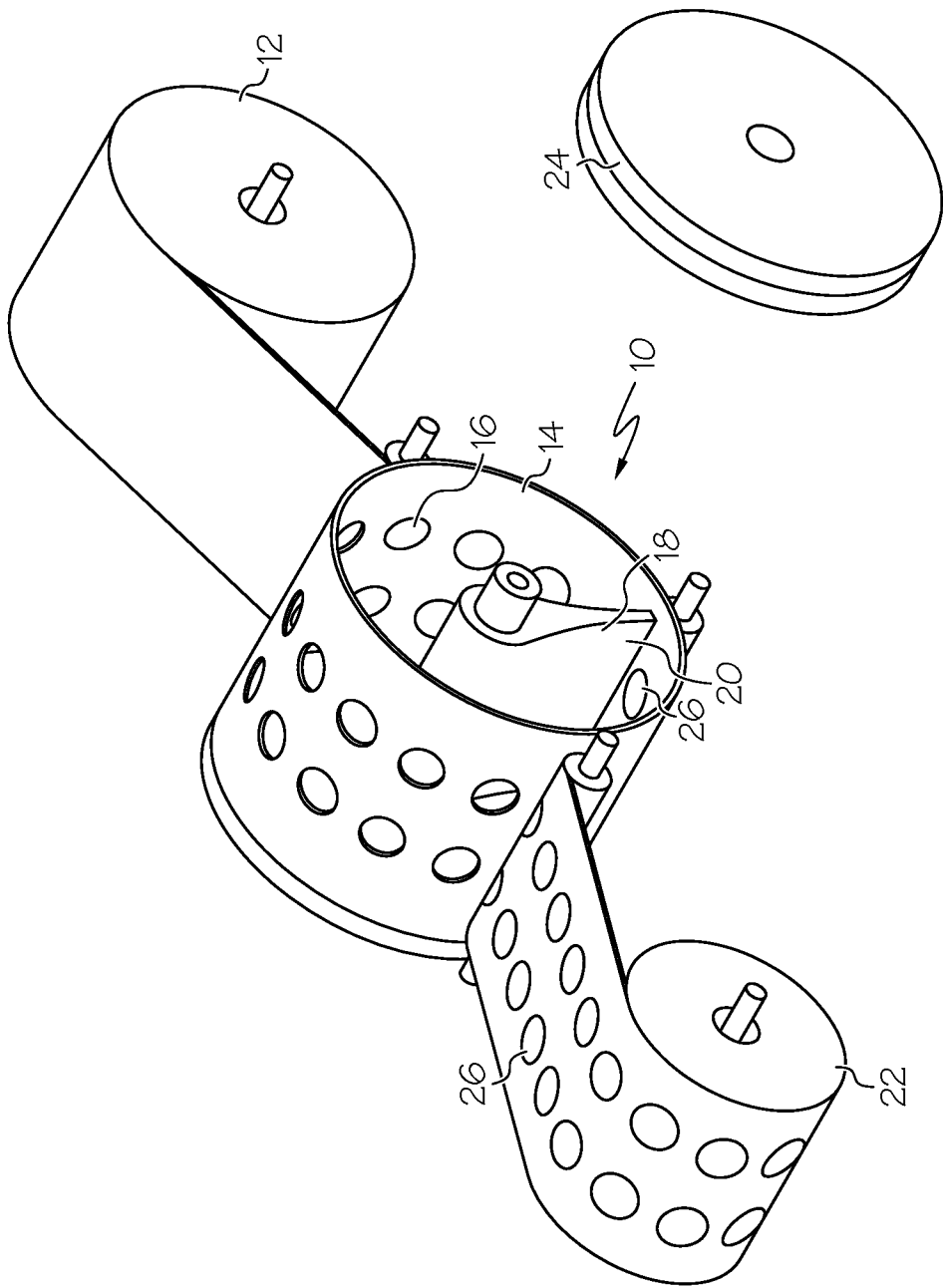


FIG. 1

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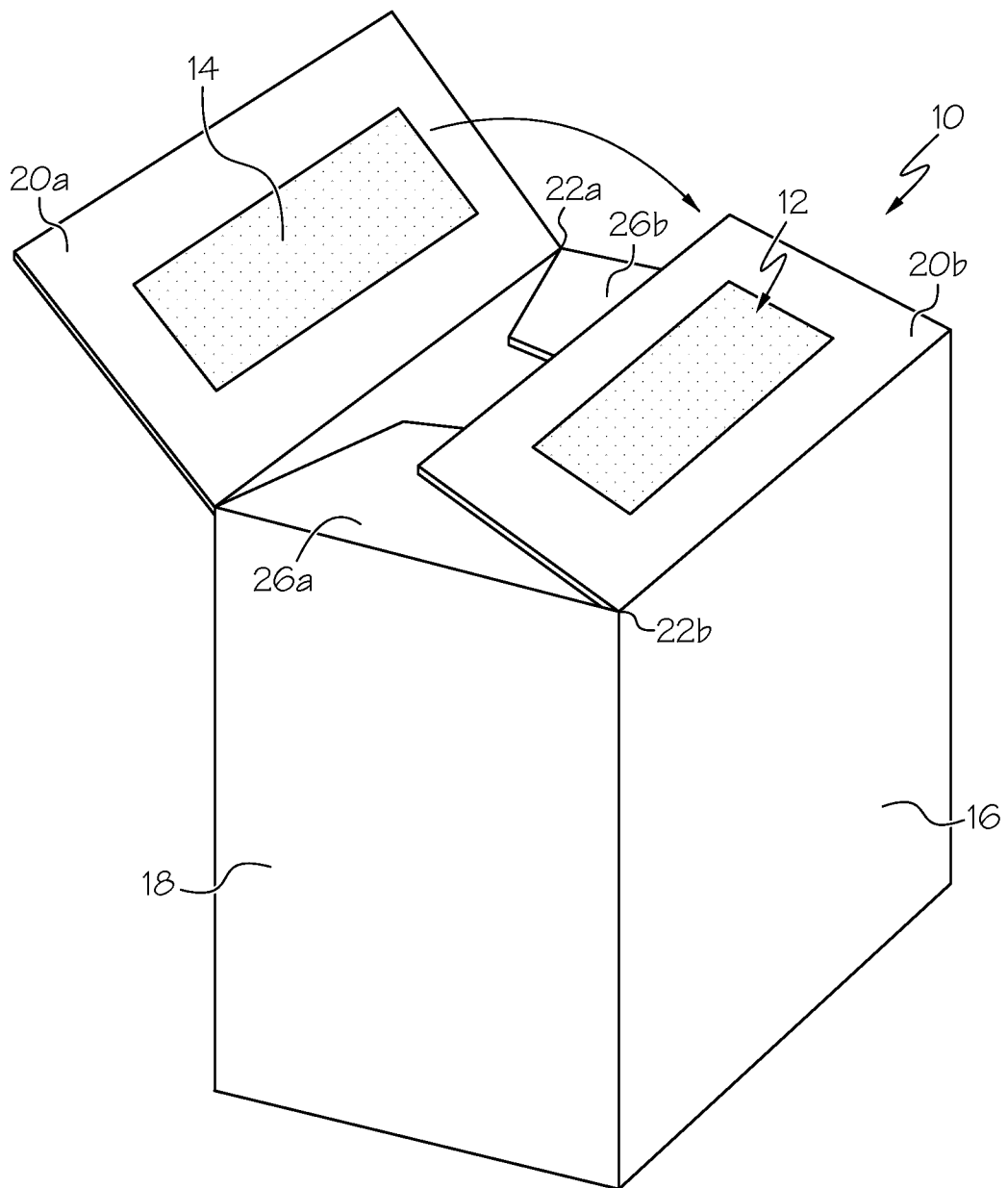


FIG. 2

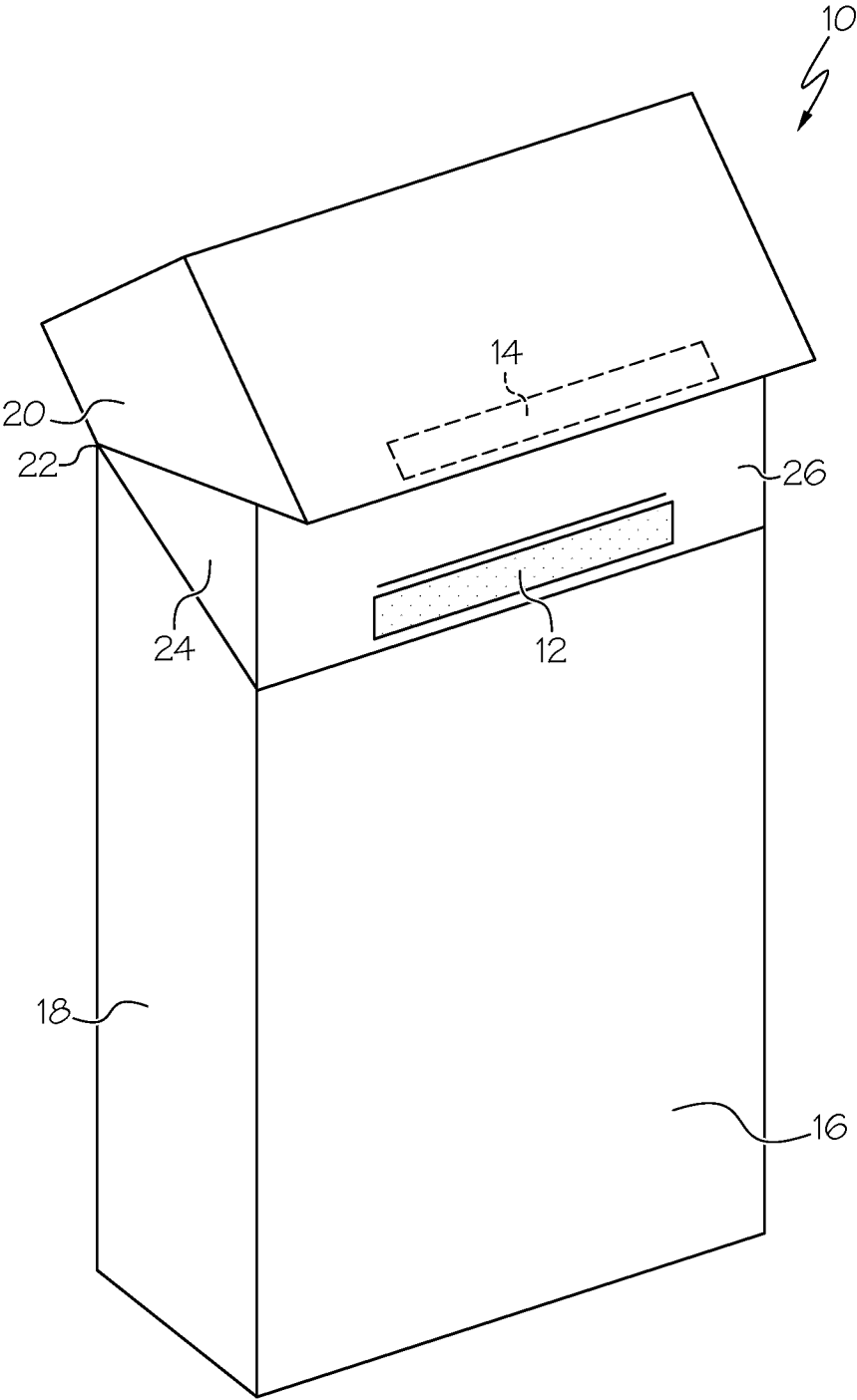


FIG. 3

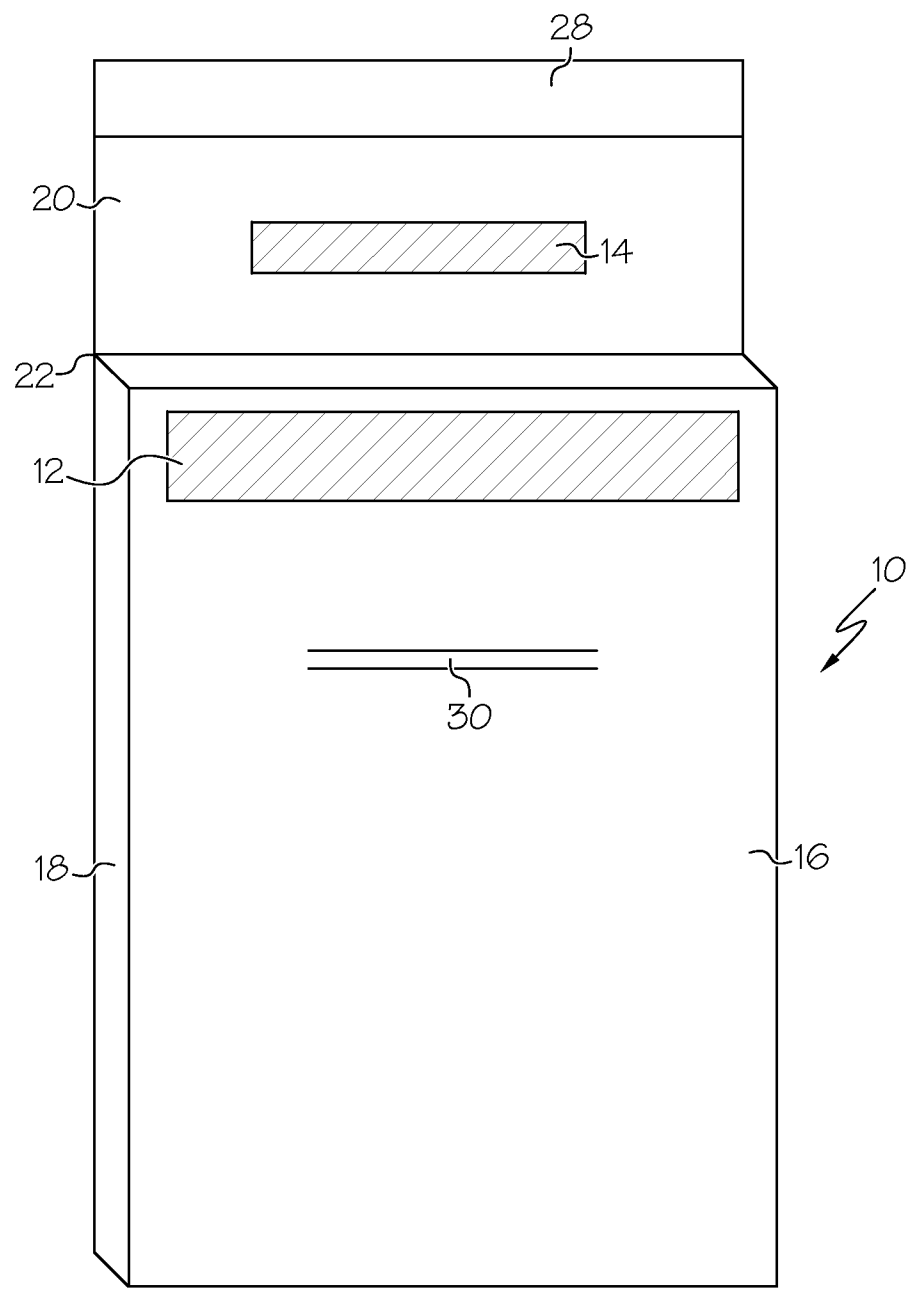


FIG. 4

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2015/019637

## A. CLASSIFICATION OF SUBJECT MATTER

INV. H01F41/16  
ADD. H01F1/00

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

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/103506 A1 (LOVE THOMAS G [US]) 3 May 2012 (2012-05-03) abstract paragraph [0040] - paragraph [0073]; figures 2-8	1-21
A	GB 1 444 858 A (KASEI CO C I) 4 August 1976 (1976-08-04) page 2, line 46 - page 3, line 56	1-21
A	US 5 869 148 A (SILVERSCHOTZ STANFORD B [US] ET AL) 9 February 1999 (1999-02-09) abstract column 3, line 14 - column 4, line 54; figure 5	1-21



Further documents are listed in the continuation of Box C.



See patent family annex.

## \* Special categories of cited documents :

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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

9 June 2015

Date of mailing of the international search report

09/07/2015

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040,  
Fax: (+31-70) 340-3016

Authorized officer

Warneck, Nicolas



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2015/019637

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