Sept. 2, 1958 J. A. GOOD ET AL 2,850,005

OBSERVATION WINDOW

Filed Jan. 18, 1955

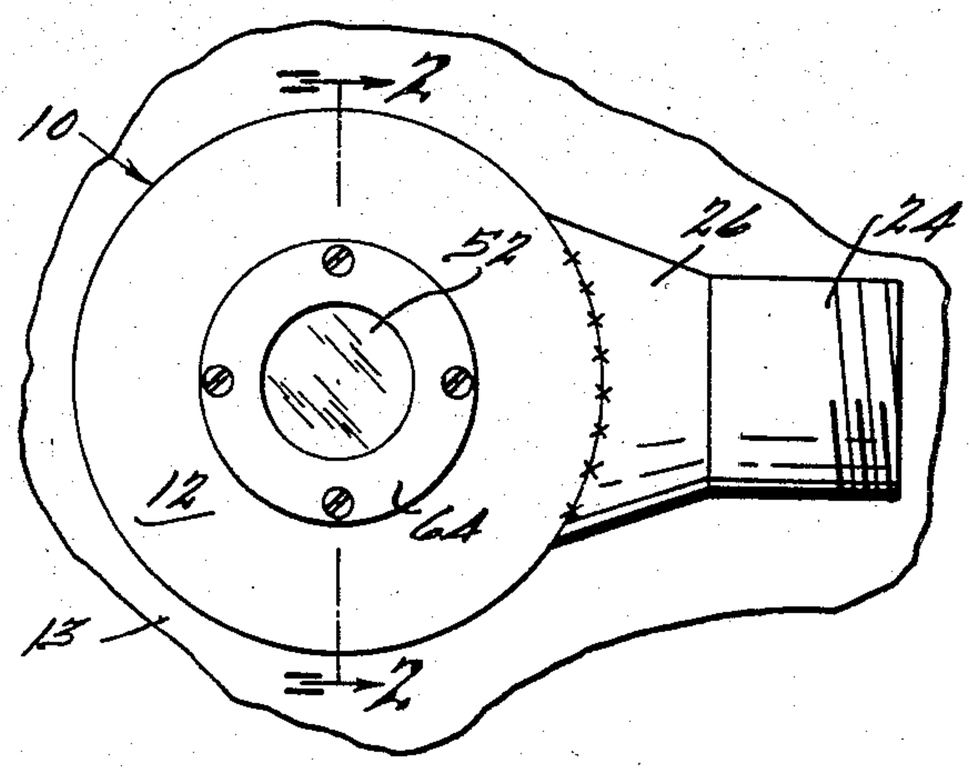

FIG. 1.

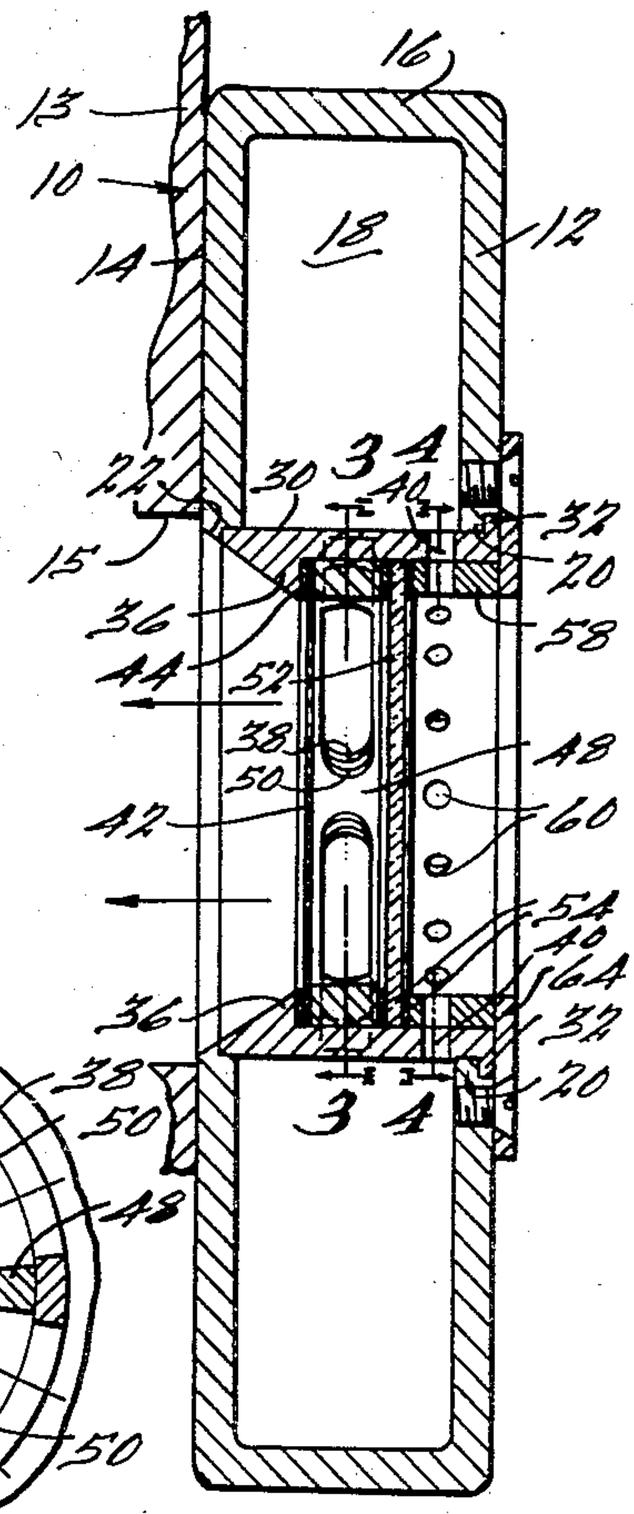

FIG. 2.

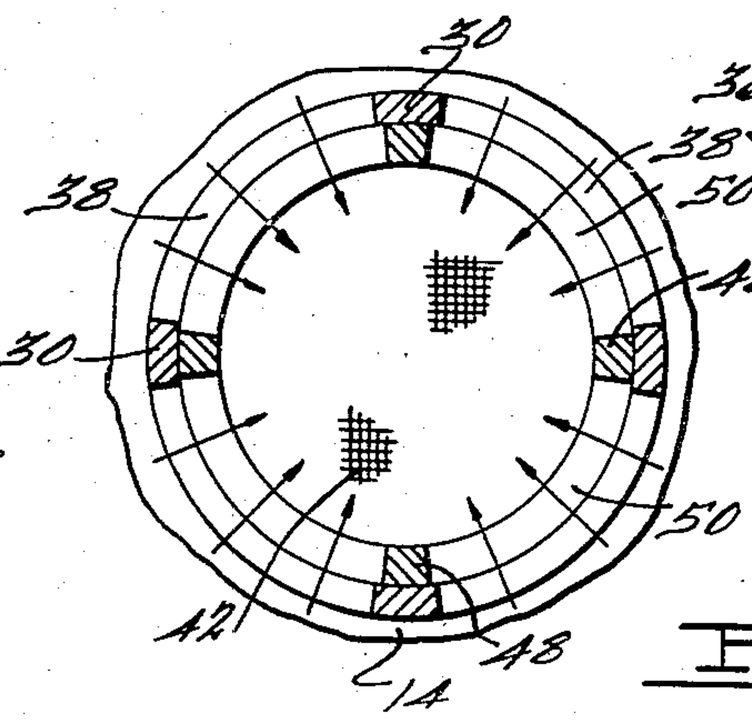

FIG. 3.

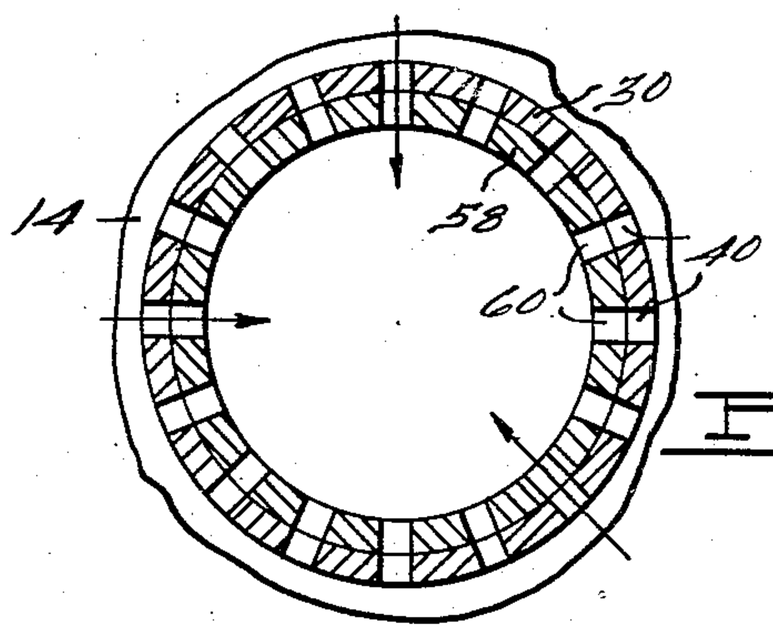

FIG. 4.

INVENTORS
James A. Good
James C. Magestro.
BY
Harness, Dickey & Pierce.
ATTORNEYS.

United States Patent Office

2,850,005

Patented Sept. 2, 1958

2,850,005

OBSERVATION WINDOW

James A. Good and James C. Magestro, Lancaster, Ohio, assignors to Diamond Power Specialty Corporation, Lancaster, Ohio, a corporation of Ohio

Application January 18, 1955, Serial No. 482,505

10 Claims. (Cl. 126—200)

This invention relates to window structures and more particularly to observation ports for furnaces, boilers and the like.

In connection with the operation of furnaces and boilers it is desirable to observe their interiors. One advantageous method which permits observing the interiors of one or many furnaces from a central control station involves the use of a television system. Consequently, in practice, individual observation ports or windows have been installed in the wall of each furnace or boiler the operation of which is to be observed.

Under severe service conditions such as exist in systems designed to observe the flame and combustion zones of furnaces, these observation windows should transmit but a small fraction of the heat applied to their fire-side surfaces in order to protect the optical systems positioned adjacent the windows. The extent of the heat differential and the rigorousness of the requirement have necessitated not only that selected transparent materials be employed in the window construction but also that additional cooling means be provided.

One expedient has been to employ a pair of spaced transparent elements and to flow air between and around those elements. The heat transmitting characteristics of such ports have, in general, been reasonably adequate. However, the inner face of the inner glass is subjected not only to heat, but also to smoke, soot, and particles of slag and other foreign matter, and unburned fuel, projected at high velocity directly thereagainst, in addition to the impingement of corrosive gases.

These conditions have been so severe that it has frequently been found that previously known designs of observation windows, even though provided with artificial cooling means, have a service life of but a few days, when installed adjacent to the combustion zones of high temperature furnaces, due to the fact that the transparency of the inner glass is destroyed by the pitting and etching effect of the particles and gases, and/or to the deposits of foreign material thereupon. Frequently the turbulence within the furnace is such that the window will be etched and pitted in some areas and coated in other areas. It will be appreciated that some of the particles within such a combustion zone are molten or partly molten, and are relatively dense, so that they possess substantial inertia, are difficult to deflect from a course, and are inclined to stick and freeze upon the cooled glass, as well as to melt and etch the surface of the glass.

As a result, the light transmitting characteristics of the ports soon become impaired to such an extent that replacement is required. In some installations the conditions are so severe that it has been necessary to replace the glass after less than a day's operation.

Efforts to sweep the fire-side surface of the window with air to prevent the impinging of particles and harmful gases have proved to be less than fully successful. Attempts to screen the glass by directing a plurality of converging air streams into the area adjacent the fire-side viewing surface from points spaced around the periphery of the glass have

also been found unsuccessful, due, apparently, to unavoidable turbulence and voids, or low-pressure areas, in which there is not enough sweeping or screening effect, whereby pitting and particle deposition occur.

The primary object of this invention therefore is to provide an improved observation port which incorporates cooling means adequate to protect the observation equipment and which is so designed as to maintain its transparency for long periods of time, even under severe operating conditions.

A feature of this invention is an observation port including a perforate barrier preventing the passage therethrough of relatively large soot, unburned fuel and slag particles.

Another feature of this invention is such an observation port in which the perforate barrier is so coupled with an air stream as to provide an effective and highly uniform wall of air moving outwardly away from the glass in a direction to provide the maximum average arresting and deflecting effect with respect to material and gases which would otherwise strike the glass.

The manner of accomplishment of the foregoing object, the nature of the foregoing features, and other objects and features of the invention will be understood from the following detailed description of an embodiment of the invention when read with reference to the accompanying drawings in which:

Figure 1 is an elevational view of the outer face of a viewing window or port embodying the principles of the invention;

Fig. 2 is an enlarged sectional view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 2; and

Fig. 4 is a sectional view taken substantially along the line 4—4 of Fig. 2.

As may be seen in Figs. 1 and 2 of the drawings, the window assembly includes an air chamber member **10** comprising an outer face **12**, an inner face **14**, and an annular rim **16**. These elements may be formed integrally, as shown, or may be individually formed and interjoined by welding. The faces **12** and **14** are suitably spaced to define an inner cylindrical chamber **18**. Further, the faces **12** and **14** are provided with aligned circular apertures, the edge of the aperture in the outer face **12** being so formed as to define an annular flange **20**, and the edge of the aperture in the inner face **14** being so formed as to define an annular flange **22**. The member **10** is, in the use of the device, clamped or otherwise tightly held against the outer surface of the wall as **13** of the furnace, with the aligned openings in the faces **12**, **14** in registry with a suitable port **15** in the wall.

As may best be seen in Fig. 1 of the drawings, filtered air may be supplied to the chamber **18** by means of a tubular air connection **24**, adapted to be connected to any appropriate supply line, and a transition member **26** affixed to the circular air chamber member **10** and provided with an inner channel communicating both with the air connection **24** and with the air chamber **18**.

A tubular lens housing **30** is mounted within the air chamber member **10** in line with the coaxial apertures in the outer face **12** and the inner face **14**, the annular base of the lens housing **30** abutting the annular flange **22** adjacent the aperture in the inner face **14**, and an annular flange **32** upon the lens housing **30** engaging the annular flange **20** on the outer face **12**. The inner face of the lens housing **30**, near its base, is so tapered and re-entrant as to define an additional annular flange **36**.

Near the annular flange **36**, the lens housing **30** is provided with a group of apertures **38** of substantial width, those apertures **38** constituting a relatively large part, and the bridging members therebetween constitut-

ing a relatively small part, of the circumference of the lens housing 30, as may best be seen in the sectional view of Fig. 3 of the drawings.

Intermediate the first group of apertures 38 and the annular flange 32, the lens housing 30 is provided with a second group of apertures 40, as may be seen in Figs. 2 and 4 of the drawings. Apertures 40 are spaced apart around the circumference of the lens housing 30. It is desirable that the total area of the apertures 40 be appreciably less than the total area of the apertures 38.

A shielding member 42, welded or otherwise affixed to a ring 44, is mounted within the lens housing 30 in a position abutting the annular flange 36 so as to constitute the first of the elements within the lens housing 30 to be contacted by the heat and particles present in the furnace or boiler under observation. The shielding member 42 preferably is in the form of a screen, stainless steel having been found to be suitably capable of resisting the heat and corrosive action to which it is subjected. Shielding member 42 should not only possess this capability of resisting heat and withstanding being struck by various hot particles, but also should be capable of reducing the radiant heat transmitted therethrough and of preventing the passage of at least the larger among the particles striking it, while offering minimum interference with vision. As will be seen hereinafter, it is also an important characteristic of the shielding member 42 that it be able to pass air applied to one side thereof evenly to the other side. A ten-mesh screen i. e., one in which there are ten perforations per linear inch or 100 perforations per square inch, has been found to be about the coarsest which will meet the aforesaid requirements acceptably. Excellent results have been achieved using a sixteen-mesh screen made of No. 27 B. & S. gauge stainless steel wire.

Abutting the shielding member 42 and holding that member in place is a spacer ring 48. Spacer ring 48 is annular in form and is provided with a plurality of apertures 50 around its periphery preferably of angular length at least equal to, and aligned with, the apertures 38 in the lens housing 30, as may best be seen in the sectional view of Fig. 3 of the drawings.

A transparent window 52 is insertable within the lens housing 30 in abutment with the spacer ring 48. This window should have high heat-resisting and poor heat-transmitting characteristics. Even with the provision of the shielding member 42, the temperature differential between the inner and the outer faces of the window 52 is great during the operation of the furnace or boiler being observed. It has been found that if the window 52 be made of substantially pure quartz glass it will possess the capability of withstanding the thermal shock to which it is subjected. Since quartz glass is relatively fragile when subjected to mechanical shock, and since air sealing is advantageous, the window 52 may be mounted in the housing 30 by means of a gasket 54.

The window 52 may be imbued with a heat reflecting characteristic by coating one or both faces of the glass with any suitable commercially available, heat-reflective transparent coating, such as a tin suboxide.

A retaining sleeve 58 is mounted within the lens housing 30 and abuts the gasket 54 so as to retain the member 52 in position. Retaining sleeve 58 is provided with a plurality of apertures 60 spaced around its circumference, those apertures preferably being of the same size and alignable with the apertures 40 in the lens housing 30, as may best be seen in the sectional view of Fig. 4 of the drawings.

All of the foregoing elements may be retained in place within the air chamber member 10 by means of an apertured plate or flange 64 screwed or otherwise affixed to the outer face 12 of the air chamber member 10. By removing the flange 64, the lens housing 30, the retaining sleeve 58, the outer transparent member 52, the spacer ring 48, and the shielding member 42 may be removed for replacement of any defective one of those parts.

A fluid coolant, preferably air, is supplied to the hollow member 10 through the connection 24 and the transition member 26 (Fig. 1). The air may be supplied, for example, at a rate of 75 cubic feet per minute and under a pressure of 7" of water. As a result, a substantially constant supply of air, under a substantially constant pressure, exists at all points within the chamber 18 (Fig. 2).

A portion of this air will pass through the smaller apertures 40 around the periphery of the lens housing 30, and through the mating apertures 60 in the retaining sleeve 58, sweep across the outer face of the transparent window 52, and be exhausted outside the boiler setting. This sweeping action will not only tend to remove dust particles from the outer face of the window 52 but also will serve to cool that surface, thereby reducing the amount of heat which is applied to the television system's optical elements.

A larger portion of the air in chamber 18 will flow through the larger apertures 38 in the lens housing 30, and through the apertures 50 in the spacer ring 48 aligned therewith, so that air enters the inner area of the spacer ring intermediate the window 52 and the shielding member 42 in an even flow and from substantially all points around the periphery of the spacer ring 48. This air then flows through the screen shielding member 42 and is exhausted into the furnace.

This air flow not only cools the inner face of the window 52 but also cools the shielding member 42. Further, this effective wall of air emanating from the shielding member 42 serves as a barrier to the impingement upon the shielding member 42 of gases, particles, and sliding or projecting molten slag. Any such particles which are so large or so heavy as to continue their paths toward the shielding member 42 despite meeting this wall of air are also too large to pass through the apertures in the shielding member 42 and, consequently, are stopped at that point rather than passing on into contact with the inner face of the window 52. These heavier particles may strike the shielding member 42 and immediately rebound into the furnace, or they may momentarily adhere. The continuous flow of air through the screen of the shielding member 42, however, will tend to dislodge such particles.

The direction of air flow has, in part, been represented by arrows in the sectional views of Figs. 2, 3 and 4 of the drawings.

By virtue of the above-described construction, the heat appearing on the room side of the observation port is sufficiently low in intensity as not to damage the optical system of the television apparatus positioned adjacent thereto, and the assembly retains its transparency for prolonged periods despite the subjection of the observation port to exceedingly severe furnace or boiler conditions.

While it will be apparent that the embodiment of the invention herein disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. In a window assembly for viewing the interior of a combustion chamber or the like, a transparent outer member, and means for establishing a continuous, uniform wall of air opposing the movement of gases and particles from the combustion chamber to said transparent outer member comprising a fine-mesh-screen shielding inner member spaced from said transparent member, said fine-mesh-screen shielding member having therein a plurality of openings spaced closely enough together to provide substantially continuous vision therethrough, and means for delivering and directing air into and towards

the center of the space between the transparent member and the shielding member and from substantially all sides of said space to force said air to flow through the openings in said shielding member in a direction substantially perpendicularly away from the transparent member and as a continuous uniform wall of air.

2. An assembly as defined in claim 1 wherein said shielding member is substantially planar, said transparent member is substantially parallel to the shielding member, and said openings extend substantially perpendicularly to said planes and are provided throughout substantially the entire effective area of the shielding member.

3. In a window assembly for viewing the interior of a combustion chamber or the like, a transparent outer member, an inner shielding member spaced from said transparent outer member, said shielding member having therein a plurality of perforations, there being at least one hundred such perforations per square inch over at least a portion of the area of said shielding member, and means for directing air into and towards the center of the space between the transparent member and the shielding member and from substantially all sides of said space to force said air to flow through the perforations in said shielding member in a direction away from the transparent member for establishing a continuous, uniform wall of air opposing the movement of gases and particles from the combustion chamber to said transparent outer member.

4. In a window assembly adapted to be associated with a heated chamber containing various sized airborne particles as a result of combustion, an outer transparent member, an inner shielding member spaced from said transparent member, said shielding member being a fine-mesh screen having therein a plurality of perforations each smaller in size than at least some of said particles, and means for forcing air from a plurality of points around the periphery of said shielding member and through the perforations therein for establishing a continuous, uniform wall of air opposing the movement of gases and particles from the combustion chamber to said transparent outer member.

5. In a window assembly adapted to be associated with a heated chamber containing various sized airborne particles created as a result of combustion, a tubular housing having a first and a second group of apertures around its periphery, each of those groups of apertures being spaced from the other along the length of said housing, an outer transparent circular member supported within said housing on one of said first group of apertures and between said first and second groups of apertures, means for forcing air through said second group of apertures, past said transparent member and to the atmosphere, an inner circular perforated shielding member supported in said housing parallel to said transparent member and positioned on the other side of said first group of apertures in said housing from said transparent member, and means for forcing air through said first group of apertures and through said shielding member for establishing a continuous, uniform wall of air opposing the movement of gases and particles from the combustion chamber to said transparent outer member.

6. In a window assembly adapted to be associated with a heated chamber containing various sized airborne particles created as a result of combustion, a tubular housing having a first and a second group of apertures evenly spaced around its periphery, the total area of said first group of apertures being greater than the total area of said second group of apertures, each of those groups of apertures being spaced from the other along the length of said housing, an outer transparent circular member supported within said housing on one side of said first group of apertures and between said first and second groups of apertures, means for forcing air through said second group of apertures, past said transparent member

and to the atmosphere, an inner circular perforated shielding member supported in said housing parallel to said transparent member and positioned on the other side of said first group of apertures in said housing from said transparent member, and means for forcing air through said first group of apertures and through said shielding member for establishing a continuous, uniform wall of air opposing the movement of gases and particles from the combustion chamber to said transparent outer member.

7. In a window assembly adapted to be associated with a heated chamber containing various sized airborne particles created as a result of combustion, a tubular housing having a first and a second group of apertures around its periphery, each of those groups of apertures being spaced from the other along the length of said housing, an outer transparent circular member supported within said housing on one side of said first group of apertures and between said first and second groups of apertures, means for forcing air through said second group of apertures, past the transparent member and to the atmosphere, an inner circular perforated shielding member supported in said housing parallel to said transparent member and positioned on the other side of said first group of apertures in said housing from said transparent member, and means for forcing air through said first group of apertures and through said shielding member for establishing a continuous, uniform wall of air opposing the movement of gases and particles from the combustion chamber to said transparent outer member, said means comprising a hollow air chamber surrounding and supporting said housing, and means supplying air to said chamber.

8. In a window assembly adapted to be associated with a heated chamber containing various sized airborne particles created as a result of combustion, a tubular housing having a first and a second group of apertures around its periphery, each of those groups of apertures being spaced from the other along the length of said housing, a flange at one end of said housing, an outer transparent circular member supported within said housing on one side of said first group of apertures and intermediate said first and second groups of apertures, a retaining sleeve positioning said transparent member and having a plurality of apertures therein aligned with said second group of apertures in said housing, an inner circular perforated shielding member supported in said housing parallel to said transparent member and positioned on the other side of said first group of apertures in said housing from said transparent member, said shielding member engaging said flange, a spacer ring within said housing and intermediate said transparent member and said shielding member, said spacer ring having a plurality of apertures therein aligned with said first group of apertures in said housing, and means for forcing air through said first group of apertures and through said shielding member, said means comprising a hollow air chamber member surrounding and supporting said housing, and means supplying air to said chamber member.

9. In a window assembly adapted to be associated with a heated chamber containing various sized airborne particles created as a result of combustion, a tubular housing having a first and a second group of apertures around its periphery, each of those groups of apertures being spaced from the other along the length of said housing, a flange at one end of said housing, an outer transparent circular member supported within said housing on one side of said first group of apertures and intermediate said first and second groups of apertures, a retaining sleeve positioning said transparent member and having a plurality of apertures therein aligned with said second group of apertures in said housing, an inner circular perforated shielding member supported in said housing parallel to said transparent member and positioned on the other side of said first group of apertures in said housing from said transparent member, said shielding member engaging said

flange, a spacer ring within said housing and intermediate said transparent member and said shielding member, said spacer ring having a plurality of apertures therein aligned with said first group of apertures in said housing, each of the perforations in said shielding member being smaller in size than at least some of said particles, and means for forcing air through said first group of apertures and through said shielding member, said means comprising a hollow air chamber member surrounding and supporting said housing, and means supplying air to said chamber member.

10. In a window assembly adapted to be associated with a heated chamber containing various sized airborne particles created as a result of combustion, a tubular housing having a first and a second group of apertures around its periphery, each of those groups of apertures being spaced from the other along the length of said housing, a flange at one end of said housing, an outer transparent circular member supported within said housing on one side of said first group of apertures and intermediate said first and second groups of apertures, a retaining sleeve positioning said transparent member and having a plurality of apertures therein aligned with said

second group of apertures in said housing, an inner circular perforated shielding member supported in said housing parallel to said transparent member and positioned on the other side of said first group of apertures in said housing from said transparent member, said shielding member engaging said flange, a spacer ring within said housing and intermediate said transparent member and said shielding member, said spacer ring having a plurality of apertures therein aligned with said first group of apertures in said housing, there being at least 100 perforations per square inch over at least a portion of the area of said shielding member, and means for forcing air through said first group of apertures and through said shielding member, said means comprising a hollow air chamber member surrounding and supporting said housing, and means supplying air to said chamber member.

References Cited in the file of this patent

UNITED STATES PATENTS

1,717,637 Vastine ---------- June 18, 1929

FOREIGN PATENTS

581,394 Great Britain ---------- Oct. 10, 1946

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,850,005 September 2, 1958

James A. Good et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, line 50, after "one" insert -- side --.

Signed and sealed this 31st day of March 1959.

(SEAL)
Attest:
KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents