

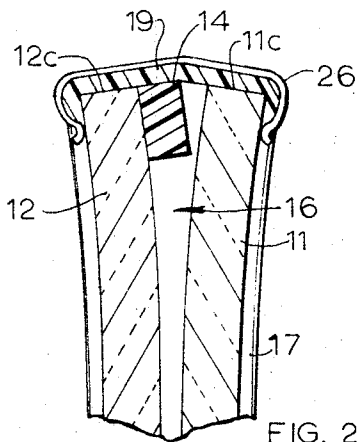
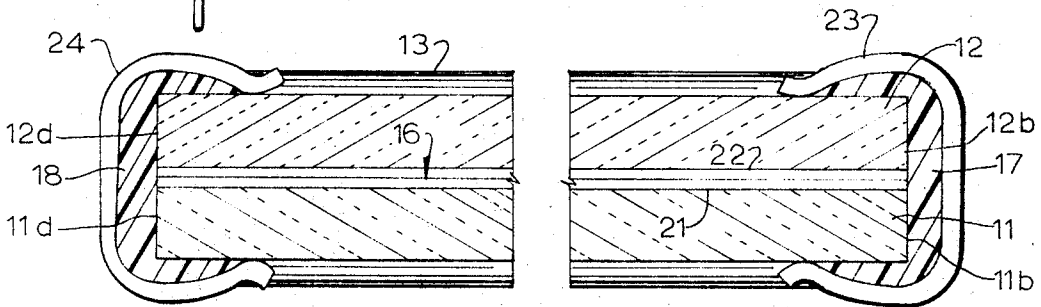
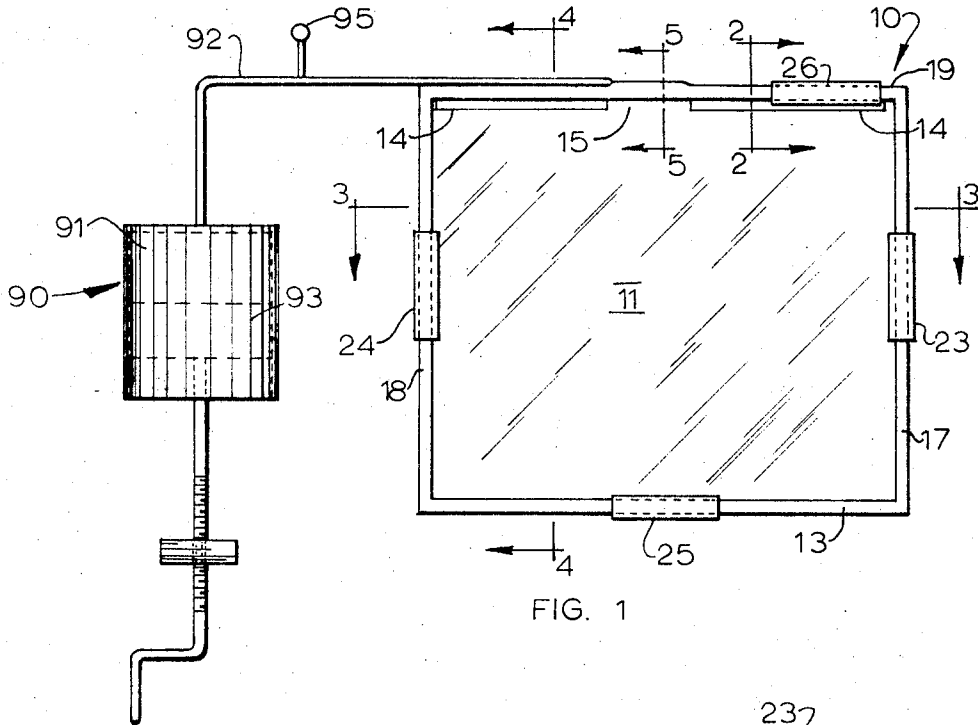
Jan. 28, 1969

G. RISK
WINDOW CONSTRUCTION HAVING CONTINUOUSLY VARIABLE
TRANSVERSE LIGHT TRANSMISSION

3,424,515

Filed Aug. 23, 1965

Sheet 1 of 2



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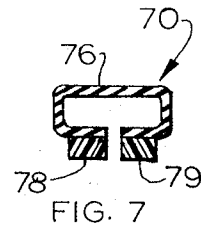
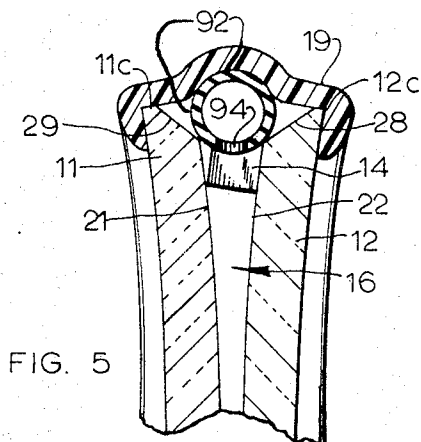
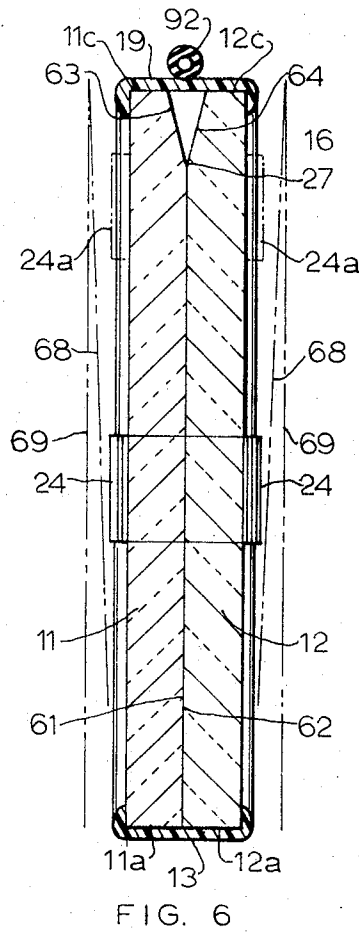
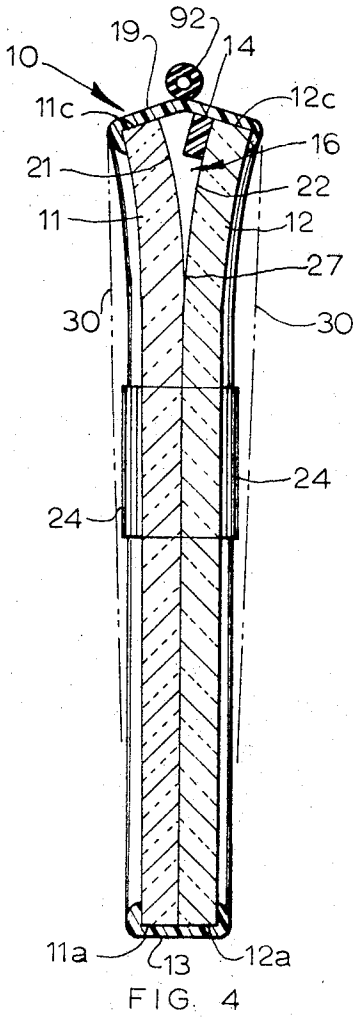
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Sheet 2 of 2



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3,424,515 WINDOW CONSTRUCTION HAVING CONTINUOUSLY VARIABLE TRANSVERSE LIGHT TRANSMISSION

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Filed Aug. 23, 1965, Ser. No. 481,790

U.S. Cl. 350—258

Int. Cl. G02b 17/00, 27/00

8 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to dual-panel window systems wherein a layer of colored fluid can be introduced between non-opaque panels so as to alter the color and transverse light transmission of the window construction. In particular, this invention relates to a dual-panel window construction wherein the transverse light transmission can be quickly, continuously, controllably and reversibly varied from "T_n," e.g. the inherent or unadulterated transverse transmission of the naked non-opaque panels, to virtual opacity.

There are in the prior art window constructions comprising a pair of non-opaque, vertically positioned opposed panels wherein the periphery of the spatial gap between the panels is provided with a fluid-impervious seal to provide a central chamber between the panels. Further, the prior art teaches the introduction of chromatically and achromatically colored fluids, either liquid or gas, into the central chamber and thus effect simultaneous changes in both the color and the transverse light transmission of the dual-panel window construction.

Prior art structures have invariably employed a rigidly fixed spatial separation between parallel panels. With the prior art fixed spatial separations, the introduction of a colored liquid will provide, in addition to the color and the transverse light transmission of T_n, only one other colored state, said other colored state being fixably determined by the panels' spatial separation and the color properties of the colored liquid employed. While the prior art teaches that the introduction of compressed volumes of a colored gas e.g. bromine, will afford continuously and controllably variable color vividness and transverse light transmission, it is a time-consuming procedure requiring cumbersome pump means to utilize a gaseous coloring layer. Further, most colored gases are toxic and would present health hazards in the event of a leaky seal. Workers in the art generally prefer liquids over gases because liquids can be readily dyed or pigmented to result in whatever color characteristics desired (including hue, saturation, and brilliance), whereas the number of available colored gases is limited. Yet, as previously mentioned, there is no provision in the prior art to provide continuously variably visual effects including the transverse light transmission, from T_n to virtually opacity with any one colored liquid.

It is accordingly an object of the present invention to provide a dual-panel window construction wherein the transverse light transmission value can be quickly, continuously, and controllably varied from T_n to a level closely approaching absolute opacity.

It is another object of the present invention to exclusively utilize the versatile class of colored liquids as the intervening colored layer.

It is another object of the present invention to provide means for readily changing the type of colored liquid solution employed.

It is a further object to optionally provide for a uni-

form transverse light transmission over the entire glass.

It is a further object to optionally provide for a transverse light transmission variation between areal portions of the window structure to assimilate the effect of a movable curtain so that, for example, direct sun rays can be retarded or impeded at upper areas of the window while lower areas thereof simultaneously admittably transmit indirect light rays.

It is yet another object of the present invention to utilize a wide range of color concentration for the colored liquid so that the transverse light transmission for the window can be changed either very rapidly and profoundly or at a more gradual rate.

These and other objects and advantages are attained with: spacer means that provide an arbitrarily prescribed peripheral spatial gap between the panels, major areal surfaces of the adjacently disposed interior broad surfaces being positioned closer together than the arbitrary peripheral gap; appropriately positioned resiliently distensible sealer means to allow the panels to move apart when colored liquid is forceably introduced between the panels; and tension means normally resisting the introduction of the colored liquid to provide at the appropriate time a continuous decrease in the color vividness and the transverse light transmission.

For the purposes of this patent application, the terms "non-transparent," "non-opaque," "semi-transparent," "semi-opaque," and "translucent" are all defined to mean "at least partially transmissive to the visible light spectrum." The terms "opacify" and "opacifiable" relate to decreasing the transverse light transmission through the opposed panels while the terms "transparentize" and "transparentizable" relate to increasing the transverse light transmission.

In the drawing, wherein like numbers refer to like parts in the several views, and in which:

FIGURE 1 is a front elevational view of the entire window system of the present invention, comprising the window construction portion and a pump.

FIGURE 2 is a sectional elevational view of the window construction portion taken along line 2—2 of FIGURE 1.

FIGURE 3 is a sectional plan view taken along line 3—3 of FIGURE 1.

FIGURE 4 is a sectional elevational view taken along line 4—4 of FIGURE 1.

FIGURE 5 is a sectional elevational view taken along line 5—5 of FIGURE 1.

FIGURE 6 is a sectional elevational view similar to that of FIGURE 4 for an alternate embodiment of the window construction portion.

FIGURE 7 is an elevational view of an alternate sealer means.

The window system of the present invention comprises a pump means 90 and a dual pane window construction 10. Window construction portion 10 comprises a pair of fluid-impervious sheet-like panels 11 and 12, each panel having a pair of opposed broad linearly generated surfaces and each panel being in the transverse direction between the opposed broad surfaces at least partially transmissive to the visible light spectrum. Conveniently broad panels 11 and 12 are shown herein as colorless and transparent rectangular glass panes, each pane being of substantially uniform transverse thickness and having planar opposed broad surfaces. Panes 11 and 12 are of substantially equal dimensional size, and the panes are disposed in a substantially continuous opposed relationship by suitable support means, as for example vertically supported with conventional window glazing (not shown). Thus, the respective four edges of glass panes 11 and 12 are substantially parallel; specifically, lower horizontal edges 11a and 12a, upper horizontal edges 11c

and 12c, upright width edges 11b and 12b, and upright width edges 11d and 12d.

There is a spacer means disposed between the panels to provide an arbitrary spatial separation between minor peripheral areal portions of interior broad surfaces 21 and 22 of panels 11 and 12, respectively. Conveniently herein, as shown in the FIGURES 2, 4, and 5 section views, the spacer means comprises two distinct colinear strips of resin 14 (having a gap 15 therebetween) along horizontal upper edges 11c and 12c; the transverse width of spacer strip is about 0.020 inch to provide that degree of arbitrary dimensional spacing. Herein, spacer strips 14 are of non-elastic material and are attached to interior surface 22 only; for reasons to be explained later, if spacer strip 14 is of an elastic resinous material, strip 14 could be attached to both interior broad surfaces 21 and 22. Obviously, the spacer means could take a variety of alternate forms, as for example a plurality of button-like spacers, a permanent peripheral bend in the glass, or an elongate chamfer as shown in FIGURE 6. Whatever exact type spacer means are employed, they should be positioned near the panel edges so as not to detract from the aesthetic appeal of the window construction.

Certain major areal portions of interior broad surfaces 21 and 22 remote of said peripheral chamber 16, herein as lower areal portions along lower horizontal edges 11a and 12a, are spaced closer together than the transverse distance of the spacer means e.g. width of spacer strips 14. This sub-arbitrary spacial separation is provided with suitable tension means including peripheral clips 23-26 clamping against the exterior surfaces of panels 11 and 12, together with atmospheric pressure which as will be explained later. Expandable clips 23-26 convexly bow lower portions of panels 11 and 12 toward each other so that lower major areas of surfaces 21 and 22 are substantially parallel and closer than about 1 mil so as to "functionally" abut each other. The glass panels 11 and 12 each having a thickness of 250 mils and a vertical height of 15 inches, readily convexly bow 20 mils toward each other. As will be pointed out later under "operation," it is desirable that lower areal portions of surfaces 21 and 22 abut firmly and for this reason the contours of our bridge-like sealer means attached to both panels to rigidly inflexible, the other panel should be thinner or of otherwise greater flexibility to provide the sub-arbitrary spacing. Of course, resinous panels e.g. "Plexiglas" are desirable because of their higher flexibility.

As in the prior art, there is a continuous fluid-impervious bridge-like sealer means attached to both panels to provide a fluid-impervious chamber 16 between panels 11 and 12. The sealer means is coincident with the rectangular edgewise periphery of panels 11 and 12 and does herein fully surround that transverse axis passing through the geometrical centers of panels 11 and 12. The sealer means may conveniently take the form of a 10 mil thick strip of cured silastic silicone rubber. The resin is as an amorphous resinous paste which, under exposure to a humid atmosphere, cures to a higher molecular weight. A 10 mil thick strip of resin is adherently applied to the peripheral edges e.g. between 11b and 12b, to result in a flexible and elastic cured resin sealer means.

Thus the entire continuous bridge-like sealer means comprises four lineal sections. There is upper section 19 along panel edges 11c and 12c which will be described in greater detail later. There are the oppositely disposed sections 17 and 18 that are adhered to and lie coextensively between panel edges 11b and 12b and 14d and 12d, respectively. Finally, there is lower section 13 along abutting edges 11a and 12a. For reasons to be pointed out under "operation," bridge-like sealer means 13 need be flexible, though not necessarily elastic; elasticity is not strictly necessary along one of the lineal sections of the sealer means.

Pump means 90 comprises a cylinder 91 having an internal reservoir, a piston 93, and an exterior conduit 92, said cylinder 91, piston 93, and conduit 92 being of fluid-

impervious structural materials. Conduit 92, which provides a continuous passageway between the interior reservoir of cylinder 91 and the central chamber 16, is attached to window construction 10 as follows. As can be seen in the FIGURES 2 and 4 section views, there is an edgewise resinous strip 19 along the upper horizontal edge 11c and 12c coincident with spacer 14, said strip 19 serving both as a sealer means and as an elastic bridge means as do resinous strips 17 and 18. There are interior chamfers 29 and 28 on panels 11 and 12, respectively, at the horizontal edge coincident with gap 15, as shown in FIGURE 5. Sideward opening 94 of conduit 92 communicates with gap 15, and conduit 92 is held in this position (within the chamfered length) by means of resinous strip 19 which overlies the terminal portion of conduit 92.

The internal reservoir of pump 90 is filled with whatever colored liquid desired to ultimately fill central chamber 16. Preferably the colored liquid is of the type having a low freezing point so that the window structure may be employed with equal facility under colder climatic conditions. Further, the concentration of the coloring matter e.g. dyes, pigments, etc., should be sufficiently high so that a 20-30 mil layer thickness will provide an almost opaque layer. In addition, the viscosity of the colored liquid should not be unduly thick or heavy; otherwise the colored liquid cannot be readily forced into and withdrawn from the narrow inter-panel chamber 16. While a great number of colored liquid solutions having the above properties can be readily formulated, the following solution can be considered as typically acceptable:

490 milliliters of water at 75° F.

490 milliliters of methanol at 75° F.

20 milliliters of ethylene glycol at 75° F.

0.50 gram of Alumina Black C, commercially available from Sandoz, Inc., of Cincinnati, Ohio.

Piston 93 has a tight peripheral seal which contacts cylinder 91 so that, considering the gas-impervious structural materials of pump 90, said pump has the characteristics of a "vacuum" pump, and is equally adapted to both positively discharge and immitably draw the colored liquid through exterior conduit 92. Thus, owing to the gas-impervious conditions of pump 90, including conduit 92, and central chamber 16, there is an air-tight fluid-system extending from piston 93, through conduit 92, and into central chamber 16. It is essential that the aforesaid air-tight fluid-system be maintained air and gas free, and thus there is valve means 95 to release or vent any air bubbles during the operational life of the window system. If an auxiliary parallel pump (not shown) were to be employed, together with an appropriate valve means between the two pumps, the original liquid can be evacuated and replaced with an alternately colored liquid.

Operation of this preferred embodiment is as follows. As piston 93 is pushed toward conduit 92, the colored fluid flows through conduit sideward opening 24 into chamber 16. The so formulated colored liquid will not under atmospheric pressure flow between the glass panels if the spatial gap is less than about 1 mil. Thus, the panels do "functionally" abut at a 1 ml spatial separation. With more viscous colored liquids, there could be "functional" abutment at a spatial separation of up to 5 mils. As can best be seen in the FIGURES 2, 4, and 5 sectional views, prior to introduction of the colored liquid between panels 11 and 12, chamber 16 is a narrow peripheral gap having a wedge-like configuration with the apex 27 being the initial interfacial contact point between interior surfaces 21 and 22. However, upon the forceable introduction of the colored liquid into peripheral chamber 16 the panels begin to flex outwardly from each other, the degree of areal abutment between interior surfaces 21 and 22 gradually decreases, and the non-annular peripheral chamber 16 gradually extends vertically downwards from original apex 27 toward lower horizontal edges 11a and 12a. During the gradual divergency of interior surfaces 21 and 22, elastic sealer means 17-19 stretch or distend; how-

ever there is primarily a pivotal flexure along sealer strip 13 with little or no stretch thereof. The net result of the decreasingly convex panels is a wedge-like colored curtain dropping from original apex 27 toward lower horizontal edges 11a and 12a. Because of the high color concentration in the colored liquid, the curtain is virtually opaque. Obviously, lower color concentrations in the colored liquid would provide a curtain having lower transverse transparency.

The operator may readily control the degree of travel for piston 93 and thus control the vertical extension of the curtain-like intervening layer of the colored liquid. The extreme or ultimate unbowed panels configuration is shown in phantom lines 30 in FIGURE 5.

Provided the fluid-system between piston 93 and intermediate chamber 16 is substantially air-tight, upon the withdrawal of piston 93 from the direction of conduit 92, atmospheric pressure tension means forces the panels into progressive reabutment (upwardly toward the initial interfacial contact point 27) and the colored liquid is forced back into pump cylinder 91. Clips 23-26 and the elasticity of sealer means 17-19 provide auxiliary tension means upon panels 11 and 12 to force the colored liquid back into pump cylinder 91. Thus, upon the controlled withdrawal of piston 93, the three aforesaid tension means cause panels 11 and 12 to gradually reassume their normal abutting relationship and the curtain progressively reversibly withdraws to initial contact point 27.

In summary, then, the original broad abutment of panels 11 and 12 provides an unadulterated and uncolored transverse light transmission "Tn," there being colored fluid only at the narrow peripheral spatial gap between contact point 27 and upper horizontal edges 11c and 12c. If panels 11 and 12 are substantially transparent, then the abutting panels are also substantially transparent. Upon the gradual divergent spreading of panels 11 and 12, the transverse light transmission becomes opaque in curtain-like fashion, the vertical level of said curtain being continuously variable in its extension unidirectionally from peripheral chamber 16 downwardly toward lower horizontal edges 11a and 12a. The tension means is provided to permit controllably continuous reversal of the curtain travel e.g. back towards initial contact point 27.

While panels having planar interior adjacent surfaces 21 and 22 have been described, it should be reiterated that any type of abutably mateable adjacent interior surfaces may be employed. While actual abutment between the panels is preferred, mere "functional" abutment is sufficient. If curved panels are employed, the aforescribed window system can be utilized for motor vehicle windshields, the dropping curtain effect being admirably suited to provide a controlled visor effect.

The alternate embodiment shown in FIGURE 6 will provide either the dropping curtain effect or controllably uniform transverse light transmission depending upon the permitted stretch of elastic sealer means 17 and 18. Window construction 60 is in all respects identical to window construction 10 except that the spacer means is provided by very deep chamfers 63 and 64 in panels 61 and 62, respectively, rather than spacer strips 14. Chamfers 63 and 64 are substantially coextensive with the entire length of upper horizontal edges 11c and 12c. Further, panels 11 and 12 are normally parallel and functionally abut each other without the necessity of being convexly bowed.

As previously described, panels 11 and 12 are generally planar rectangular glass panes. However, the panels have deeply chamfered interior portions 63 and 64 to provide a peripheral spatial gap or chamber. There is initial interfacial contact point 67 between adjacent interior broad surfaces 61 and 62. The panels are attached together with the identical sealer means 13 and 17-19. In every other respect, the window construction 60 is identical to that of construction 10. Further, the pump construction

90 is identical. As the aforementioned colored liquid is forceably introduced into interpanel chamber 16, the panels 61 and 62 flex outwardly in identical fashion to panels 11 and 12 to provide a dropping curtain visual effect.

This effect is indicated in phantom lines 68 of FIGURE 6.

If the edgewise tension along vertical edges 11b-12b and 11d-12d decreased linearly from upper horizontal edge 11c-12c to lower horizontal edge 11a-12a, as with auxiliary sideward clips located nearer to upper edges 11c-12c, e.g. clip 24a, then a different visual effect will result. As the colored fluid is forceably introduced into the interpanel chamber, the panels 61 and 62 will tend to move apart in parallelism, as indicated in phantom lines 69, and the visual effect will be of general and uniform color and transverse transmission, rather than the dropping curtain effect. So as to provide a continuously controllable variation in this vertically uniform colored structure, lower dye concentrations in the colored liquid are essential. For this reason, the aforescribed formula is diluted with the three solvents in the ratios previously specified to reduce the dye concentration to 0.50 gram per 2,000 liters solvent.

While in the description of the present invention, the arbitrary spatial separation is located at the upper end of the window construction, it is obvious that this arbitrarily prescribed space could be located at any peripheral portion without affecting the general function of the device. Of course, no matter where the arbitrary separation is located, the colored liquid is and must be introduced at this spatial gap.

The alternate sealer means 70 shown in FIGURE 7 can be readily substituted for sealer strips 17 and 18. Bridge-like sealer means 70 comprises a bent strip of metal 76 as the intermediate span and elastic resin strips 78 and 79 as terminal span segments. Terminal segments 78 and 79 are each adherently attached to a respective panel e.g. 11 and 12.

From the foregoing, the construction and operation of the window construction will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

I claim:

1. A dual-panel window construction comprising a pair of fluid-impervious flexible panels, each panel having a pair of opposed broad surfaces, each panel having in the transverse direction between the opposed broad surfaces at least partial transmission to the visible light spectrum, said pair of panels being attached together in an opposed relationship, horizontally disposed lower portions of said panels being attached together with a flexible bridge-like sealer means, spacer means disposed between upper portions of the panels so that opposed minor peripheral areas near the upper edges of said adjacently positioned interior broad surfaces are spaced apart an arbitrarily prescribed distance to provide a peripheral chamber between the panels, tension means tending to maintain the arbitrarily prescribed distance between opposed minor peripheral upper areas of the adjacently positioned interior broad surfaces, said tension means also tending to convexly bow at least one of the opposed panels toward the other so that lower areas constituting the major areal portion of the opposed broad surfaces are parallel to and functionally abut each other, bridge-like sealer means attached to both said panels along the peripheral edges to provide a continuous fluid-impervious seal that substantially surrounds that transverse axis passing through the geometric centers of both said panels, said bridge-like sealer means along the lower horizontal peripheral edge being flexible, the bridge-like sealer means along a pair of oppositely disposed peripheral edges including an elas-

tic resin as a segment of the transverse span thereof to allow the opposed panels and their lower interior surfaces to flex outwardly away from each other when pressurized hydraulic fluid is introduced into the inter-panels peripheral chamber, so as to cause said peripheral chamber to extend toward lower portions of the window construction.

2. A dual-panel window system comprising a pair of rectangular conterminous glass panels, each panel having a pair of opposed rectangular planar surfaces, each panel in the transverse direction between the opposed panels being substantially colorless and transparent, said pair of panels being vertically supported and attached together in an opposed conterminous relationship, spacer means disposed between said panels along the upper horizontal edges, said spacer means comprising a pair of colinear strips having a gap therebetween, each of said spacer strips being attached to at least one of the glass panels, said spacer means providing an arbitrary prescribed spatial separation between minor areal portions of the panels' interior broad surfaces to result in a horizontal peripheral chamber between the panels along the upper horizontal edges thereof, tension means tending to maintain the arbitrarily prescribed peripheral spatial separation, said tension means including a plurality of expandable clips along the two opposed vertical peripheries to promote convex bowing of at least one of the panels toward the other so that major lower areal portions of the panels are parallel to and functionally abut each other, bridge-like sealer means along the four peripheral edges to provide a continuous, quadra-section fluid-impervious seal about the entire periphery, said bridge-like sealer means along the lower horizontal peripheral edge being as a flexible resin, the bridge-like sealer means along the opposed vertical peripheries including an elastic resin as a segment of the transverse span thereof to allow at least one of the opposed panels and its lower interior surface to flex outwardly from the adjacent panel when pressurized hydraulic fluid is introduced into the inter-panels peripheral chamber so as to cause said upper peripheral chamber to extend toward the lower horizontal edges of the opposed panels, and vacuum pump means including an exterior conduit communicating with the inter-panels chamber, the reservoir of said vacuum pump means containing a homogeneously colored liquid, said pump exterior conduit being attached to said opposed panels, said exterior conduit having a valve-type vent means, the pump reservoir, the pump exterior conduit, and the inter-panels chamber constituting an air-tight fluid-system.

3. A dual panel window construction having substantially horizontal upper and lower ends and wherein the transverse light transmission through both respective panels can be continuously controllably and reversibly varied from that value inherently provided by the transverse thickness of the two naked panels to a higher value, the transverse light transmission gradually decreasing from the horizontal upper end toward the lower end to provide a "descending curtain" effect for the dual-panel window construction when a colored liquid is disposed between the two panels, said window construction comprising a pair of fluid-impervious sheet-like panels, each panel having a pair of substantially conterminous opposed broad surfaces and substantially horizontal upper and lower ends, each panel having in the transverse direction between the opposed broad surfaces, at least partial transmission to the visible light spectrum, said pair of sheet-like panels being attached together in an opposed relationship with the lower regions of the panels broadly functionally abutting each other whereby the lower ends of the two panels provide the horizontal lower end of the dual-panel window construction and the horizontal upper ends of the two panels provide the horizontal upper end of the dual-panel window construction, at least one of the two panels at the horizontal upper end being bowed transversely outwardly from the other panel to provide a

substantially horizontal peripheral chamber disposed along the horizontal upper end to further provide an arbitrarily prescribed transverse spatial separation between the panels at the horizontal upper end of the dual-panel construction, the transverse distance between the panels at the lower end of the dual-panel window construction being permanently less than that of the transverse spatial separation at the upper end, and bridge-like sealer means attached to both said panels including along the horizontal lower end to provide a continuous annular fluid-impervious seal that substantially surrounds that transverse axis passing through the geometric centers of both said panels, said bridge-like sealer means except along the horizontal lower end comprising elastic resin as a segment of the transverse space thereof to allow the opposed panels except at the horizontal lower end to bow transversely apart from each other when pressurized colored liquid is forceably introduced into the peripheral chamber to provide an extension of said peripheral chamber toward the horizontal lower end of the dual-panel window construction.

4. The dual-panel window construction of claim 3 wherein there are tension means tending to maintain the respective panels close together, and wherein the magnitude of the tension means decreases gradually from the upper horizontal end to the lower horizontal end.

5. A dual-panel window construction having substantially horizontal upper and lower ends and wherein the transverse light transmission through both respective panels can be continuously controllably and reversibly varied from that value inherently provided by the transverse thickness of the two naked panels to a higher value, the transverse light transmission gradually decreasing from the horizontal upper end toward the lower end to provide a "descending curtain" effect for the dual-panel window construction when a colored liquid is disposed between the two panels, said window construction comprising a pair of fluid-impervious sheet-like panels, each panel having a pair of substantially conterminous opposed broad surfaces and substantially horizontal upper and lower ends, said two panels broadly functionally abutting each other at the lower region, each panel having in the transverse direction between the opposed broad surfaces at least partial transmission to the visible light spectrum, said pair of sheet-like panels being attached together in an opposed relationship whereby the horizontal lower ends of the two panels provide the horizontal lower end of the dual-panel window construction and the horizontal upper ends of the two panels provide the horizontal upper end of the dual-panel window construction, at least one of the two panels being chamfered along the horizontal upper end to provide a substantially horizontal peripheral chamber disposed along the horizontal upper end and to further provide an arbitrarily prescribed transverse spatial separation between the panels at the horizontal upper end of the dual-panel construction, the transverse distance between the panels at the lower end of the dual-panel window construction being permanently less than that of the transverse spatial separation at the upper end, and bridge-like sealer means attached to both said panels including along the horizontal lower end to provide a continuous annular fluid-impervious seal that substantially surrounds that transverse axis passing through the geometric centers of both said panels, said bridge-like sealer means except along the horizontal lower end comprising elastic resin as a segment of the transverse span thereof to allow the opposed panels except at the horizontal lower end to move transversely apart from each other when pressurized colored liquid is forceably introduced into the peripheral chamber to provide an extension of said peripheral chamber toward the horizontal lower end of the dual-panel window construction.

6. The dual-panel window construction of claim 5 wherein there are tension means tending to maintain the respective panels close together, and wherein the magni-

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tude of the tension means decreases gradually from the upper horizontal end to the lower horizontal end.

7. The dual-panel window construction of claim 4 wherein both panels at the horizontal upper end are bowed transversely outwardly from each other to provide said arbitrarily prescribed transverse spatial separation; wherein the magnitude of the tension means decreases linearly from the upper horizontal end to the lower horizontal end; and wherein there are vacuum pump means including a fluid-impervious exterior conduit communicating with the inter-panels peripheral chamber, the reservoir of said vacuum pump means containing a homogeneously colored liquid, the pump exterior conduit, and the inter-panels peripheral chamber constituting an air-tight fluid-system.

8. The dual-panel window construction of claim 6 wherein both panels at the horizontal upper end are chamfered to provide said arbitrarily prescribed transverse spatial separation; wherein the magnitude of the tension means decreases linearly from the upper horizontal end to the lower horizontal end; and wherein there are vac-

uum pump means including a fluid-impervious exterior conduit communicating with the inter-panels peripheral chamber, the reservoir of said vacuum pump means containing a homogeneously colored liquid, the pump reservoir, the pump exterior conduit, and the inter-panels peripheral chamber constituting an air-tight fluid system.

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JULIA E. COINER, *Primary Examiner.*

U.S. Cl. X.R.

350—267, 312

**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 3,424,515

January 28, 1969

George Risk

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 43, cancel "our bridge-like sealer means attached to both panels to" and insert -- 21 and 22 should abutably mate. If one of the panels is --. Column 4, line 3, "9f" should read -- 9l --.

Signed and sealed this 31st day of March 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents