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(54) Title: MAGNETIC GLASS MEMBER

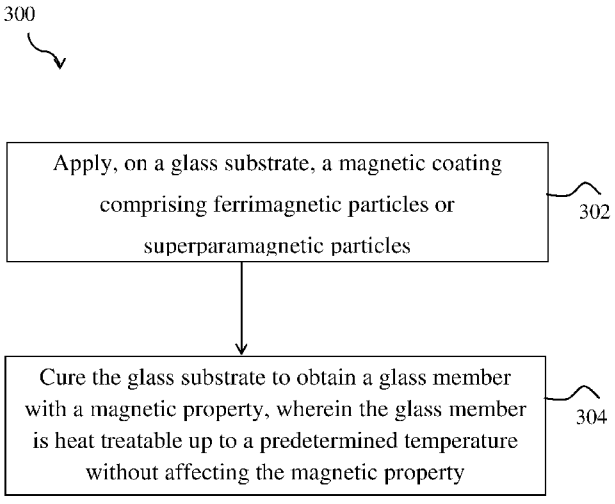

FIG. 3

(57) Abstract: A glass member comprising a glass substrate and a magnetic coating disposed on a first surface of the glass substrate are provided. The magnetic coating includes a magnetic material. The first surface and a second surface opposite to the first surface have a magnetic property.

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MAGNETIC GLASS MEMBER

Technical Field

The present disclosure relates in general to glass, and more particularly to glass having magnetic property.

Background

Generally, various types of glass panels are being used for building applications. For improved use of these glass panels, other properties are to be integrated into the glass panels. One such property is a magnetic property for the glass. Conventional methods for providing magnetic property to the glass include attaching a metal back sheet to the glass. Few magnetic paints also exist that can be coated on a surface of the glass substrate thereby providing magnetic property to the substrate.

For reference, European Patent 1,339,41 is related to a screen printing of magnetically effective ink containing a binder, a pigment and, optionally, a filler. The pigment constitutes finely divided iron obtained by reduction and comprises rounded particles having a particle size in the range of 0.01 to 0.06 mm, and a weight ratio of pigment/binder in the range of 0.8 to 2.4. The invention produces magnetically active areas on selected areas of the substrate and uses magnetically active colors.

United States patent application 20160376190 is related to creation of textured surface by aligning magnetic particles coated on the glass under a magnetic field. The coated glass substrate is used for inscriptions, logos, for generating a desired design and also to assist particular technical functions, such as in the case of display windows or as markings of cooking zones.

However, coating magnetic paints available in the market on the visible side of the glass may not be aesthetic in nature and may be prone to scratches, chipping or peeling. Moreover, the prior art patents does not

disclose a glass substrate having magnetic property on the side opposite to the coating side. Further, there exists a need for a magnetic paint that is durable and having desired properties for use in conjunction with the glass.

The present disclosure provides a magnetic coating composition for coating on a glass substrate. The present disclosure further provides a magnetic glass article having better mechanical properties prior to tempering and also capable of being handled and transported before the tempering process.

Summary of the Disclosure

In one aspect of the present disclosure, a glass member comprising a glass substrate and a magnetic coating disposed on a first surface of the glass substrate is provided. The magnetic coating includes a magnetic material. A second surface opposite to the first surface also has a magnetic property.

In another aspect of the present disclosure, a magnetic coating composition for coating on a glass substrate is provided. The magnetic coating composition includes ferrimagnetic particles.

In another aspect of the present disclosure, method of manufacturing a heat treatable magnetic glass member is provided. The method includes applying a magnetic coating on a glass substrate. The magnetic coating includes ferrimagnetic particles. The method also includes curing the coated glass substrate to obtain the glass member with a magnetic property. The glass member thus obtained is heat treatable up to a predetermined temperature without substantially affecting the magnetic property of the glass member after the heat treatment.

In another aspect of the present disclosure, a magnetic glass kit comprising a magnetic glass member and one or more magnets for

holding objects on the magnetic glass member is provided.

Other features and aspects of this disclosure will be apparent from the following description and the accompanying drawings.

Brief Description of the Drawings

Embodiments are illustrated by way of example and are not limited in the accompanying figures.

FIG. 1 illustrates a graph of a weight sustained by magnets of various sizes relative to a distance of a magnetic coating on a glass member from the magnet, according to one embodiment of the present disclosure;

FIG. 2 illustrates a graph of a weight sustained by magnets of various sizes relative to a distance of a magnetic coating on the glass member from the magnet, according to another embodiment of the present disclosure; and

FIG. 3 illustrates a flowchart for a method of manufacturing a heat treatable magnetic glass member, according to an embodiment of the present disclosure.

Skilled artisans appreciate that elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, the dimensions of some of the elements in the figures may be exaggerated relative to other elements to help to improve understanding of embodiments of the invention.

Detailed Description

Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or the like parts. Embodiments disclosed herein are related to a glass member and a magnetic coating composition.

The glass member includes a glass substrate having a first surface and a second surface opposite to the first surface. In an embodiment, the glass substrate may include an inorganic coating or an organic hybrid coating. For example, the glass substrate may include a non-transparent coating containing a coloring pigment which can be organic or inorganic. In an example, the glass substrate may be a lacquered glass. In another embodiment, the substrate may have an inorganic reflective coating including, but not limited to silver, niobium, aluminum, gold and nickel. In an example, the substrate may be a mirror. In another embodiment, the substrate may be a temperable glass. In yet another embodiment, the substrate may be a to-be-tempered glass. Alternatively, the substrate may also be a clear glass without any coatings thereon.

In various other embodiments, the substrate may include any of a colored glass, a lacquered glass with surface or bulk treatment, a laminated glass, a patterned glass, an enamel coated glass and the like. It may also be contemplated to apply concepts of the present disclosure to any transparent/translucent glass or a glass substrate with one or more coatings based on the type of the application. Further, the embodiments of the present disclosure may be applied to a substrate with any configuration, shape and size. In one example, the substrate may be a sheet glass. In other examples, the substrate may be any of curved, irregular, flat or the like. It may also be contemplated to apply concepts of the preset disclosure to any transparent/translucent glass or a glass substrate and further coat/overlay the magnetic composition coated glass substrate with one or more coatings based on the type of the application.

In one embodiment, the glass member includes a magnetic coating on the first surface. The magnetic coating includes magnetic particles. With such an implementation, the second surface of the glass member exhibits a magnetic property. In one other aspect, the first

surface of the glass member also exhibits a magnetic property.

In one embodiment, the magnetic coating may further include an inorganic or an organic hybrid coating along with the magnetic material. For example, the magnetic paint may be a lacquered paint that includes a coloring pigment.

In another embodiment, the magnetic coating may include a resin, and a solvent. Additionally, the magnetic coating may include one or more of pigment, thickener, adhesion promoter, surfactant, defoamer and/ or the like. In an embodiment, the solvent may be water-based. In another embodiment, the solvent may be organic or a mixture of two or more components. In an example, the solvent may include at least one of the solvents such as, diacetone alcohol, butyl acetate, xylene, isopropyl alcohol or the like. In another example, the solvent may include aliphatic or aromatic hydrocarbons, alcohol, ether, ester, ketone from C_1 to C_{10}.

Further, the resin may include one or more of polyurethane, polyacrylate ester and amides, polyimide, polyolefins, polyester, methacrylate or the like. However, it may be contemplated to use other suitable solvents and resins based on the type of application of the magnetic paint. In an embodiment, the magnetic coating may further include one or more inorganic additives like metal oxides, ceramic materials, metal salts and complexes, glass frits, silica, aluminosilicates or the like.

In various embodiments of the present invention, the magnetic material may include ferromagnetic particles or ferrimagnetic. The ferromagnetic particles may include, for example, Fe, Co, Ni, Gd, Dy, Tb, EuO, Fe_2O_3, CrO_2, MnSb, MnAs, MnBi, Awaruite and Wairakite or the like. The ferrimagnetic particles may include, for example, magnetite (iron(II,III) oxide; Fe_3O_4), $NiOFe_2O_3$, $CuOFe_2O_3$, $MgOFe_2O_3$, yttrium iron garnet, cubic ferrites composed of iron oxides or other elements such as aluminum, cobalt, nickel, manganese and zinc, hexagonal ferrites

containing magnetic components such as $PbFe_{12}O_{19}$, $BaFe_{12}O_{19}$ and pyrrhotite. In a preferred embodiment, the ferrimagnetic particles may include cobalt ferrite. In an embodiment, the magnetic coating may include any of ferromagnetic or ferrimagnetic particles having a particle size less than 10 nm or less than 20 nm.

In a preferred embodiment, the concentration of the magnetic particles in the coating may not be greater than 95%. In another embodiment, the concentration of the magnetic particles in the coating may not be lesser than 40%. In yet another embodiment, the concentration of the magnetic particles in the coating may be in greater than or equal to 20%. In another preferred embodiment, the concentration of the magnetic material may be in a range of 85% to 95% by weight.

Further, the size of the magnetic particles may be in a range of 0.001 to 300 microns. In a preferred embodiment, the size of the magnetic particles may be in a range between 10 to 200 microns. In another preferred embodiment, the size of the magnetic particles may be in a range between 10 to 75 microns. In yet another preferred embodiment, the size of the magnetic particles may be less than 45 microns. Further, the size of the magnetic materials may vary based on a type of the magnetic particles. In various other embodiments, a suitable size for the magnetic materials may be selected to provide desired densification, ageing and other useful properties to the magnetic coating.

In an embodiment, the thickness of the magnetic coating on the glass substrate may be at least about 150 micrometers and not greater than at least about 4 mm. In another embodiment, the thickness of the magnetic coating may be greater than or equal to 210 micrometers. Moreover, based on a desired magnetic effect and adhesion to the glass substrate, the thickness of the magnetic coating may be varied.

In one embodiment, the magnetic coating may additionally include a rust inhibitor that can prevent rust caused by water. In another

embodiment, the magnetic coating may also include a thickening agent having thixotropic and viscosity characteristic such that the magnetic coating has higher viscosity when subjected to substantially no shear movement and has a lower viscosity when the composition is subjected to movement having high shear rate. The thickening agent may be, for example, emulsions, based on acrylic polymers. In other embodiments, the magnetic coating may also include a hygroscopic drying control agent to control the rate of drying of the paint and/or an anti-microbial agent.

In an embodiment, a laminated glass may include a glass with the magnetic property, as described above. The laminated glass may also include a secondary glass substrate. Further, the laminated glass may further include a polymeric interlayer disposed between the first surface of the glass member and the secondary glass substrate. The secondary glass substrate and/or the polymeric interlayer may or may not be magnetic.

An exemplary process of preparation of the magnetic coating is described below: A magnetic powder having the magnetic materials with a particle size less than or equal to 44 microns was taken in a beaker. A suitable concentration of a lacquer paint having an organic solvent was taken. Further, the lacquer paint was mixed with the magnetic powder using a stirrer till slurry or a paste was obtained.

The viscosity may be modified as required by addition of required materials such as solvents, diluents, thinners etc., The viscosity may be adjusted based on the coating methodology used and may affect the durability of the paint coating achieved and the magnetic force felt from the glass side. Additional magnetic powder can be incorporated into the mixture to increase the magnetic force, as needed.

An exemplary process of coating the magnetic composition on the glass substrate such as the lacquered glass or glass coated with an enamel is described. In an embodiment, the magnetic paint of desired

specification was coated on the glass member using a coater e.g., a curtain coater, roller coater or a spray coater. The glass substrate was first cleaned on both sides to ensure that the surface is free from any contamination.

The substrate was then attached with the first surface, i.e., the lacquer side facing upwards on a coater. Further, a scale specified on the coater was set based on a desired thickness for the coating. The magnetic composition was then poured evenly onto the coater.

At a desired speed range the coater moved over the entire glass member to create a uniform coating on the lacquered side or enamel side. The sample was then allowed to cure or dry either at room temperature or at elevated temperatures. With such an implementation, the second surface opposite to the lacquered side exhibited magnetic property.

In one embodiment, the magnetic coating may be coated covering the entire first surface. In other embodiments, the magnetic coating may be coated to cover a portion of the first surface. In one example, the magnetic coating may be coated adjacent to the edges of the glass member. In other examples, the magnetic coating may be coated in various patterns. With such an implementation, the corresponding opposite portions on the second surface exhibited magnetic property. Further, various objects such as, paper, figurines, stickers, dusters, pen holders, magnetic darts, buttons, hooks and the like may be held between the corresponding magnetic portions of the second surface and a magnet. In an embodiment, the magnet may be a rare earth magnet. For example, the magnets that can be attached on the second surface of the glass member include family of NdFeB ($Nd_2Fe_{14}B$), SmCo (Sm_2Co_{17}) or the like. In an embodiment, the magnet can be embedded in an accessory and shaped into a rod, a triangle, a pyramid, a cone, a solid sphere, a hemisphere, a hollow sphere, a cuboid, a hollow cuboid or the like. Alternatively, the accessory embedded with the magnet can be randomly shaped.

Magnetic attraction test

A magnetic attraction test was performed on the glass member having the magnetic property. The maximum weight sustained by the glass member for a given thickness of the magnetic coating was determined. The experiments showed that for a critical thickness of 210 microns, the maximum load that the glass member can withstand using rare earth magnets of different sizes and dimensions vary significantly.

The weight sustained by different magnets on the glass member may depend on various parameters such as, distance from a layer of the magnetic coating, shape of the magnet, size of the magnet, type of magnetic field lines within the magnet, frictional coefficient, temperature etc. FIGS. 1 and 2, illustrate a plot showing a trend of a change in weight sustained by different magnets on a Y-axis with a distance from the magnetic coating on X-axis.

As illustrated in FIG. 1, lines 102, 104 correspond to a 10 mm and 8 mm spherical magnets, respectively. Similarly, lines 106, 108 correspond to 10x5 mm cylinder, 10x5 mm ring-shaped magnets, respectively. As illustrated in FIG. 2, lines 202, 204 correspond to a 10x10x2 mm and 25x25x12 mm square magnets, respectively. Similarly, lines 206, 208 correspond to 30x30x10 mm, 12x7.5x2 mm square magnets, respectively.

Various loading tests were conducted to determine optimum parameters of the magnet that can be used on a glass member. In an example, square magnets of the dimensions 30x30x10 mm^3, cylinder magnets of 10 X 5 mm^3, and spherical magnet (10 mm in diameter) are suitable magnets for use on a 4 mm thick glass member. However, it may also be envisioned to use other sizes and shapes of the magnets depending on a type of application.

In an example, for a glass substrate of 4 mm thickness and a magnetic coating of thickness 210 microns, the weights and dimensions of the magnets that can be used are given in Table 1.

Table 1: Weights and dimensions of the magnets for use on a 4mm thick

glass substrate having a magnetic coating of 210 microns

Shape	Dimension (mm)	Weight of the magnet(g)
Cuboid	40 x 25 x 5	98.43
Cuboid	40 x 25 x 10	153
Cuboid	30 x 30 x 5	103
Cuboid	30 x 10 x 5	34
Cuboid	20 x 20 x 3	30
Cylindrical	25 x 6	98.35
Cylindrical	20 X 6	65.49

Ferromagnetic material of magnetization 77 emu/ g were coated onto a 4 mm glass substrate and a slide test was performed for different dimensions of magnets, making sure that sliding does not exceed more than 5 mm. It was observed that a 10 g of a given sample could be attached using a magnet of 300 Oe.

Pull Test

A pull test was performed by loading magnets of different dimensions onto the glass side of a lacquered glass and the amount of pull force required to lift a magnet above 2 mm from the surface of the substrate was determined. Results of the pull test are tabulated in Table 2.

Table 2: Results of Pull Test

Magnet	Gauss	Pull Force (g)
Square	1100	147
Square	1300	146
Cylinder	2174	153
Cylinder	2349	111

The glass member with the magnetic paint may be installed on any substrate such as, plywood, fiber cement, drywall and the like. In a

preferred embodiment, the first surface of the glass member may be installed on the substrate. Mechanical fixtures or adhesives e.g., silicones, or adhesive tapes may be used to accomplish the installation of the glass member on the substrate.

In another aspect of the present disclosure, a magnetic coating composition for coating on the glass substrate includes ferrimagnetic particles. The magnetic coating composition may be coated on any of the first surface or the second surface of the glass substrate based on a type of application of the glass substrate. In a preferred embodiment, the concentration of the ferrimagnetic particles in the magnetic coating composition may be at least about 40% and not greater than at least about 90%. In one other embodiment, the concentration of the ferrimagnetic particles in the magnetic coating composition may be in a range of 30% to 40% or 40% to 50% or 50% to 60% or 60% to 70% or 70% to 80% or 80% to 90%. In another embodiment, the concentration of the ferrimagnetic particles may be in a range of 20% to 40% or 40% to 60% or 50% to 70% or 60% to 80% or 70% to 90% or 80% to 95%. In an example, the concentration may be 80% or greater.

In one embodiment, the ferrimagnetic particles may include cobalt ferrite. In other embodiments, the ferrimagnetic particles may include any of magnetite (Iron (II,III) oxide; Fe_3O_4), $NiOFe_2O_3$ $CuOFe_2O_3$, $MgOFe_2O_3$, cubic ferrites composed of iron oxides and other elements such as aluminum, nickel, manganese and zinc, hexagonal ferrites such as $PbFe_{12}O_{19}$ and $BaFe_{12}O_{19}$, or the like.

The ferrimagnetic particles may withstand a temperature of up to 800 °C without affecting the magnetic property. As such, by selecting other suitable components such as resin, glass frits and a solvent for the magnetic coating composition, the glass substrates applied with such a magnetic coating, may be made heat-treatable. For example, the glass member may be transported, handled or cut into required shapes and sizes and then tempered at a preferred location. Few such components of the

magnetic coating compositions along with the magnetic particles are described below.

In one embodiment, the magnetic coating composition may further include a resin, glass frits and a solvent. In an example, the magnetic coating composition may include an enamel. The magnetic coating may additionally include any other inorganic content, organic content or the like. For example, the magnetic coating composition may include a thickener, a pigment, an adhesion promoter, a defoamer, surfactant, other additives etc. as required. In one embodiment, the concentration of the resin may be in a range of 6 to 20%. In another embodiment, the concentration of the resin may be in a range of 6 to 12% or 8 to 14% or 10 to 16% or 12 to 18% or 14 to 20%. The solvent may be any of water based solvents, organic solvents or the like.

In another embodiment, the magnetic coating composition may include mineral paint along with the magnetic particles. Such a magnetic coating composition may render the glass substrate heat-treatable without affecting the magnetic property thereof. In an example, the heat-treatment may include tempering.

Alternatively, the magnetic coating composition may include a paint in which the ferrimagnetic may be dispersed. The paint may include an organic and/or an inorganic content. For example, the paint may be a lacquered paint.

Various parameters such as, the concentration, size and shape of magnetic particles etc., may be determined based on the type of magnetic particles, the type of solvent and the desired magnetic property.

Examples of magnetic coatings according to one or more embodiments of the present disclosure are described below. However, it should be noted that these examples are non-limiting of this disclosure.

Example 1:

One of the magnetic coating compositions for coating on the glass

substrate may include the following:

Table 3: Magnetic Coating Composition 1

Component	Weight (%)
Ferrimagnetic[1]: Magnetite, Cobalt Ferrite, Manganese Ferrite, $BaFe_{12}O_{19}$, Yttrium Iron garnet, barium strontium ferrite. Size range[2]: 0-200µm	40-90 %
Resin	6-20%
Frits	10-25 %
De-foamer	0.05-0.20%
Adhesion promoter/Coupling agent	2-3 %
Pigment	0-15%

Wherein:

[1]Preferred Ferrimagnetic particles- Magnetite/Cobalt Ferrite

[2]Preferred Size range for Ferrimagnetic: 10-75 µm

Upon coating the glass substrate with the above coating composition, the glass substrate may be further heat-treatable to a temperature of up to 800 °C without affecting the magnetic property. Weights sustained by the glass member coated with the coating composition were determined both before and after the heat treatment and results of a few magnet dimensions are presented in Table 4 as an example.

Table 4: Weights Sustained Before and After Heat Treatments

Shape	Dimension	Weight of the magnet(g)

		Before heat treatment	After heat treatment
Cuboid	30 x 10 x 5 mm	34	34
Cuboid	20 x 20 x 3 mm	30	30
Cylindrical	25 x 6 mm	98.35	98.35
Cylindrical	20 X 6 mm	65.49	65.49

It is well evident from Table 4 that the magnetic glass member does not undergo any change in the magnetic property even after heating to a temperature of up to 800 °C. This makes the magnetic glass member heat-treatable.

Durability Studies

Taber Abrasion test and adhesion of the magnetic coated article in the presence of water were determined. The magnetic coated article was immersed in water for 7 minutes and dried. Elcometer adhesive tapes were applied on the magnetic coated article. The tapes were adhered for 6-7 minutes and then pulled at right angles to the substrate. The durability study result of the heat-treatable magnetic glass substrate coated with magnetic composition 1 is given in Table 5.

Table 5: Durability Results of Magnetic Coating Composition 1

Test	No of Cycles	Initial Weight (g)	Final Weight (g)	% Weight change
Taber Abrasion (ASTM D 4060-10)	500	103.8	101.6	2%
	1000	101.6	101.3	0.2%
Adhesion in the presence of water	No peeling and delamination			

Example 2:

One other magnetic coating composition for coating on the glass substrate is given in the table below:

Table 6: Magnetic Coating Composition 2

Component	**Weight (%)**
Ferrimagnetic[1]: Magnetite, Cobalt Ferrite, Manganese Ferrite, $BaFe_{12}O_{19}$, barium strontium ferrite. Size range[2]: 0-200microns	40-90 %
Resin	6-20%
Solvent	15-35 %
De-foamer	0.05-0.20 %
Adhesion promoter/Coupling agent	2-3 %
Pigment	0.4-0.8%

Wherein:

[1]Preferred Ferrimagnetic - Magnetite/Cobalt Ferrite

[2]Preferred Size range for Ferrimagnetic: 10-75 µm

Resin, solvent, defoamer, adhesion promoter and pigment were mixed in a beaker for 5-10 minutes. The magnetic materials were added into the mixture and thoroughly mixed for 10 minutes to obtain a magnetic coating. The mixture was then uniformly coated on the lacquered/enameled side of the glass substrate using a suitable coating methodology and was allowed to cure at a temperature greater than 100 ^{o}C to obtain a magnetic glass member.

Durability Studies

Taber Abrasion test, Lucite test, EBT (Washability) and adhesion in the presence of water were determined. The durability study result of the magnetic glass substrate coated with magnetic composition 2 is given in Table. 7.

Table 7: Durability Results of Magnetic Coating Composition 2

Test	No of Cycles	% Weight change
Taber Abrasion (ASTM D 4060-10)	500	0.09 - 0.14%
	1000	0.17 - 0.25%
Lucite test	No surface defects	
EBT (Washability) ASTM D2486	No peeling and delamination	
Adhesion in the presence of water	No peeling and delamination	
Wet belt grinding (300* 200mm)	No chipping or peeling	

Example 3:

One other magnetic coating composition for coating on the glass substrate is given below:

Table 8: Magnetic Coating Composition 3

Component	**Weight (%)**
Ferromagnetic[1]: Co, Fe, MnBi, Ni, MnSb, CrO_2, MnAs, Gd, Tb, Dy, EuO, Awaruite and Wairakite Size range[2]: 0-200µm	40-90 %
Resin	12-30%

Solvent	5-20 %
De-foamer	0.05-0.20 %
Adhesion promoter/Coupling agent	2-3 %
Pigment	0.4-0.8%

Wherein:

[1]Preferred Ferromagnetic - Cobalt or Nickel

[2]Preferred Size range for Ferrimagnetic: 10-75 µm

Durability Studies

Taber Abrasion test, Lucite test, EBT (Washability) and adhesion in the presence of water were determined. The durability study result of the magnetic glass substrate coated with magnetic composition 3 is given in Table. 9.

Table 9: Durability Results of Magnetic Coating Composition 3

Test	No of Cycles	% Weight change
Taber Abrasion (ASTM D 4060-10)	500	0.05%
EBT (Washability) ASTM D2486	No peel off or delamination of powder	
Adhesion in the presence of water	No peeling and delamination of paint layer	

FIG. 3 illustrates a flowchart for a method 300 for manufacturing a heat treatable magnetic glass member, according to an embodiment of the present disclosure. At step 302, the method 300 includes applying a

magnetic coating on the glass substrate. In one embodiment, the magnetic coating includes ferrimagnetic particles. In yet another embodiment, the concentration of the ferrimagnetic particles may be at least about 40% and not greater than at least about 90% by weight.

The thickness of the magnetic coating may depend on the thickness of the glass, composition of the paint and desired magnetic properties among other parameters. In an embodiment, the coating thickness may be at least about 140 microns and not greater than at least about 4 mm. In an embodiment, the coating thickness may be greater than or equal to 210 microns.

At step 304, the method 300 includes curing or drying the coated glass member to obtain the glass member with the magnetic property. The glass member may be cured either at a room temperature or at other suitable temperatures. Further, the glass member is heat treatable up to a predetermined temperature without affecting the magnetic property. In an embodiment, the predetermined temperature is not greater than at least about 800 °C. As such, the glass member with the magnetic paint may be transported, handled or cut to suitable sizes and shapes and then heat treated at a preferred location without affecting the magnetic property.

In an embodiment, the magnetic coating may also include a solvent, a resin, and glass frits as described above. Additionally, the magnetic coating may also include pigments, additives or the like. In another embodiment, the magnetic coating may include a mineral paint. However, other suitable compositions for the magnetic coating including ferrimagnetic particles may be contemplated for rendering the glass member with such a coating as heat-treatable.

The magnetic glass member of the present invention can be used in building interiors for example in kitchens, interior wall partitions, ceilings, projection halls and as display or notice boards. The magnetic glass member of the present invention can also be used as writable boards in office, schools etc. The application area mentioned are only

indicative and does not in any way limit the scope of the invention. The magnetic glass member of the present invention can be used in any application area that requires glass substrates having magnetic property.

Note that not all of the activities described above in the general description or the examples are required, that a portion of a specific activity may not be required, and that one or more further activities may be performed in addition to those described. Still further, the order in which activities are listed is not necessarily the order in which they are performed.

Benefits, other advantages, and solutions to problems have been described above with regard to specific embodiments. However, the benefits, advantages, solutions to problems, and any feature(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential feature of any or all the claims.

The specification and illustrations of the embodiments described herein are intended to provide a general understanding of the structure of the various embodiments. The specification and illustrations are not intended to serve as an exhaustive and comprehensive description of all of the elements and features of apparatus and systems that use the structures or methods described herein. Certain features, that are for clarity, described herein in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features that are, for brevity, described in the context of a single embodiment, may also be provided separately or in a sub combination.

Further, reference to values stated in ranges includes each and every value within that range. Many other embodiments may be apparent to skilled artisans only after reading this specification. Other embodiments may be used and derived from the disclosure, such that a structural substitution, logical substitution, or another change may be made without departing from the scope of the disclosure. Accordingly,

the disclosure is to be regarded as illustrative rather than restrictive.

The description in combination with the figures is provided to assist in understanding the teachings disclosed herein, is provided to assist in describing the teachings, and should not be interpreted as a limitation on the scope or applicability of the teachings. However, other teachings can certainly be used in this application.

As used herein, the terms "comprises," "comprising," "includes," "including," "has," "having" or any other variation thereof, are intended to cover a non-exclusive inclusion. For example, a method, article, or apparatus that comprises a list of features is not necessarily limited only to those features but may include other features not expressly listed or inherent to such method, article, or apparatus. Further, unless expressly stated to the contrary, "or" refers to an inclusive-or and not to an exclusive-or. For example, a condition A or B is satisfied by any one of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present).

Also, the use of "a" or "an" is employed to describe elements and components described herein. This is done merely for convenience and to give a general sense of the scope of the invention. This description should be read to include one or at least one and the singular also includes the plural, or vice versa, unless it is clear that it is meant otherwise. For example, when a single item is described herein, more than one item may be used in place of a single item. Similarly, where more than one item is described herein, a single item may be substituted for that more than one item.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. The materials, methods, and examples are illustrative only and not intended to be limiting. To the extent that certain details regarding specific materials

and processing acts are not described, such details may include conventional approaches, which may be found in reference books and other sources within the manufacturing arts.

While aspects of the present disclosure have been particularly shown and described with reference to the embodiments above, it will be understood by those skilled in the art that various additional embodiments may be contemplated by the modification of the disclosed machines, systems and methods without departing from the spirit and scope of what is disclosed. Such embodiments should be understood to fall within the scope of the present disclosure as determined based upon the claims and any equivalents thereof.

List of Elements

TITLE: MAGNETIC GLASS MEMBER

102	Line
104	Line
106	Line
108	Line
202	Line
204	Line
206	Line
208	Line
300	Method
302	Step
304	Step

Claims

We Claim:

1. A glass member comprising:

   a glass substrate; and

   magnetic coating disposed on a first surface of the glass substrate, wherein the magnetic coating comprises a magnetic material, and wherein a second surface opposite to the first surface has a magnetic property.

2. The glass member of claim 1, wherein the magnetic material has a concentration of at least about 40% and not greater than about 95% by weight.

3. The glass member of claim 1, wherein the magnetic coating further comprises a resin and a solvent.

4. The glass member of claim 3, wherein the solvent is selected from a group consisting of water, xylene, organic solvents including aliphatic or aromatic hydrocarbons, alcohol, ether, ester, ketone from C_1 to C_{10}.

5. The glass member of claim 3, wherein the resin includes one or more of polyurethane, polyacrylate ester, polyacrylate amides, polyimide, polyolefins or polyester.

6. The glass member of claim 1, wherein the magnetic material includes ferromagnetic particles or ferrimagnetic particles.

7. The glass member as claimed in claim 6 wherein the magnetic material undergoes a reversible/irreversible transformation on magnetization at about 20 emu/g and not greater than about 25 emu/g.

8. The glass member as claimed in claim 7, wherein the transformation can be one of thermal, structural and/ or magnetic transformation.

9. The glass member of claim 1, wherein the magnetic material has a particle size at least about 0.001 microns and not more than at least about 300 microns.

10. The glass member of claim 1, wherein the magnetic material includes one or more of magnetite, $NiOFe_2O_3$, $CuOFe_2O_3$, $MgOFe_2O_3$, cobalt ferrite, cubic ferrites, barium strontium ferrite or hexagonal ferrites.

11. The glass member of claim 1, wherein the thickness of the magnetic coating is at least about 150 micrometers and not more than at least about 4 mm.

12. A laminated glass comprising:

the glass member of any one of preceding claims;

a secondary glass substrate; and

a polymeric inter layer disposed therebetween.

13. The glass member of any of the preceding claims withstands a temperature of up to 800 °C.

14. A magnetic coating composition for coating on a glass substrate comprising ferrimagnetic particles.

15. The magnetic coating as claimed in claims 14, wherein the magnetic material undergoes a reversible/irreversible transformation on magnetization at about 20 emu/g and not greater than about 25 emu/g.

16. The magnetic coating as claimed in claims 14, wherein the transformation can be one of thermal, structural and/ or magnetic transformation.

17. The magnetic coating composition of claim 14, wherein the concentration of the particles is at least about 40% and not greater than about 95% by weight.

18. The magnetic coating composition of claim 14 further comprising a resin, glass frits and a solvent.

19. The magnetic coating composition of claim 14 further comprising an enamel.

20. The magnetic coating composition of claim 14 further comprising a mineral paint.

21. The magnetic coating composition of claim 14, withstanding a temperature of up to 800 °C.

22. A method of manufacturing a heat treatable magnetic glass member, the method comprising:
applying a magnetic coating on a glass substrate, wherein the magnetic coating comprises ferrimagnetic particles; and
curing or drying the glass substrate to obtain a glass member with a

magnetic property, wherein the glass member is heat treatable up to a predetermined temperature without substantially affecting the magnetic property after the heat treatment.

23. The method of claim 22, wherein the ferrimagnetic particles have a concentration of at least about 40% and not greater than about 95% by weight of the magnetic coating.

24. The method of claim 22, wherein the magnetic coating further comprises a resin, frits and a solvent.

25. The method of claim 22, wherein the magnetic coating further comprises an enamel.

26. The method of claim 22, wherein the magnetic coating further comprises a mineral paint.

27. The method of claim 22, wherein the predetermined temperature is not more than about 800 °C.

28. A magnetic glass kit comprising,

a magnetic glass member of claim 1; and

one or more accessories embedded with a magnet for holding objects on the magnetic glass member.

29. The magnetic glass kit of claim 28, wherein the accessories can be shaped into a rod, a triangle, a pyramid, a cone, a solid sphere, a hemisphere, a hollow sphere, a cuboid or a hollow cuboid.

30. The magnetic glass kit of claim 28, wherein the magnets are rare earth magnets including but not limited to NdFeB ($Nd_2Fe_{14}B$) or SmCo (Sm_2Co_{17}).

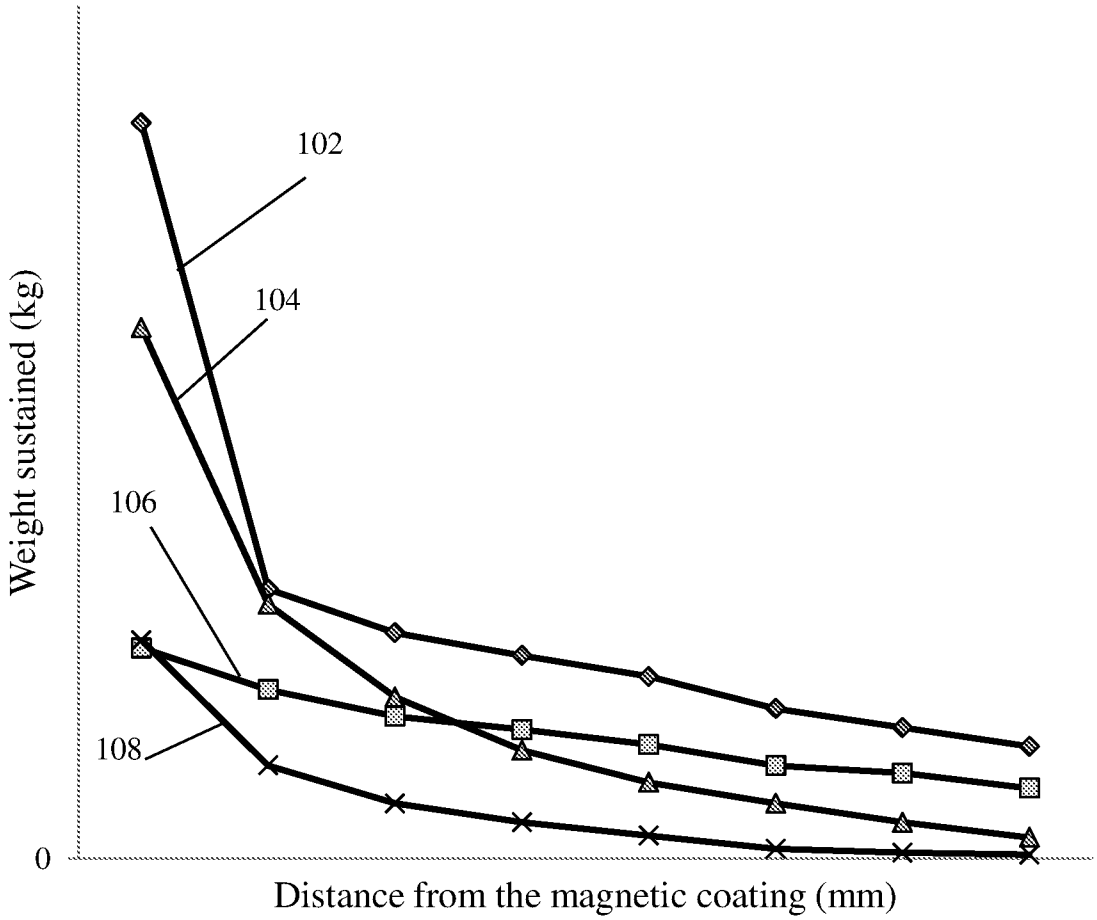
102
104
106
108
Weight sustained (kg)
0
Distance from the magnetic coating (mm)

FIG. 1

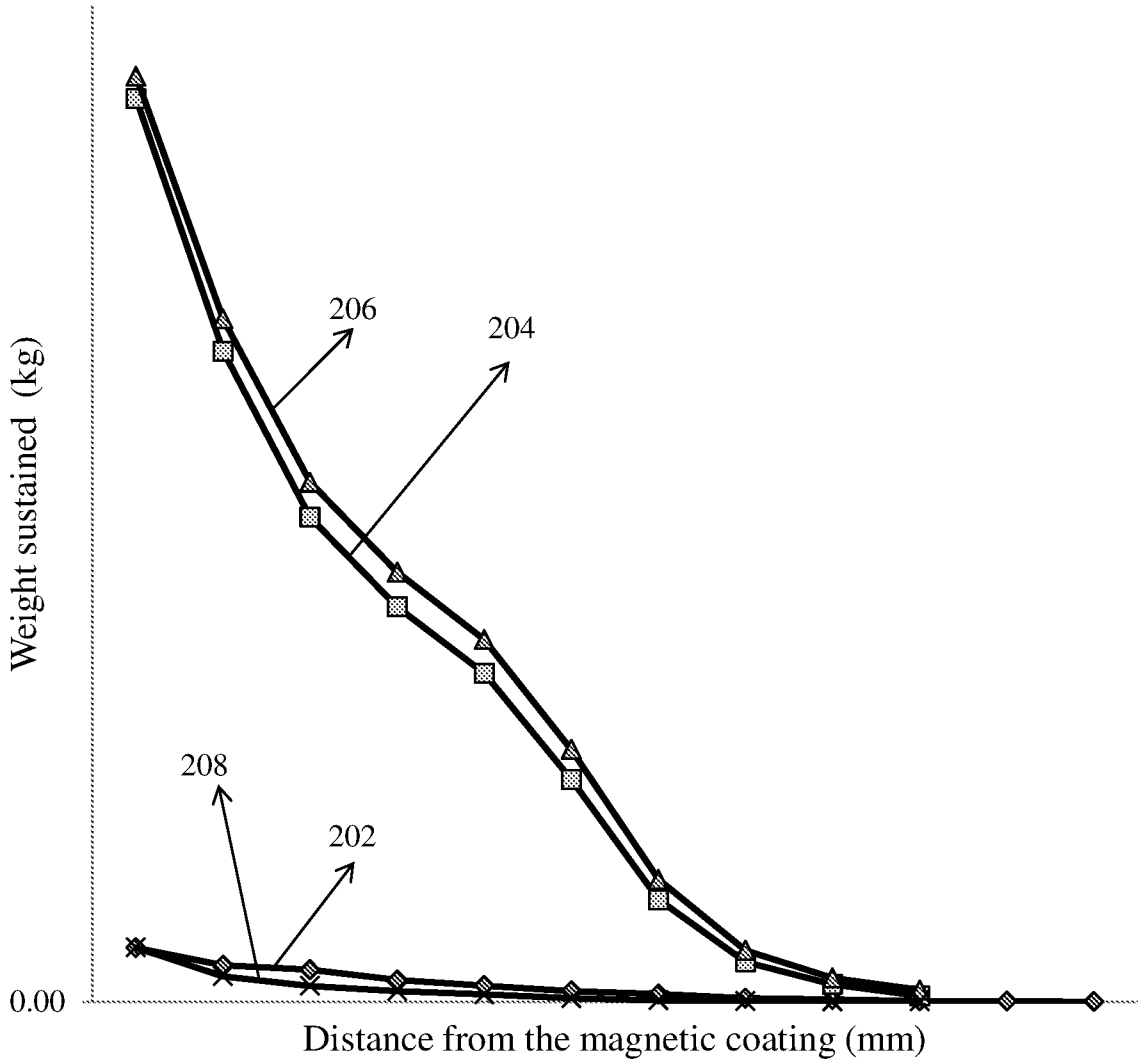
Weight sustained (kg)
206
204
208
202
0.00
Distance from the magnetic coating (mm)

FIG. 2

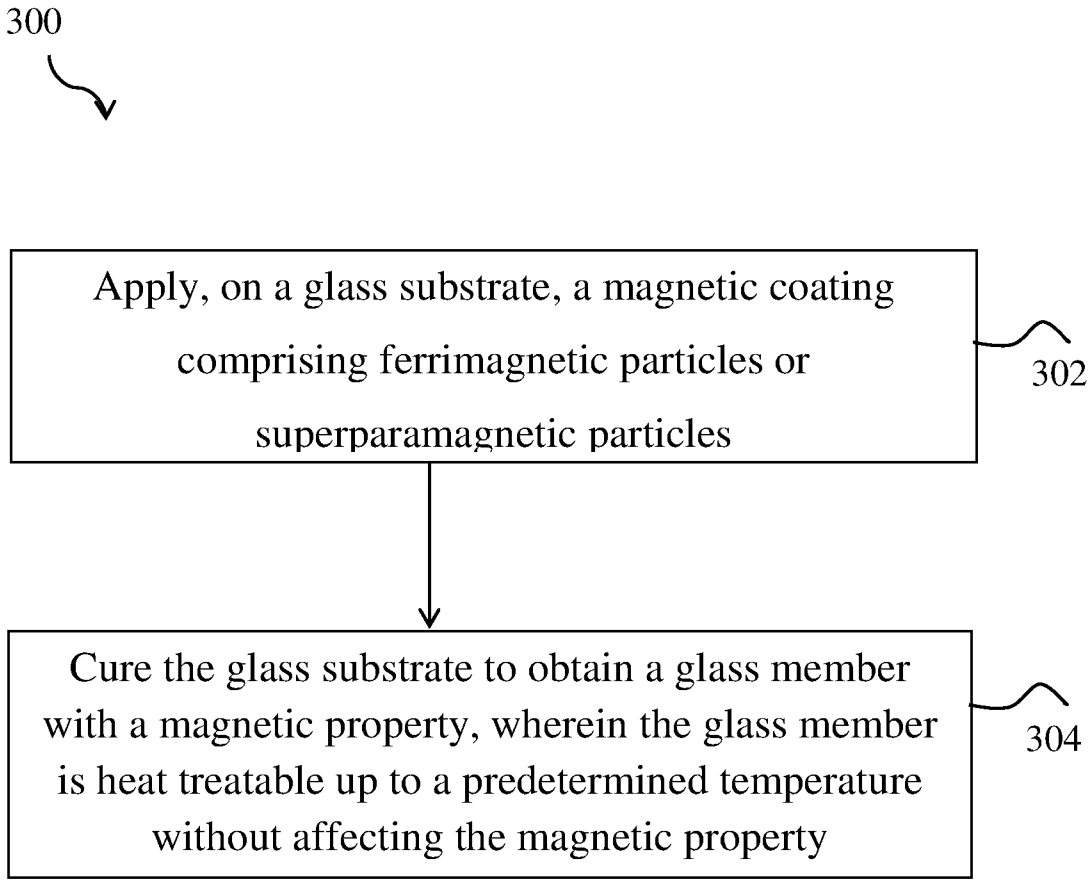
300
Apply, on a glass substrate, a magnetic coating comprising ferrimagnetic particles or superparamagnetic particles
302
Cure the glass substrate to obtain a glass member with a magnetic property, wherein the glass member is heat treatable up to a predetermined temperature without affecting the magnetic property
304

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2017/050111

A. CLASSIFICATION OF SUBJECT MATTER
C03C17/00 Version=2017.01

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)

C03C

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)

Patseer, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO2003000801 A2 (FLEX PRODUCTS INC) 3 JAN 2003 (03-01-2003); The whole document	1-30
A	US20030098436 A1 (GRAHAM R. WILLIAM ET AL) 29 MAY 2003 (29-05-2003); The whole document	1-30
A	EP0133941 A1 (SCHLIEPER HERBERT) 13 MAR 1985 (13-03-1985); cited in the application; The whole document	1-30
A	US5843329 A (DEETZ, DAYTON J) 1 DEC 1998 (01-12-1998); The whole document	1-30
A	EP1541642 A1 (ROHM & HAAS) 15 JUN 2005 (15-06-2005); The whole document	1-30

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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
26-07-2017	26-07-2017
Name and mailing address of the ISA/ Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Authorized officer Manganna Dora Sambha Telephone No. +91-1125300200

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IN2017/050111

Citation	Pub.Date	Family	Pub.Date
WO 2003000801 A2	03-01-2003	CN 1505668 A	16-06-2004
		EP 1412432 A2	28-04-2004
		US 20030143400 A1	31-07-2003
US 20030098436 A1	29-05-2003	US 6790378 B2	14-09-2004
EP 0133941 A1	13-03-1985	DE 3325960 A1	07-02-1985
		DE 3480139 D1	16-11-1989
EP 1541642 A1	15-06-2005	US 20050123764 A1	09-06-2005