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# (54) A SOUNDPROOF GLASS UNIT COMPRISING A VISCOELASTIC ADHESIVE STRIP

(57) A soundproof glass unit comprising at least one insulating glazing mounted in a framework and the framework mounted in a building frame in an opening of a building structure is disclosed. Viscoelastic adhesive strips are attached to the flanges of the insulating glazing for mounting in the framework and thereafter attached to the framework for mounting the framework in the building frame. The viscoelastic adhesive strip comprises at least one sound damping copolymer selected from the group consisting of vinyl acetate-olefin copolymer; terpolymers of vinyl acetate, olefin & vinyl ester monomer; terpolymers of vinyl acetate, vinyl ester & (meth)acrylate monomer; copolymer of vinyl acetate & acrylic monomer; or acrylic ester-styrene copolymer. The sound damping copolymer has a loss factor greater than 1.6 at a temperature at least in the range of -10° C to +70° C and at a frequency of 100Hz and a glass transition temperature that varies from -20°C to +25°C.

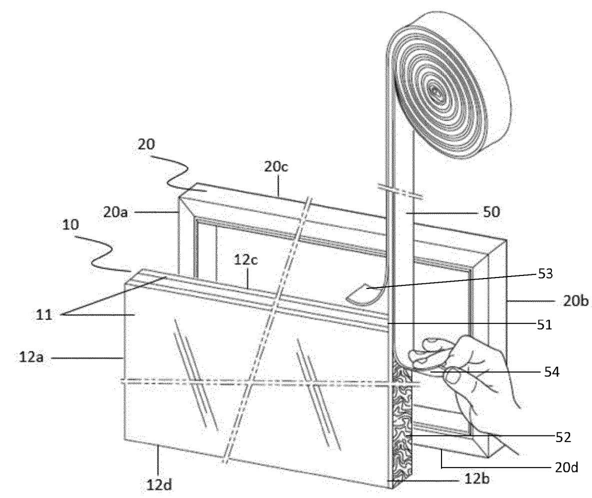


FIG. 1

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## Description

### Technical Field

**[0001]** The present invention relates, in general to a soundproof glass unit comprising an insulating glazing and viscoelastic adhesive strips for mounting the insulting glazing in a framework and mounting the framework in an opening of a building frame. The viscoelastic adhesive strips provide an acoustic seal between the insulating glazing and the framework, the framework and the building frame, respectively.

### Background

**[0002]** Bonding an insulated glazing into a building structure often requires cleaning the surface of the framework housing the insulating glazing to remove contaminants, applying a primer to the area of the framework to which an adhesive is to be applied and then applying the adhesive generally to the periphery of the framework. Thereafter, the insulated glazing with the adhesive applied thereto is placed into a building frame in an opening of a building structure with the adhesive disposed between the building frame and framework housing the insulating glazing and the adhesive is cured to hold the insulated glazing in place. Thus the conventional practice of mounting an insulated glazing is cumbersome, time consuming and is often done by unskilled labors often necessitating additional bonding, caulking etc.

**[0003]** In an office or apartment, windows are one of the main causes of heat loss in cold weather and glass being a rigid, inelastic material is a bad conductor of sound and therefore reflects noise. Thus a traditional single pane window does relatively little to actually prevent noise from entering the home. Adjusting thickness of the glass panes, adding interlayers between the glazing and increasing spacing between the glazing panels are some of the known ways of achieving acoustic benefits. While these approaches are very effective, prices associated with them are relatively huge.

**[0004]** Acoustically effective coatings and foams are used for vibration damping and noise damping of sounds transmitted through windows in a building. Apartments, condominiums, hotels, schools and hospitals all require rooms with windows that reduce the transmission of sound thereby minimizing, or eliminating, the disturbance to people in adjacent rooms. Soundproofing is particularly important in buildings adjacent to public transportation, such as highways, airports and railroad lines. Additionally, theaters, home theaters, music practice rooms, recording studios and the like require increased noise abatement. Thus acoustic benefit has been widely recognized as a measure of acoustic comfort which results in comfort living.

**[0005]** Solutions that describe sound damping by way of the configuration of the insulated glazing bonding system have therefore already been described in the patent literature. The document US7041377 relates to sound insulating members exhibiting both high vibration damping performance and high sound insulation performance. The invention proposes the use of vibration damping materials such as chlorine-containing thermoplastic resins containing 20 to 70 wt. % of chlorine to be formed into sheets, films, plates, bars, blocks or the like and affixing transparent rigid members onto the vibration damping materials. The resulting assembly maybe affixed to an existing window glass plate.

**[0006]** The document US7087127 describes a method for bonding a window into a structure by applying to the window or a window frame a silane functional adhesive composition that eliminates the need for a primer. However, the described adhesive composition has no damping properties and hence cannot provide any acoustic benefit. A few other patent applications (e.g. DE19806122 and WO99/16618) propose combinations of two different products: strength-developing adhesive layers or profiles, combined with vibration-damping substances of varying consistency. The arrangement of these combinational products with respect to the window varies. Because of the complex application technology and lack of suitable products, none of the aforesaid developments has yet succeeded in finding a popular use in the market place.

**[0007]** Thus the use of a single adhesive that combines both good damping and sufficient mechanical strength seems advantageous to reduce the complexities associated with the existing combinational products. A demand therefore exists for an adhesive whose performance matches that of the well-known one-component polyurethane window adhesives in terms of its processing, strength, adhesion properties, and its long-term stability, and additionally possessing good damping properties in the form of a high dynamic mechanical loss factor.

**[0008]** Thus notwithstanding all the existing technology there is still a need in the art for simpler installation methods for insulating glazing involving less labor, time and skill. There is also a need in the art for acoustically and mechanically improved installation methods that eliminate further additional attention and care.

**[0009]** The present invention therefore proposes a soundproof glass unit comprising:

at least one insulating glazing to be mounted in a framework; and

at least one viscoelastic adhesive strip attached to at least one of the flanges of the insulating glazing or adapted to be attached to at least one of the profiles of the framework,

wherein said viscoelastic adhesive strip comprising at least one sound damping copolymer selected from the group consisting of vinyl acetate-olefin copolymer; terpolymers of vinyl acetate, olefin & vinyl ester monomer; terpolymers of vinyl acetate, vinyl ester & (meth)acrylate monomer; copolymer of vinyl acetate

& acrylic monomer; or acrylic ester-styrene copolymer or their combinations thereof, and
wherein the copolymer has a loss factor greater than 1.6 at a temperature at least in the range of -10° C to +70° C and at a frequency of 100Hz, said insulating glazing being adapted to be attached to a framework or the framework being adapted to be attached to a building frame thanks to the viscoelastic adhesive strip.

**[0010]** The use of the viscoelastic adhesive strip comprising sound damping copolymers for mounting a glazing unit in a framework and thereon mounting the framework in a building frame permits involving less labor, time and skill with regard to the conventional manner of installing glazing units and an inexpensive, simple and effective way of providing an acoustically improved glazing unit. The sound damping copolymers in the viscoelastic adhesive strip of the present invention, with their properties as defined in claim 1, reduces vibration and noise disturbances in a building window, permitting an acoustically and mechanically improvement.

**[0011]** The invention further proposes a method for mounting a glass unit.

Summary of the Disclosure

**[0012]** The objective of the present invention is therefore to provide a soundproof glass unit, that is efficient more particularly at low frequency (about 100 Hz) and high frequency located at 'dip' of around 1000 Hz, using viscoelastic adhesive strips as an alternative or complimentary to the existing means of bonding and sealing the insulating glazing unit.

**[0013]** According to the invention, the soundproof glass unit comprises at least one insulating glazing unit to be mounted in a framework and at least one viscoelastic adhesive strip which is attached to at least one of the flanges of the insulating glazing and that comprises at least one component made of sound damping copolymers, having a loss factor greater than 1.6 at a temperature at least in the range of -10° C to +70° C and at a frequency of 100Hz. The glass transition temperature of the sound damping copolymers varies between -20°C and +25°C. Once the insulating glazing unit is mounted in the framework, at least one viscoelastic adhesive strip is attached to at least one of the profiles of the framework for mounting the framework with the insulating glazing in a building frame present in an opening of the building.

**[0014]** The glass transition temperature and loss factor of the sound damping copolymers are measured using differential calorimetry analysis according to the ISO 11357-1:2009 standard.

**[0015]** Increasing building window thickness is an obvious way of increasing mass for better acoustic. However, a phenomenon that limits the improved reduction in noise occurs due to a 'dip' in performance at certain frequencies. This is referred to as coincidence dip. The coincidence dip is dependent on the material's stiffness and thickness and occurs at a point where the sound transmitted through the insulating glass unit matches the natural frequency of the glass panes. This phenomenon occurs at higher frequencies in glass. Using absorptive material to cover the surface of the framework in between the panes of glass provides additional attenuation. This increases the Sound Transmission Class (STC) rating that describes the acoustical capabilities of a window and substantial reductions are achieved for higher frequency noise of up to 10 dB.

**[0016]** The inventors of the present invention have demonstrated that the combination of a viscoelastic adhesive strip with the insulating glazing unit in order to dissipate noise is even more effective when the material of the strip has sound damping properties (which is linked to the loss factor) and especially when the strip is rigid (which is linked to the Young's modulus of the material or materials constituting the strip) in order to ensure contribution to window acoustics.

**[0017]** Preferably, the viscoelastic adhesive strip is arranged on each of the flanges of the insulating glazing unit or on each of the profiles of the framework. It preferably extends over most of the length of flanges of the insulating glazing unit and/or most of the length of the profiles of the framework. The geometry of the strip can be adapted to the shape of the glazing or the framework, accordingly. The viscoelastic adhesive strip could thus have a conventional rectangular shape, or a more complex shape such as a trapezium, for example. Further the strips applied over the flanges or the framework are provided either in a continuous or a discontinuous manner to cover the length of the flanges or framework, respectively. With this manner of arrangement of the viscoelastic adhesive strips, the strips seal or bond the insulating glazing unit in the framework and further seal and bond the insulated glazing unit (comprising the insulating glazing unit mounted within the framework) to a building frame that is arranged in an opening of a building. The mounted glazing and framework seldom require additional sealants or adhesive for bonding and/or caulking.

**[0018]** According to another feature, the viscoelastic adhesive strip can be arranged in the vicinity of the edge or at the edge of the flanges of the insulating glazing unit and/or arranged in the vicinity of the edge or at the edge of the profiles of the framework. In such an arrangement, the strips do not contribute to sealing of the insulating glazing unit within the framework or caulking/ bonding of the framework on a building frame, respectively but rather necessitate the use of conventional sealants or caulking agents for establishing the seal or bond, while contributing particularly to the acoustic properties of the glass unit.

**[0019]** According to another feature, the viscoelastic adhesive strip can comprise a plurality of components made from the sound damping copolymers. According to another feature, flanges of the insulating glazing unit and/or profiles of the framework may comprise viscoelastic adhesive strips that comprise the same sound damping copolymers or a combination of different sound damping copolymers. The viscoelastic adhesive strip comprises at least one sound damping copolymer selected from the group consisting of vinyl acetate-olefin copolymer; terpolymers of vinyl acetate, olefin & vinyl ester monomer; terpolymers of vinyl acetate, vinyl ester & (meth)acrylate monomer; copolymer of vinyl acetate & acrylic monomer; or acrylic ester-styrene copolymer or their combinations thereof.

**[0020]** The insulating glazing mounted in the framework is to be housed in a building frame with the strips being hidden from view.

**[0021]** According to another feature, the framework according to the present invention further comprises a sash.

**[0022]** Another objective of the present invention is a method for mounting the glass unit in a building opening with an objective of reducing the acoustic and vibrational disturbances in the building, the method comprising attaching to the flanges of the insulating glazing or the profile of the framework housing the insulating glazing at least one viscoelastic adhesive strip and mounting the insulating glazing in the framework or the framework in an opening of a building frame using the viscoelastic adhesive strips to form an acoustic seal between the insulating glazing and the framework or between the framework and the building frame.

**[0023]** The viscoelastic adhesive strip being a double-sided adhesive tape is compatible in bonding to the surfaces of the flanges of the glazing, profiles of the framework, as well as the surface of the building frame. Thus requiring no additional adhesives for establishing the sealing, bonding and/or caulking of the glass unit.

**[0024]** Other features and aspects of this disclosure will be apparent from the following description and the accompanying drawings. The figures and the description of the invention which follow will make it possible to understand what was the technical problem to be solved and how it has arrived at in the solution according to the invention is to provide.

## Brief Description of the Drawings

**[0025]** Embodiments are illustrated by way of example and are not limited to those shown in the accompanying figures.

**FIG.** 1 illustrates an isometric view of an insulating glazing before being mounted in a framework, according to one embodiment of the present invention;
**FIG. 1A** illustrates front view of an insulating glazing before being mounted in a framework, according to another embodiment of the present invention;
**FIG. 2** illustrates a cross-sectional view of an insulating glazing being mounted in a framework, according to one embodiment of the present invention;
**FIG. 2A** illustrates a cross-sectional view of an insulating glazing being mounted in a framework, according to another embodiment of the present invention;
**FIG. 3** illustrates an isometric view of an insulated glazing being mounted on a building frame in an opening of a building structure, according to one embodiment of the present invention;
**FIG. 4** illustrates an isometric view of an insulated glazing mounted on a building frame in an opening of a building structure, according to one embodiment of the present invention;
**FIG. 5** the cross-sectional view of an insulated glazing mounted on a building frame, according to one embodiment of the present invention;
**FIG. 6** shows the loss factor of copolymers plotted at 20°C; according to the present invention; and
**FIG. 7** shows the loss factor of copolymers plotted at 100 Hz according to the present invention.

**[0026]** 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

**[0027]** Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or similar parts. Embodiments disclosed herein are related to viscoelastic adhesive strips that enable mounting of an insulating glazing in a framework and thereon the framework in a building frame present in an opening of a building structure to provide a soundproof glass unit.

**[0028]** **FIG. 1** illustrates an insulating glazing 10 equipped with at least one viscoelastic adhesive strip 50 of the present invention, according to one embodiment of the present invention. The insulating glazing 10 shown here is double glazed and therefore comprises two sheets of glass 11, but in alternate embodiments, it could comprise two or more glass sheets separated by spacers placed circumferentially between the glass sheets. The circumferential edges of the insulating glazing 10 are defined by flanges 12a, 12b, 12c and 12d. According to the first objective of the present invention the insulating glazing 10 is intended to be to be mounted in a framework 20 formed by a pair of left and right longitudinal profiles 20a, 20b, and an upper transverse profile 20c and a lower transverse profile 20d. The upper transverse profile 20c and lower transverse profile 20d are connected to the longitudinal profiles 20a, 20b at upper and lower positions of the longitudinal profiles, respectively.

**[0029]** The at least one viscoelastic adhesive strip 50 is positioned, preferably on each of the flanges 12a, 12b, 12c and 12d as illustrated in **FIG. 1**, where the viscoelastic adhesive strip 50 is seen to be positioned on the flange 12b of the insulating glazing such that while mounting the viscoelastic adhesive strip 50 is positioned between the flange 12b and the right longitudinal profile 20b of the framework 20. Cross-sectional view of the embodiment described in **FIG. 1** is shown in **FIG. 2.**

**[0030]** In another embodiment, the insulating glazing 10 further comprises a marginal part 13 that is present a little away from the circumferential edges of the insulating glazing 10 and delimited by a dotted line shown in **FIG. 1A.** The marginal part 13 is known to abut the profiles of the framework 20 while the insulating glazing 10 is mounted in the framework 20. Thus, in another embodiment of the present invention, the viscoelastic adhesive strip 50 is seen to be provided in the space between the circumferential edges of the flanges and the marginal part 13. A cross-section view of the said embodiment is illustrated in **FIG. 2A.**

**[0031]** The at least on viscoelastic adhesive strip 50 comprises at least one sound damping copolymer. The sound damping copolymer has a loss factor greater than 1.6 at a temperature at least in the range of -10 °C to +70 °C and at a frequency of 100Hz. This frequency of 100Hz is advantageous, as the frequencies to be conserved in general in windows ranges from 125 to 4000 Hz, and at higher frequencies the phenomena of the coincidence dip occurs in glass. It is around this frequency of 100Hz that the transmission of noise from outside the building through the glass unit is the most significant and is expressed as pronounced drop in the acoustics. The invention therefore relates more particularly to this frequency in order to improve the viscoelastic damping of the glass unit.

**[0032]** According to one embodiment, the sound damping copolymer present in the viscoelastic strip 50 is selected from the group of copolymers consisting of vinyl acetate-olefin copolymer; terpolymers of vinyl acetate, olefin & vinyl ester monomer; terpolymers of vinyl acetate, vinyl ester & (meth)acrylate monomer and copolymer of vinyl acetate & acrylic monomer. The copolymers of vinyl acetate and olefin have a glass transition temperature that varies from -10°C to +25°C. In yet another embodiment, the sound damping copolymer is acrylic ester-styrene copolymers, a high solids aqueous dispersion, which have a glass transition temperature that varies from -20 to 10°C. The copolymer of vinyl acetate & acrylic monomer has a total solid content of 57% and a viscosity of 2250 mPa.s. The acrylic ester-styrene copolymer is a high solids aqueous dispersion of acrylic ester and styrene. The dispersion contains an anionic emulsifier system and is free from film forming aids, solvents, plasticizers, and ammonia. The acrylic ester-styrene copolymer has a glass transition temperature of -11°C.

**[0033]** The viscoelastic adhesive strip 50 (also referred as strip 50), according to one embodiment is a double-sided adhesive tape with a first bonding face 51 to be attached to the flanges 12 of the insulating glazing 10 and a second bonding face 52 which is to be attached to the profiles of the framework 20, according to the embodiment illustrated in **FIG. 1.** In an optional embodiment, the first and second bonding faces 51, 52 of the viscoelastic adhesive strip 50 can further comprise a first liner 53 and a second liner 54, respectively. The first liner 53 and second liner 54 are peelably attached to the first and second bonding faces, respectively and are peeled before use of the viscoelastic adhesive strip 50. According to the embodiment illustrated in **FIG. 1**, the first liner 53 is peeled away before attaching the first bonding face 51 to the flanges 12 of the insulating glazing 10 and just before the insulating glazing 10 is ready to be mounted in the framework 20, the second liner 54 is peeled away from the second bonding face 52.

**[0034]** The self-adhesive property of the viscoelastic adhesive strip 50 of the present invention eliminates the use of other additional sealants for bonding the insulating glazing 10 to the framework 20. The viscoelastic adhesive strip 50 can be applied on the flanges 12 in a continuous manner as illustrated in **FIG. 1.** However, in other alternate embodiments, the viscoelastic adhesive strip 50 can also be applied in a discontinuous manner.

**[0035]** According to one embodiment, the viscoelastic adhesive strips 50 are provided in a discontinuous manner in each of the flanges 12a, 12b, 12c and 12d of the insulating glazing 10. The strips 50 are cut to be flush with the width of the flanges such that once the insulating glazing 10 is mounted within the framework 20 the strips 50 are hidden from view. According to one other embodiment, the strips 50 are provided only on the four edges of the flanges 12 of the insulating glazing 10. According to yet another embodiment, the strips 50 are provided only centrally on the flanges 12 in a discontinuous manner. Optionally additional sealants for bonding of the insulating glazing 10 to the framework 20 can be employed in these embodiments. These sealants may be used in the space between the strips 50.

**[0036]** In all the above variants, the strips 50 provided on all the flanges 12 of the insulating glazing 10 can be those that are comprised of the same sound damping copolymers listed earlier or can use a combination of strips 50 that are made from different copolymers. In a preferred embodiment, all the viscoelastic strips 50 are made from acrylic ester-styrene copolymer. For example, the strips 50 provided on the flanges 12d, 12c can be comprised of one of the copolymers while the strips 50 provided on the flanges 12a, 12b can be comprised from another copolymer different from that present in the strips 50 provided in the flanges 12c, 12d. In a preferred embodiment, the upper and the flanges are provided with viscoelastic strips 50 comprising acrylic ester-styrene copolymer while the left and right flanges are provided with viscoelastic strips 50 comprising vinyl ester & (meth)acrylate monomer. In yet another variant the strips 50 can be made from a blend of any two or more sound damping copolymers listed earlier. In a preferred embodiment, the viscoelastic strips 50 are made from a blend of ester-styrene copolymer, vinyl ester & (meth)acrylate monomer.

**[0037]** It is also possible to envision, other such variant of the embodiment and all such variations will be encompassed within the scope of the present invention and the arrangements illustrated in the figures described above are indicative, intended for teaching purposes only and do not in any manner limit the scope of the present invention.

**[0038]** Thereby the insulating glazing 10 is mounted in the framework 20 according to any one or more embodiments described above. According to the second objective of the present invention, the framework 20 holding the insulating glazing 10 is to be mounted in a building frame 120 present in an opening 110 of a wall structure 100. The viscoelastic adhesive strips 50 of the present invention are again used for this objective. Preferably, each of the left, right, upper and lower transversal profiles 20a, 20b, 20c, 20d are applied with the viscoelastic adhesive strips 50 by bonding either its first bonding face 51 or second bonding face 52.

**[0039]** Again as described in the previous embodiment, the at least one viscoelastic adhesive strip 50 can be applied either in a discontinuous manner or in a continuous manner such that the strips 50 are overlaid on each of the profiles 20a, 20b, 20c, 20d of the framework 20. The at least one viscoelastic adhesive strip 50 comprising one or more sound damping copolymers is cut-to-size before being applied on the profiles of the framework 20. The at least one strip 50 is generally applied to be flush with the profiles of the framework 20 such that when the framework 20 is mounted in the building frame 120, the at least one strip 50 is hidden from view. According to multiple embodiments, the strips 50 provided on the framework 20 can be applied in any discontinuous manner as described earlier. Each of the viscoelastic strips 50 provided on the four profiles of the framework 20, according to one aspect of the embodiment is comprised of the same sound damping copolymers. In a preferred embodiment, the viscoelastic strips 50 are made from acrylic ester-styrene copolymer.

**[0040]** In one other embodiment, the viscoelastic strips 50 provided on any two profiles of the framework 20 can be comprised of a sound damping copolymer that is different from the sound damping copolymer comprised in the viscoelastic strips 50 provided on the remaining profiles of the framework 20. In a preferred embodiment, the upper and the lower transverse profiles 20c, 20d are provided with viscoelastic strips 50 comprising acrylic ester-styrene copolymer while the left and right profiles 20a, 20b are provided with viscoelastic strips 50 comprising vinyl ester & (meth)acrylate monomer. In still another embodiment, the viscoelastic strips 50 can be made from a blend of two or more sound damping polymers. In a preferred embodiment, the viscoelastic strips 50 are made from a blend of ester-styrene copolymer, vinyl ester & (meth)acrylate monomer.

**[0041]** Referring to **FIG. 3** illustrates yet another embodiment of the present invention, wherein the viscoelastic adhesive strips 50 are provided both on the framework 20 holding the insulating glazing 10 as well as the building frame 120 present in the wall opening 110. According to this embodiment, the viscoelastic adhesive strips 50 can be seen to be provided on the upper and right longitudinal profiles 12c, 12b; left and bottom portion of the building frame 120. Reverse of such an arrangement is also envisioned within the scope of this present invention, in order to establish the mounting and bonding of the framework 20 holding the glazing unit 10 on the building frame 120.

**[0042]** Still another alternate embodiment of the present invention the viscoelastic adhesive strips 50 are attached to the building frame 120 instead of being provided on the framework 20 holding the insulating glazing 10. The building frame 120 are conventionally made of wood. However, the building frame 120 can be one that is made of any such material as vinyl, aluminum, fiberglass, steel, PVC etc., As is known the height and width of the building frame 120 in the opening 110 of the wall 100 mirrors the structural dimension of the framework 20. The building frame 120 in general comprises a groove for receiving the framework 20 of the insulating glazing 10.

**[0043]** It is on this groove that the viscoelastic adhesive strips 50 of the present invention are provided with. Typically, the viscoelastic adhesive strips 50 are present in a tape roll such that the strip 50 is cut-to-size before being attached to the groove of the building frame 120 through either one of their bonding faces. Nevertheless, there could also be instances where the viscoelastic adhesive strips 50 are found to be protruding out from the building frame 120 as illustrated in **FIG. 4** post attaching the strips to the building frames 120. In such instances the portions of the strips 50 extending outward can be trimmed or cut in order to get a seamless aesthetically appealing finish to the sound proof glass unit thus installed. Cross-section view of the same is depicted in **FIG. 5.**

**[0044]** For all above described embodiments, the method of mounting an insulating glazing 10 comprises the following steps: attaching the at least one viscoelastic adhesive strip 50 entirely or partially to the insulating glazing 10 or to the framework 20 via the first bonding face 51 of the at least one viscoelastic adhesive strip 50 and mounting the insulating glazing 10 in the framework 20 or the framework 20 in an opening 110 of a building frame 120 via the second bonding face 52 of the at least one viscoelastic adhesive strip 50 to form an acoustic seal between the insulating glazing 10 and the framework 20 or between the framework 20 and the building frame 120. The first liner 53 from the first bonding face 51 is removed before attaching the at least one viscoelastic adhesive strip 50 to the insulated glazing 10 or to the framework 20 and/or the second liner 54 from the second bonding face 52 is removed before mounting the insulating glazing 10 to the framework 20 or the framework 20 to the building frame 120.

**[0045]** Thus the use of at least one viscoelastic adhesive strip 50 of the present invention reduces time, skill and complexity associated with the conventional means of mounting insulated glazing units and further provides an equally simple means of obtaining a soundproof acoustically improved glazing unit.

Comparative Example

Loss Factor

**[0046]** Loss factor of the sound damping copolymers viz., copolymer of vinyl acetate & acrylic monomer (VN) and acrylic ester-styrene copolymer (AE) prepared according to the present invention was compared against carboxylated styrene-butadiene copolymer (SB) and acrylic/PU copolymer (R) available in market place. The measurements were carried out at a fixed temperature for changing frequency values (plotted in **FIG. 6**) and at a fixed frequency for changing temperature ranges (plotted in **FIG. 7**). Such kind of measurements are critical for studying damping properties.

**[0047]** The polymers were held at a fixed temperature (20°C) and tested at varying frequencies. Peaks in tan $\delta$ and in E" with respect to the frequency is associated with the glass transition, that corresponds to the ability of the polymer chains to move past each other. This implies that the glass transition is dependent on strain rate in addition to the temperature. Secondary transitions may as well be observed. Likewise, the polymers were held at a constant low frequency (100 Hz) and tested at varying temperatures. A prominent peak in tan $\delta$ appears at the glass transition temperature of the polymer. Secondary transitions can also be observed that attribute to the temperature-dependent activation of a wide variety of chain motions. In the case of semi-crystalline polymers, separate transitions can be observed for the crystalline form and the amorphous form. Similarly, multiple transitions are often found in polymer blends.

**[0048]** From **FIG. 6** it is understood that at 20°C and at low frequencies copolymer of vinyl acetate & acrylic monomer (VN) provided the best results for a low frequency of 10 Hz. Whereas at 20°C and at high frequencies acrylic ester-styrene copolymer (AE) provided the best results at a high frequency of 1000 Hz. Thus the loss factor of the copolymers of the present invention were found to be greater than 1 resulting in improved acoustic benefit.

**[0049]** From **FIG. 7** it is understood that at 100 Hz and low temperature ranges acrylic ester-styrene copolymer (AE) provided the best results at a temperature of 10°C and at 100 Hz for high temperature ranges copolymer of vinyl acetate & acrylic monomer (VN) provided the best results at a higher temperature of 40°C. Thus the loss factor of the copolymers of the present invention were found to be greater than 1 resulting in improved acoustic benefit.

**[0050]** It will be evident that the invention has application to a wide variety of framed structures in addition to the insulated glazing illustrated, for example windows of buildings and vehicles. Although the invention is described for mounting insulating glazing, the application of the invention also extends to mounting monolithic glazing in framework and thereon the framework in the building frame. The use of the invention for mounting of frameless glazing units are also envisioned within the scope of this present invention.

**[0051]** Viscoelastic adhesive strips composed of sound damping polymers may also be used as replacements for traditional sealants used in insulating glazing units and caulking or bonding adhesives used in frame bonding during installation and renovation activities.

**[0052]** While the present invention has been described with reference to particular embodiments thereof, it will be understood that numerous modifications may be made by those skilled in the art without actually departing from the scope of the invention. Therefore, the appended claims are intended to cover all such equivalent variations as come within the true spirit and scope of the invention.

## Claims

1. A soundproof glass unit comprising:

   at least one insulating glazing 10 to be mounted in a framework 20; and
   at least one viscoelastic adhesive strip 50 attached to at least one of the flanges 12 of the insulating glazing 10 or adapted to be attached to at least one of the profiles of the framework 20, wherein said viscoelastic adhesive strip 50 comprising at least one sound damping copolymer selected from the group consisting of vinyl acetate-olefin copolymer; terpolymers of vinyl acetate, olefin & vinyl ester monomer; terpolymers of vinyl acetate, vinyl ester & (meth)acrylate monomer; copolymer of vinyl acetate & acrylic monomer; or acrylic ester-styrene copolymer or their combinations thereof, and
   wherein the copolymer has a loss factor greater than 1.6 at a temperature at least in the range of -10° C to +70° C and at a frequency of 100Hz, said insulating glazing 10 being adapted to be attached to a framework 20 or the framework 20 being adapted to be attached to a building frame 120 thanks to the viscoelastic adhesive strip 50.

2. The soundproof glass unit according to claim 1, wherein the sound dampening copolymer has a glass transition temperature that varies from -20°C to +25°C.

3. The soundproof glass unit according to one of the previous claims, wherein the viscoelastic adhesive strip 50 extends entirely or partially over the length of one or more of the flanges 12 of the insulating glazing 10 or is adapted to extend entirely or partially over the length of one or more of the profiles of the framework 20, wherein the framework 20 is formed

by a pair of left and right vertical profiles 20a, 20b, an upper and lower transverse profiles 20c, 20d connecting the left and right vertical profiles 20a, 20b at the upper and lower positions, respectively.

**4.** The soundproof glass unit according to one of the previous claims, wherein the viscoelastic adhesive strip 50 is attached to the insulating glazing 10 or is to be attached to the framework 20 in a continuous or discontinuous manner.

**5.** The soundproof glass unit according to one of the previous claims, wherein the viscoelastic adhesive strips 50 extending over the left and right vertical flanges 12a, 12b of the insulating glazing 10 or adapted to be attached over the left and right vertical profiles 20a, 20b of the framework 20 comprise sound dampening copolymers that are same or different from the sound dampening copolymers comprised in the viscoelastic adhesive strips 50 extending over the upper and lower transverse flanges 12c, 12d of the insulating glazing 10 or adapted to be attached over the upper and lower transverse profiles 20c, 20d of the framework 20.

**6.** The soundproof glass unit according to one of the previous claim, wherein the viscoelastic adhesive strip 50 is a double-sided adhesive tape with a first bonding face 51 attached to the insulating glazing 10 or attached to the framework 20 and a second bonding face 52 to be attached to a framework 20 or to a building frame 120, respectively, while mounting the insulating glazing 10 into the framework 20 or the framework 20 into an opening 110 of the building frame 120, respectively.

**7.** The soundproof glass unit of claim 6, wherein the first and second bonding faces 52, 52 further comprise first and second liner 53, 54 peelably attached to the first and second bonding faces, respectively.

**8.** The soundproof glass unit according to one of the previous claims, wherein the viscoelastic adhesive strip 50 is hidden from view when the insulating glazing 10 is mounted in the framework 20 or when the framework 20 is mounted in the opening 110 of a building frame 120.

**9.** The soundproof glass unit according to one of the previous claim wherein the framework 20 further includes a sash.

**10.** A method for mounting a glass unit according to one of the claims 1 to 9 comprising the steps of:

attaching viscoelastic adhesive strips 50 entirely or partially to the insulating glazing 10 or to the framework 20 via the first bonding face 51 of the viscoelastic adhesive strips 50; and

mounting the insulating glazing 10 in the framework 20 or the framework 20 in an opening 110 of a building frame 120 via the second bonding face 52 of the viscoelastic adhesive strips 50 to form an acoustic seal between the insulating glazing 10 and the framework 20 or between the framework 20 and the building frame 120.

**11.** The method according to claim 10, comprising removing the first liner 53 from the first bonding face 51 before attaching the viscoelastic adhesive strips 50 to the insulated glazing 10 or to the framework 20 and/or removing the second liner 54 from the second bonding face 52 before mounting the insulating glazing 10 to the framework 20 or the framework 20 to the building frame 120.

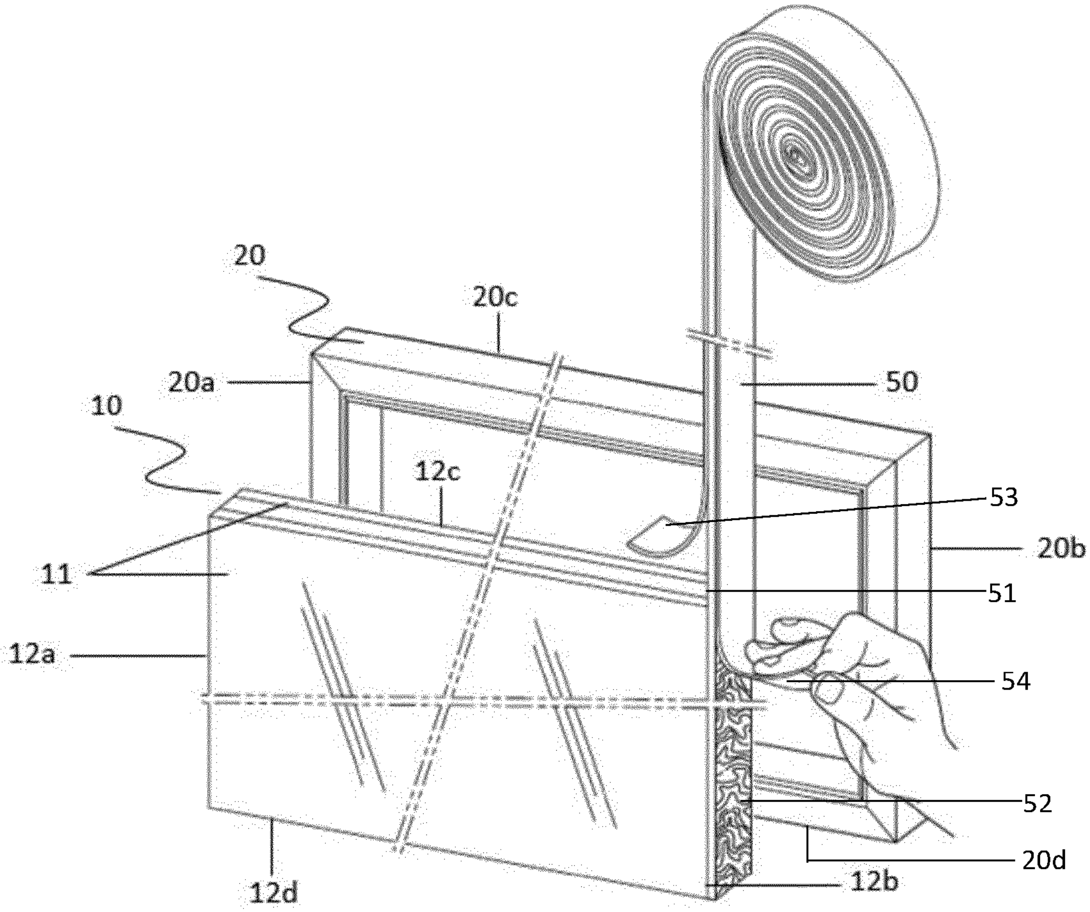
20
20c
20a
50
10
12c
53
11
20b
51
12a
54
52
20d
12d
12b

FIG. 1

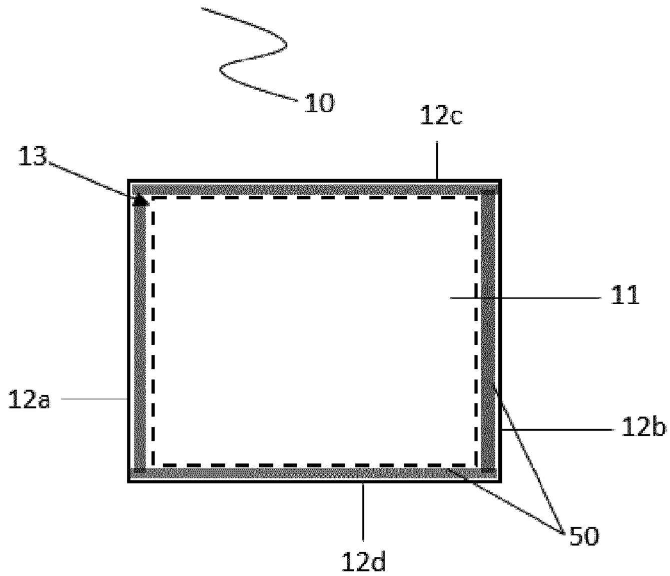
10
12c
13
11
12a
12b
50
12d

FIG. 1A

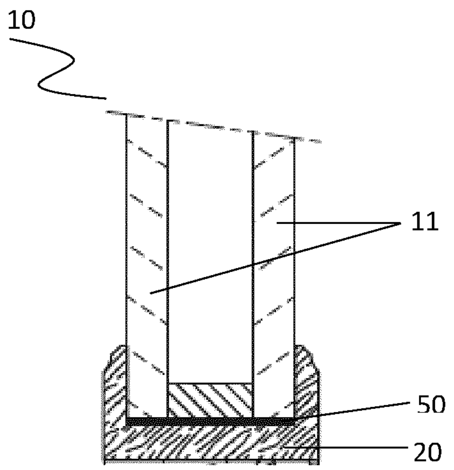


FIG. 2

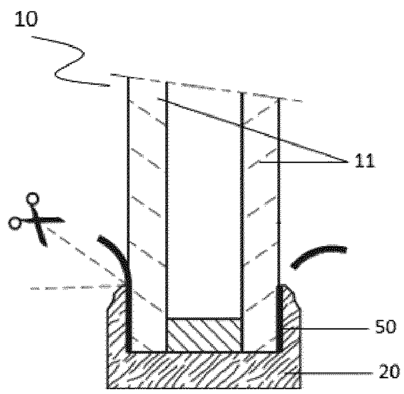


FIG. 2A

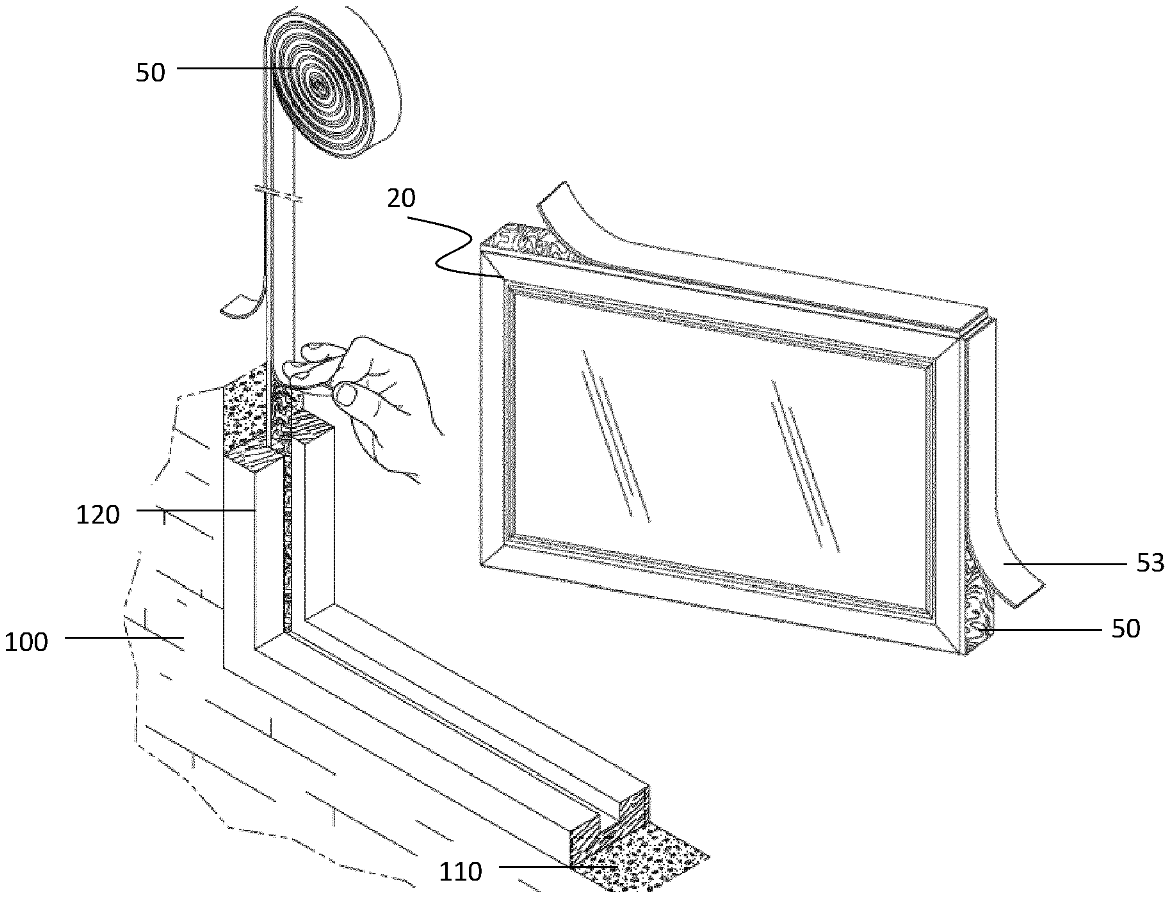


FIG. 3

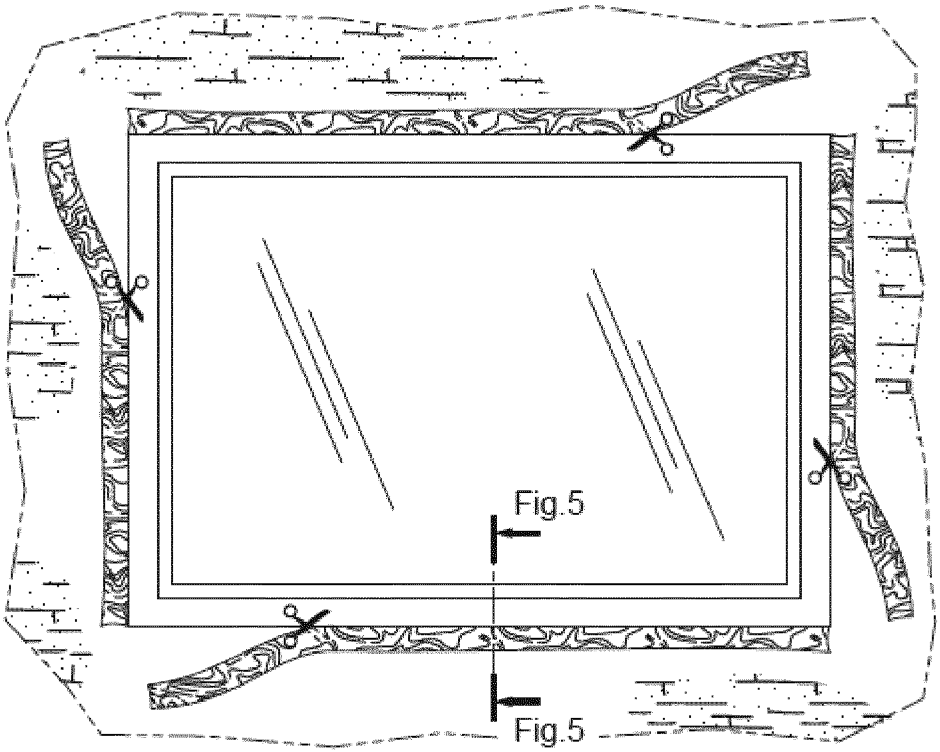


FIG. 4

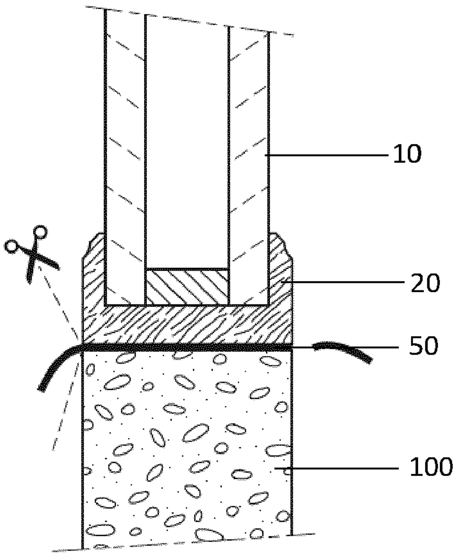


FIG. 5

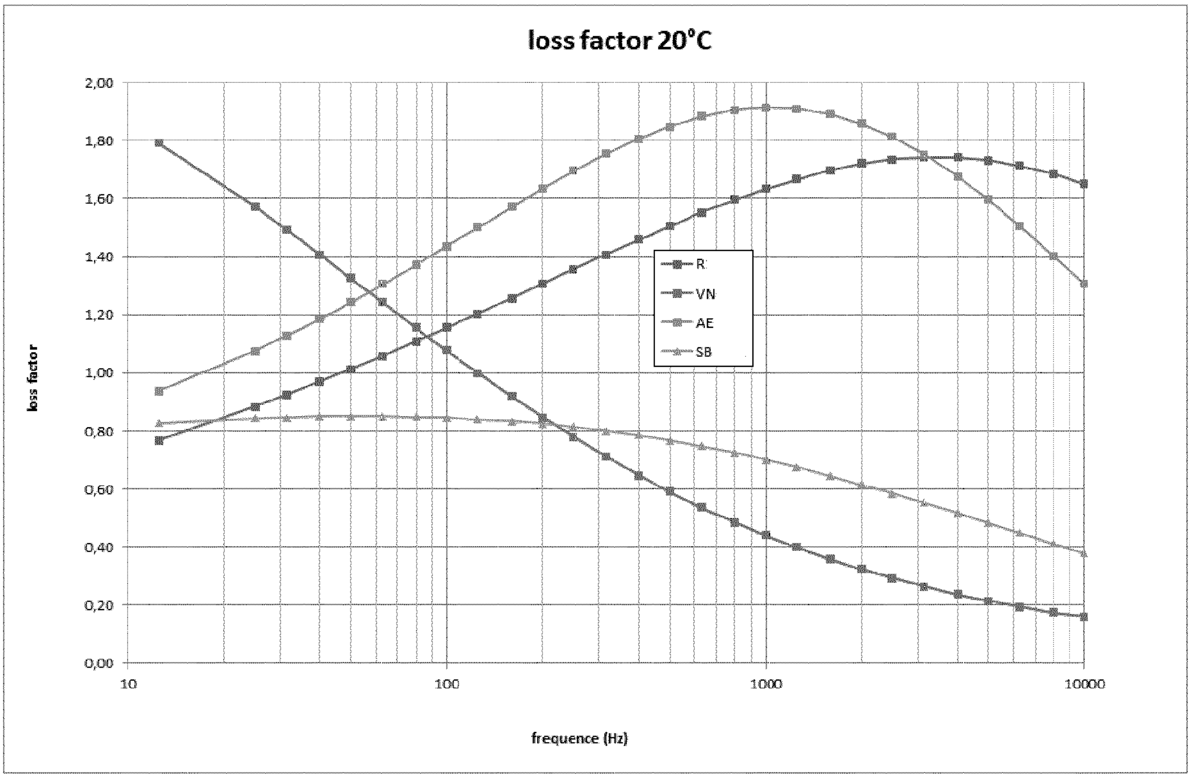
loss factor 20°C
2,00
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
loss factor
10
100
1000
10000
frequence (Hz)
R
VN
AE
SB

FIG. 6

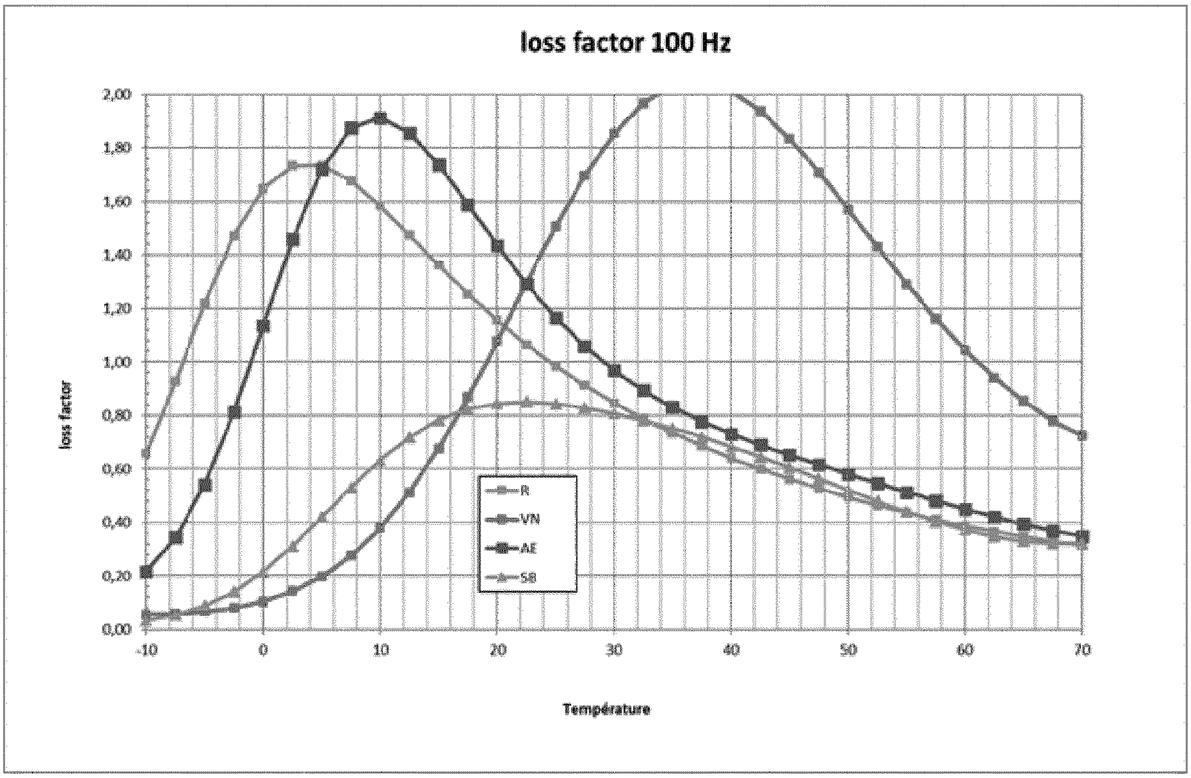
loss factor 100 Hz
2,00
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
loss factor
-10
0
10
20
30
40
50
60
70
Température
R
VN
AE
SB

FIG. 7

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Application Number
EP 20 19 9420

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E06B

The present search report has been drawn up for all claims

2

| Place of search | Date of completion of the search | Examiner |
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| The Hague | 16 March 2021 | Boufidou, Maria |

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16-03-2021

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