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SEALING ACCESS OPENINGS IN GLAZING UNITS

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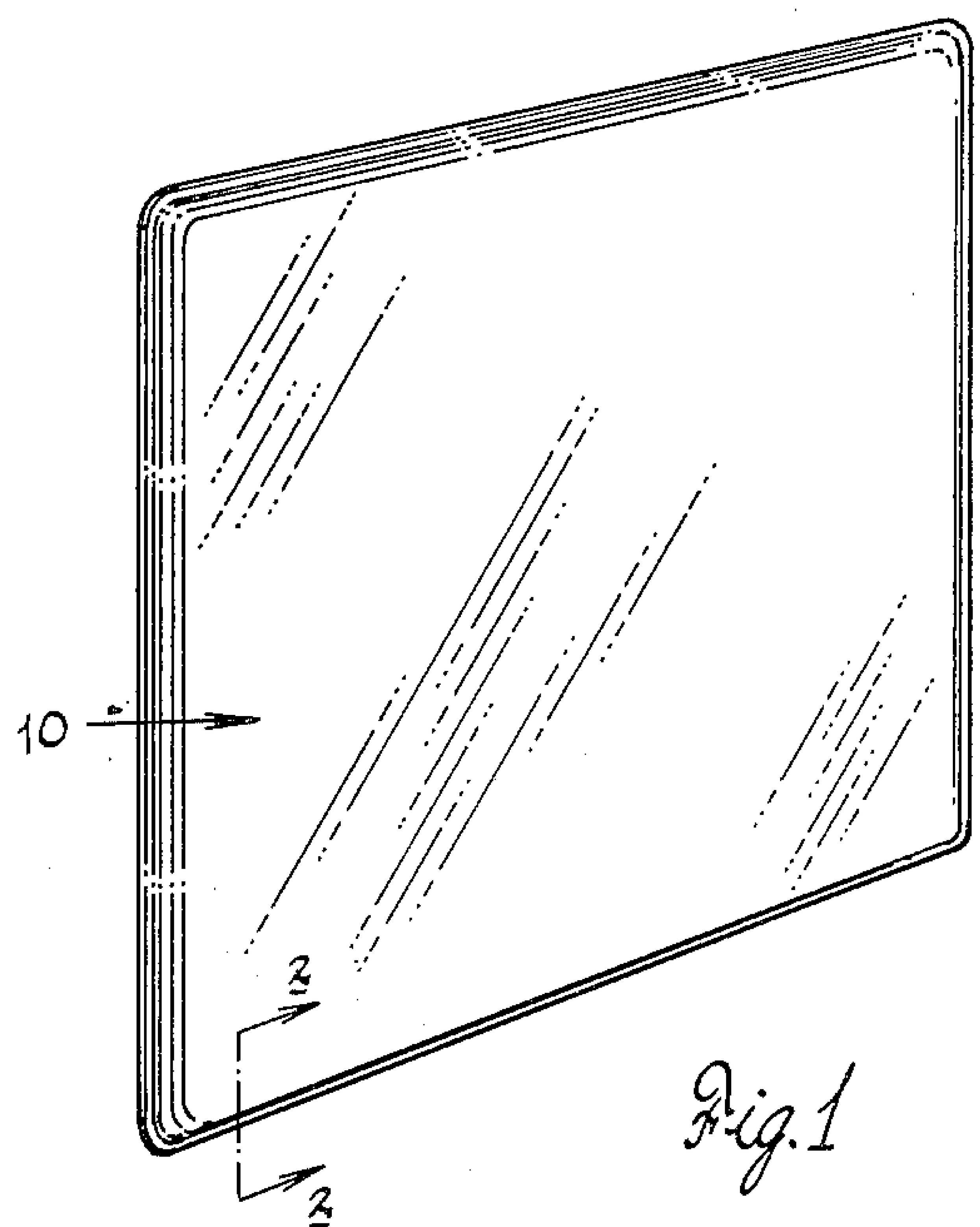

Fig. 1

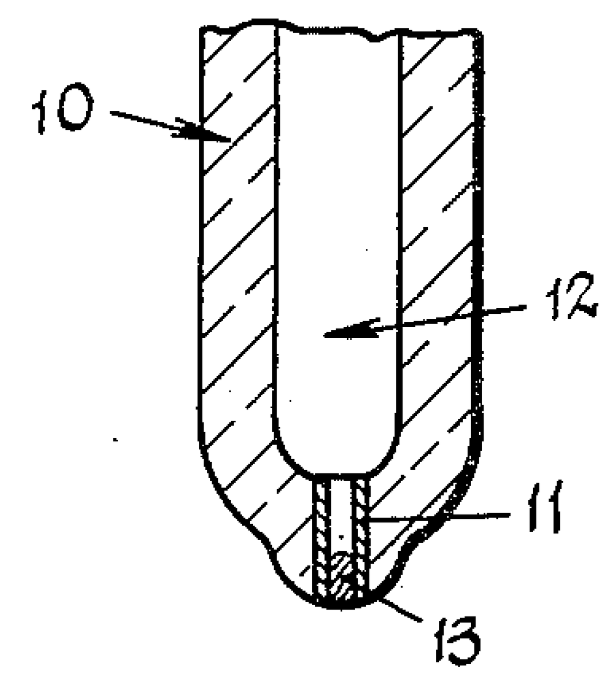

Fig. 2

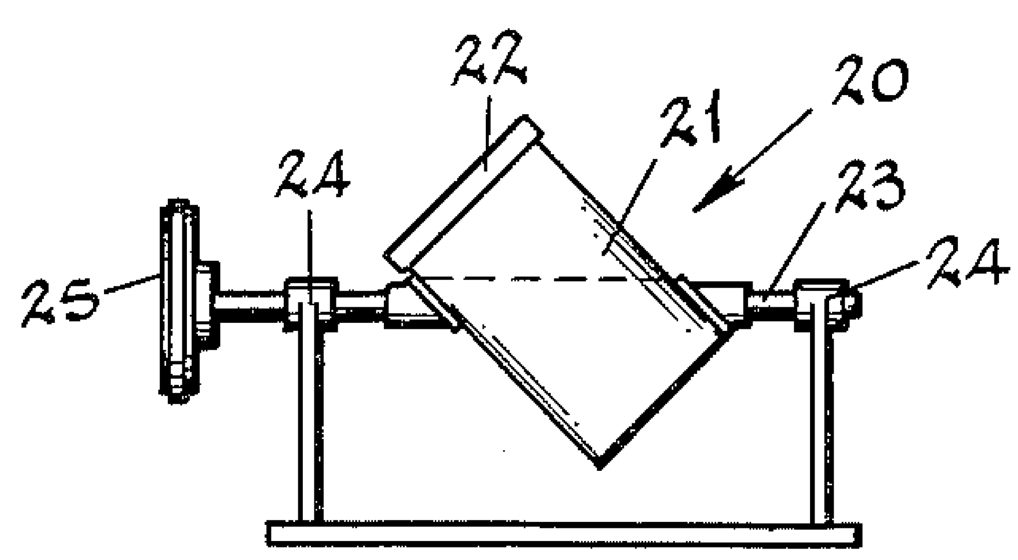

Fig. 4

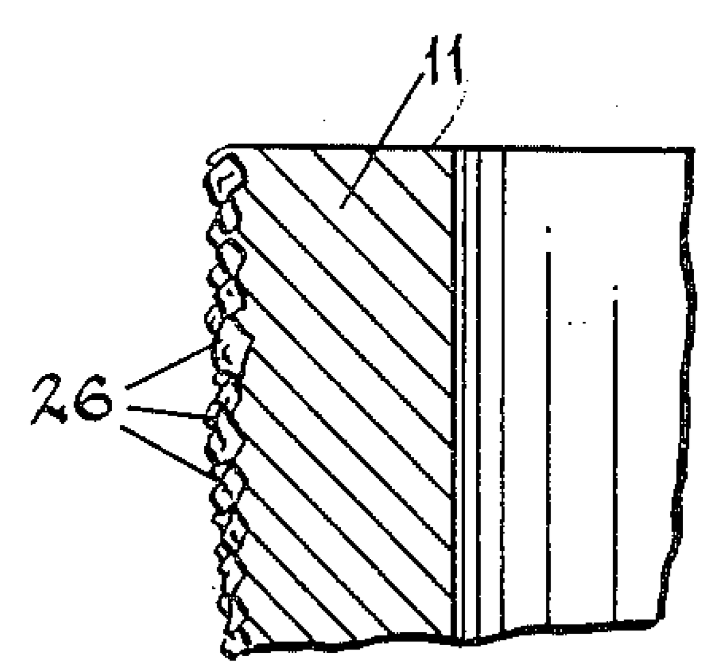

Fig. 5

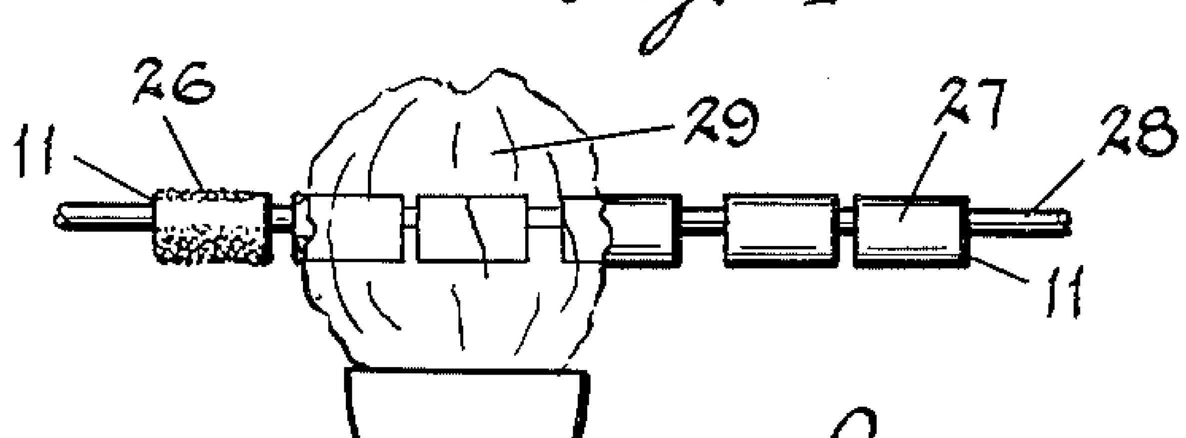

Fig. 6

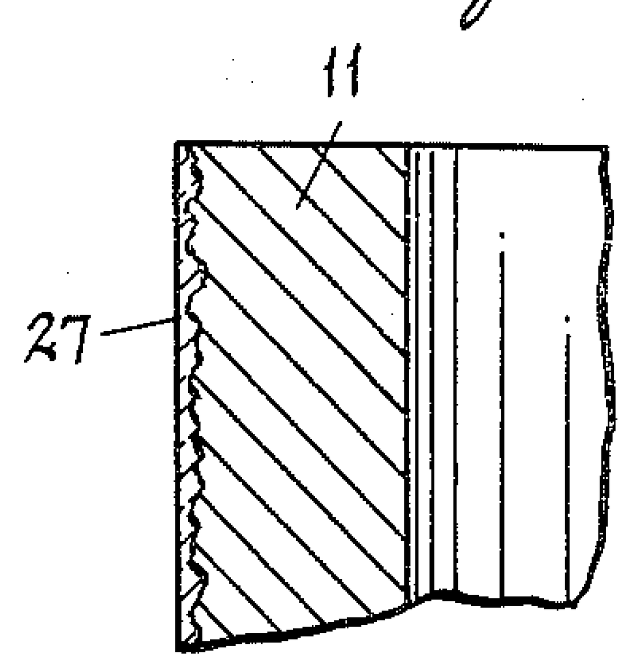

Fig. 7

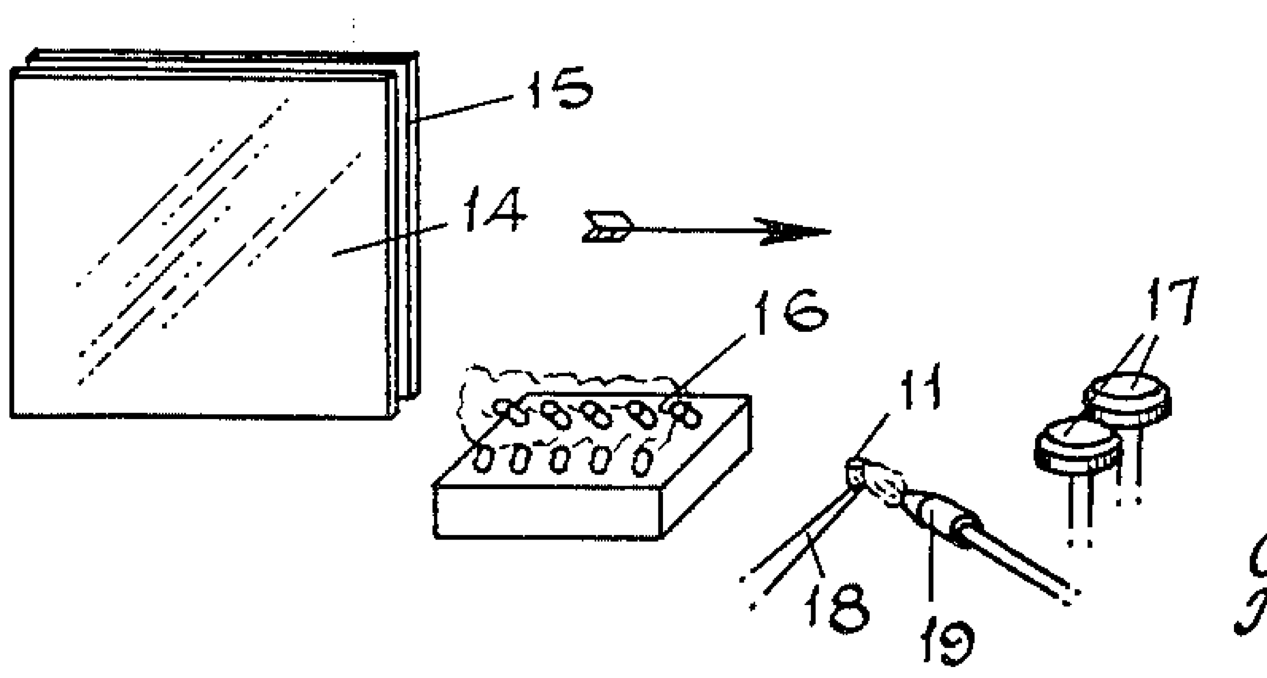

Fig. 3

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SEALING ACCESS OPENINGS IN GLAZING UNITS

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This invention relates broadly to all-glass multiple sheet glazing units, and more particularly to the sealing of the dehydration holes in such glazing units.

Multiple sheet glass glazing units of the type with which the invention is concerned generally comprise two or more sheets of glass that are arranged in spaced face-to-face relation and fused to one another entirely around their edge portions to provide an hermetically sealed air space therebetween. Due principally to their insulating and condensation-preventing qualities such units have been found to be especially valuable for use as windows in buildings, showcases, vehicles and the like.

In order to produce a multiple sheet glass glazing unit having the desired heat insulating and condensation-preventing qualities, one important step is the dehydration of the space between the glass sheets. This is conventionally performed by flushing out the normally moisture containing air from the interior of the unit and introducing dry air or gas under pressure therein. The procedure may be expedited by partially evacuating the interior of the unit before introducing the dry gas or air.

In order to remove the humid air from the enclosed space and supply dry air therefor after the sheets have been sealed together it is necessary to provide an access or dehydration opening to this space. Also after the space has been dehydrated the necessity arises to hermetically seal the opening in order to maintain the dehydrated condition of the unit.

A number of different ways of providing access openings to the enclosed space between the glass sheets have been devised. For example, the access opening can be drilled or cut in the face portions of the sheets or formed in an edge wall during fabrication.

Regardless of where in the unit the dehydration holes are placed, it is necessary to provide some type of permanent closure that will hermetically seal the opening. One method advanced for providing an adequate seal is to introduce into the opening a metallic sleeve-like insert coated with a low melting enamel and then fuse this assembly into the access hole. Such a metallic insert can be readily closed by a number of methods well known in the art, such as, the application of a solder.

However, the low melting enamels with which such inserts have heretofore been coated have not proved satisfactory in practice because under the heating necessary to seal the enamel coated metal insert into the glass of the glazing unit, the materials compounded into the low melting enamel, such as lead oxide or boric oxide, tend to produce a "bubbly" condition and do not permanently seal the opening. Moreover, the sealing heat will otherwise materially change the original identity of the enamel so as to alter its physical characteristics and properties. For example, the thermal expansion characteristics of the enamels, which initially were carefully chosen to match those of the glass of the unit, have been found to be so seriously affected by rapid and/or intense heating as to destroy the seal on temperature shock.

However, we have found that all of the disadvantages encountered with the use of enamels can be overcome by the provision of a special kind of glazed coating on the metal inserts which has substantially the same chemical composition as that of the glass sheets of the unit.

Briefly stated, applicants propose here to provide an improved closing structure for dehydration holes of all-glass multiple sheet glazing units in which an apertured metallic insert is sealed into the dehydration opening by a glazed coating on the insert that is composed of glass having substantially the same composition as that of the glass in the unit, and the glass of the coating is embedded in the metal surface.

It is therefore the primary object of the invention to provide an improved method and structure for hermetically sealing an opening in an all-glass glazing unit.

Other objects and advantages of the invention will become more apparent during the course of the following description when taken in connection with the accompanying drawings.

In the drawings wherein like numerals are employed to designate like parts throughout the same:

FIG. 1 is a perspective view of an all-glass glazing unit with which the present invention is particularly concerned;

FIG. 2 is a cross-sectional view of the glazing unit taken along line 2—2 of FIG. 1 showing the novel insert in place in an edge wall;

FIG. 3 is a diagrammatic view of the different parts of an apparatus for producing an all-glass glazing unit incorporating the novel insert of the present invention;

FIG. 4 is a perspective view of a tumbling chamber or ball-mill used in applying the glass to the metal insert;

FIG. 5 is a greatly enlarged, fragmentary, cross-sectional view of an insert with the glass thereon;

FIG. 6 is a perspective view of one step in the preparation of a glazed coating on the metal insert; and

FIG. 7 is a fragmentary, greatly enlarged, cross-sectional view of the metal insert with the glazed coating thereon.

Referring now particularly to FIGS. 1 and 2 there is illustrated an all-glass double glazing unit **10** incorporating a cylindrical metallic insert **11** coated in the novel manner of the present invention. The hollow interior of the insert **11** provides the necessary access opening to the interior **12** of the glazing unit for dehydrating the same after which the insert can be closed by a body of solder **13** in order to hermetically seal the unit.

FIG. 3 illustrates diagrammatically one way in which the glazing unit of FIG. 1 can be produced with the coated insert **11** incorporated therein. As there shown, a pair of glass sheets **14** and **15** in spaced face-to-face relation are carried past fusing burners **16** which progressively heat the marginal edges of the sheets until they are pliable. The heated edges are then passed through a pair of forming rolls **17** to progressively urge the edges together into fusing contact to produce a sealed edge wall. As the edge wall is being progressively formed, the insert **11** is introduced into position between the edges of the glass sheets just in front of the forming rolls **17** by an arm **18**. As the insert moves with the sheets toward and into contact with the forming rolls the glass edges are fused about the insert to securely seal the same into the edge wall. Preferably, the fabrication is carried out within a furnace which is maintained at an elevated temperature (approximately 1000° F.).

Although the insert **11** may be placed in the edge wall as described above without special preparation, it has been found to produce a superior sealing relationship if the insert is preheated to a condition of "redness" immediately prior to its being placed in the edge wall. In FIG. 3 this is shown being accomplished by a burner **19**. Also, in order to reduce the possibility of contaminating the surface of the insert with particles of carbon which might affect the bond of the insert to the glass, the burner **19** preferably burns a hydrogen flame.

Our experience in the sealing of glass to metallic inserts as described above indicates that in order to maintain a suitable sealing relationship it is important that the thermal expansion characteristics of the metal closely approximate that of the glass. For example, we have satisfactorily used inserts of nickel-iron and nickel-iron-cobalt alloys. However, best results have been obtained with inserts constructed of either of two nickel-iron alloys obtained commercially under the names of Driver-Harris #52 and Allegheny #4750 having the following approximate compositions:

	Allegheny #4750	Driver-Harris #52
Ni	47.66	50-51 (+ traces of Co+Cu).
Si	0.30	0.20-0.35.
S	0.014	0.01 Max.
P	0.021	0.02 Max.
Mn	0.22	0.4-0.8.
C	0.039	.08 Max.
Fe	Balance	Balance.

However, the selection of a metal having the desired properties is still not a complete answer to a satisfactory glazed insert type of seal. A proper pretreatment of the metal insert is also important; and according to the present invention the composition of the glazing coating and the manner in which the coating is applied are both important and inventive features.

A satisfactory preheatment of the metal inserts may include:

(1) Wash the inserts in a detergent or an organic solvent, such as acetone, to remove oil, grease and other foreign particles clinging to the surface.

(2) Pickle the inserts in hot hydrochloric acid (approximately 25% aqueous solution) for a period of ½ hour, stirring frequently, to remove any abrasives which may be embedded in the surface.

(3) Heat the inserts in wet hydrogen gas at a temperature of about 1700° F. for at least 4 hours to decarburize the metal.

(4) Heat the inserts at a temperature of 1240° F. for 16 hours at a pressure of less than 2×10^{-5} mm. of mercury in order to remove any dissolved or occluded gases.

As pointed out above, the different kind of glazing coating of this invention is composed of glass having substantially the same composition as that of the glass unit to be sealed. To illustrate, most of the multiple glas sheet glazing units of the type with which the invention is concerned are made with conventional soda-lime-silica plate or window glass. Applicants have found that best results are obtained in sealing metal inserts into the dehydration holes in such units when a glazed coating of substantially the same composition as the plate or window glass used in the unit is employed.

For purposes of illustration only, the approximate composition of conventional window glass is as follows:

Approximate Composition of Window Glass

	Percent
SiO_2	72.6
Al_2O_3	0.9
CaO	9.1
MgO	3.5
Na_2O	13.3
Minor oxides	0.6
CoO	0
NiO	0
Total	100.0

In carrying out the invention in connection with multiple glass sheet glazing units in which the glass has approximately this composition very satisfactory results can be obtained by employing as a glaze a coating of glass of the same composition.

However, it has been found that when oxides of cobalt, nickel and manganese for example, are incorporated into any glass or glaze composition it has a tendency to in-

crease the property of the material to "stick" to metal, and the incorporation of oxides of these metals into the glass glaze used with the present invention has been found to increase the adherence or bond between the metal and glass.

Consequently, a slight modification of the glass composition for the glaze, from the glass composition of the glass sheets in the multiple sheet glazing unit with which the glaze is to be used, may be made which will impart to the glaze better bonding characteristics while, at the same time, maintaining the coefficient of expansion between the glass sheets of the unit and the modified composition of glaze used in sealing the metal inserts into the units substantially the same.

For example, the following modified composition has proved very successful when used as a glazing coating of metal inserts to be sealed into multiple sheet glazing units made with glass sheets having the approximate composition set forth above.

Modified Composition of Window Glass Used for Glazing Grommets

	Percent
SiO_2	66.7
Al_2O_3	0.8
CaO	7.7
MgO	3.1
Na_2O	12.4
Minor oxides	0.4
CoO	0.8
NiO	8.1
Total	100.0

This modified window glass composition can be prepared by melting the following glass batch ingredients at about 2600° F.

	Parts by weight
Sand	100
Dolomitic limestone	21.48
Calcium limestone	9.24
Soda ash	31.2
Salt cake	0.97
Aluminum hydroxide	1.89
Cobalt oxide (Co_2O_3)	1.36
Nickel oxide (NiO)	12.28

In addition to the different type of glazing coating just described, and which is an important feature of this invention, applicants have also discovered a special procedure for applying the coating to the metal inserts which result in a particular mechanical connection between the coating and the inserts which is valuable not only in connection with the particular type of glazing coating disclosed here, but which will also give greatly improved results when employed in applying other types of glazing coatings including types that have heretofore been suggested but which have proved to be unsatisfactory when applied by normal procedures.

Specifically, this invention contemplates coating the metal inserts by impact between a solid form of the glaze material to be applied and the surface of the metal insert. Obviously, such impact application of the coating may be accomplished in a number of different ways but as a practical matter it has been found that it can be satisfactorily carried out by placing a supply of the metal inserts 11 into a tumbling apparatus with pieces of hard glass having the desired composition. After the glass and inserts have been tumbled together for a sufficient length of time (approximately five hours) the glass will become pulverized and it will be found that the inserts have not only been completely coated with glass particles or powder but small particles of glass will have been partially embedded in the surface of the metal.

By way of example, satisfactory results have been obtained with the following procedure:

(1) Fill the chamber of a ball-mill approximately ¾-full with cut squares of a suitable glass (3/16–7/32 inches in thickness; ½–¾ inch squares).

(2) Add a plurality of metallic inserts into the chamber containing the glass squares and tumble for about 5 hours.

(3) Screen out the powdered glass coated inserts.

One form of tumbling apparatus or ball-mill is illustrated at **20** in FIG. 4 and consists of a substantially cylindrical chamber **21** open at one end and over which opening a removable cover **22** may be tightly fitted. The chamber **21**, is carried by an axle **23** diagonally disposed relative thereto. The extremities of the axle are journaled in a pair of upright supports **24** and driven by a pulley **25** powered by a motor (not shown). Rotation of the shaft or axle **23** tumbles or agitates the contents of the chamber **21** providing a continuous impacting of the inserts by the glass.

Referring to FIG. 5 there is shown a metal insert after it has undergone the tumbling action described above. It should be particularly noted that small particles of glass **26** are partially embedded or anchored in the surface of the metal which is a primary factor in the improved bonding of the novel glazed coating to the insert.

The next step of the process is to heat the inserts which have been tumbled and covered with the glass powder **26** so as to melt the glass and provide a smooth tightly adhering coating **27** thereover (FIGS. 6 and 7). This may be done by placing a plurality of tumbled inserts on a wire **28** and passing them through a flame **29**. The flame melts the powdered glass producing the glazed coating **27**. After the inserts have been heated in this manner they are allowed to cool and after removal from the wire **28** may be either stored or used immediately. An alternative method is to fuse the powdered glass coating in an electric furnace under controlled temperature and atmospheric conditions.

It is believed that the glazed insert of the present invention achieves its superior bonding properties by the summation of the several individual features each of which contributes to the notable improvement. First of all, the embedding of the glass particles in the metal surface by the impacting operation is believed to produce a mechanical anchoring that is maintained even after the glass is melted into a smooth glazed coating. Also since the coating glass is of substantially the same composition as that of the glass sheets comprising the unit, its properties will be the same as that of the glass sheets and, accordingly, the adherence between the glazing and the glass sheets will be superior. Additionally, a third property which contributes to the superior sealing qualities is that the metal of the insert has thermal expansion characteristics closely approximating those of the glazed coating applied to it, thus inhibiting any loosening of the coating caused by differences in expansion at the elevated temperatures encountered during the fusing of the glazed insert in the unit. All of these factors contributes toward providing a superior sealing of the insert in a glass wall.

Although it is possible to seal the aperture or opening in the insert by any of a number of different ways well known in the art, the preferable way, which produces highly satisfactory results, is to apply a drop of solder in the external opening of the insert as shown best in FIG. 2.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred embodiment of the same, but that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

We claim:

1. In the production of multiple sheet glazing units composed of glass sheets spaced from one another in face-to-face relation and fused together at their marginal edges to provide a space therebetween and having a hermetically sealed dehydration opening in a passage defined by a portion of the glass in said unit and leading to the space between the glass sheets, the steps of providing an apertured metal insert with a coating of glass of the same composition as the glass sheets, fusing said metal insert into said passage, and closing the aperture of said insert by a body of solder.

2. In the production of multiple sheet glass glazing units as claimed in claim 1, in which the glass sheets are composed of and the insert is coated with a soda-lime-silica glass.

3. In the production of multiple sheet glass glazing units as claimed in claim 1, in which the metal insert is degassed prior to being coated with glass.

4. In the production of multiple sheet glass glazing units as claimed in claim 1, in which the glass coating is embedded in the surface of the metal insert.

5. In the production of multiple sheet glass glazing units as claimed in claim 1, in which the glass coating includes slight amounts of metal oxide additives.

6. The method of hermetically sealing the dehydration opening in a double glass sheet glazing unit composed of glass sheets spaced from one another in face-to-face relation and fused together at their marginal edges to provide a space therebetween, which comprises applying a powdered glass of the same composition as that of the glass sheets to an apertured metallic insert by impacting the metallic insert with hard glass to physically anchor the same to said insert, heating said insert to fuse said powdered glass into a glazed coating, inserting said coated insert into said opening, heating the coated insert and the glass portions surrounding said insert until they are fused to one another, filling the unit with dry air through said aperture in said insert, and closing the aperture of said insert by a body of solder.

7. An all-glass multiple sheet glazing unit, which comprises a pair of spaced glass sheets fused together at their marginal edge portions enclosing a space therebetween, a cylindrical apertured metal insert having a coating of glass of the same composition as that of said sheets fused into a passage to the enclosed space formed in at least one of said glass sheets, and a body of solder received within said aperture for hermetically sealing the same.

8. A multiple sheet glazing unit as claimed in claim 7, in which said metal insert is degassed prior to application of said coating thereon.

9. A multiple sheet glazing unit as claimed in claim 7, in which the glass coating is physically anchored onto the surface of said insert.

10. In an all-glass multiple sheet glazing unit comprised of a pair of spaced parallel sheets of glass fused together along their edge portions to enclose a space therebetween and having a passage formed in one edge of said unit leading to the space between the glass sheets, a cylindrical apertured metal insert received within said passage and also communicating with the space between the glass sheets, and a layer of glass of the same composition as that of said glass sheets interposed between and fused to the wall of said passage and to said insert.

11. A method of producing a multiple glass sheet glazing unit, comprising supporting two sheets of glass in spaced face-to-face relation with respect to one another, heating the spaced marginal edge portions of the glass sheets to a temperature at which they are pliable, placing a hollow metallic insert provided with a coating of glass of substantially the same composition as that of the glass sheets between the heated marginal edge portions of the glass sheets, and pressing the heated marginal edge portions of the glass sheets together to fuse them to one another and to simultaneously fuse the hollow metallic insert in place between the marginal edge portions of said sheets.

12. In a method of producing a multiple glass sheet glazing unit by pressing the heated marginal edge portions of a pair of spaced glass sheets together into fusion contact to form a sealed edge wall enclosing a space between said

sheets, the steps of impacting an apertured metal insert with hard glass to provide the surface of said insert with a layer of glass powder physically anchored thereto, melting the glass powder on said insert to form a glazed coating thereon, positioning said coated insert between the heated marginal edge portions of the glass sheets, pressing said heated marginal edge portions together to fuse them to one another and to simultaneously fuse the apertured metal insert between said marginal edge portions, dehydrating the enclosed space through the aperture in said insert, and sealing the aperture in said insert with a metallic solder to seal said aperture.

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