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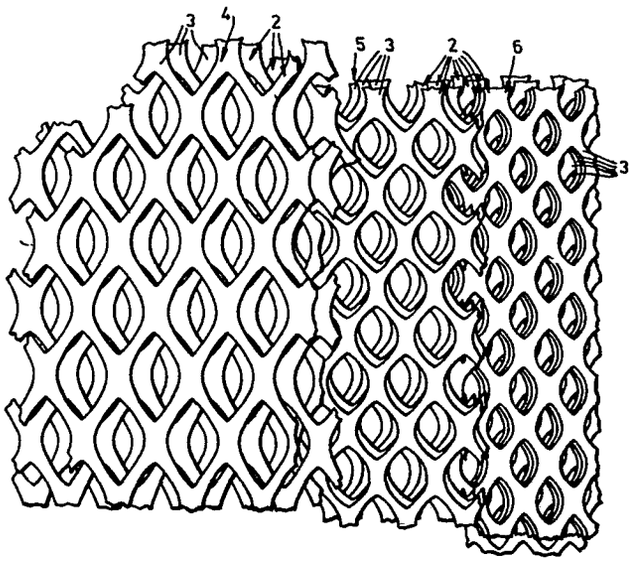
(54) **Multi-layer heat barrier.**

(57) A heat barrier comprises a plurality of layers (2) each of which is formed by a substrate of expanded metal mesh foil (3) which is coated with a heat actuated and resistive intumescent coating. In order to enable rapid and simultaneous intumescence of the coatings on the substrate layers in the event of a fire the layers on the outer side of the barrier comprise substrate meshes which have an aperture size greater than the aperture size of the substrate meshes on the other side or in the centre of the barrier.



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MULTI-LAYER HEAT BARRIER.

The present invention relates to heat barriers of the type disclosed in our European Patent Application No. 79302269.0, and in particular to those which comprise one or more layers each comprising a substrate in the form of an expanded metal mesh with a heat actuated and resistive intumescent coating disposed on the substrate.

Such heat barriers have been found to be extremely effective and, depending on the application will have a varying number of layers to provide the degree of protection required.

One of the difficulties with conventional intumescent coatings is that their insulating or heat protective properties are not proportional to their thickness and therefore there is little or no advantage in increasing the thickness of the coating beyond a predetermined amount as the increase in protection is negligible. The reason for this is that the top surface of the coating, which is exposed to the heat, intumesces rapidly to form an effective insulating layer which delays the conduction of heat to the under-parts of the coatings and thereby inhibits intumescence of these parts. With barriers of the type described in our above mentioned European Patent Application this problem is much reduced and, particularly when only say two or three layers of coated substrate are used, the problem

is negligible. However, when longer protection against heat is required, such as for example two to four hours for structural steelwork in a building, the number of layers in the barrier is increased considerably, to perhaps ten or more and similar problems can be experienced as with conventional simple intumescent coatings as described above.

In order to overcome this problem and in accordance with the present invention a heat barrier which comprises a plurality of layers, each layer comprising a substrate in the form of an expanded metal mesh with a heat actuated and protective intumescent coating disposed on the substrate, is characterized in that the size of the apertures in the substrate mesh varies between the different layers of the barrier.

Preferably the size of the apertures increases through the layers between one side of the barrier on the other, the layer in which the size of the apertures is smallest being located in use adjacent the structure to be protected.

By this means, when heat is applied initially to the barrier the same degree of intumescence will occur more slowly in the surface layers of the barrier than in the layers nearer the protected structure, allowing a greater amount of heat to reach the underlayers, thus causing those underlayers to intumesce more quickly and possibly also to a greater degree than would be the case if the sizes of the apertures in the various covering layers were uniform.

Alternatively, the size of the apertures may decrease from both sides towards the middle of the barrier if the barrier is to provide protection for either side from a heat source or fire which is on the other side of the barrier, for example, is required in ships bulkheads.

In the above mentioned European Patent Application the preferred material forming the substrate of each layer is an expanded aluminium foil. It is envisaged that the same material would be used, but that the

materials in the different layers would have different sized apertures. Alternatively, the grades of mesh used in the different layers could also be different so that, for example, the top layers might be a conventional expanded metal mesh and the underlayers an expanded metal mesh foil (i.e. of thickness less than 0.2mm).

One example of a heat barrier according to the present invention will now be described with reference to the accompanying drawings in which:-

Figure 1 illustrates comparative test results between a barrier according to the present invention and a prior heat barrier;

Figure 2 illustrates a plan view of the heat barrier with parts broken away to show different layers; and,

Figure 3 shows a side elevation of the heat barrier.

The heat barrier 1 comprises twelve layers 2 of expanded aluminium mesh foil 3 which has been coated with a heat activated and protective intumescent material as described in our European patent application No. 79302269.0. However, instead of each of the layers comprising a mesh of the same size three different sizes of mesh are utilized. The top three layers 4 comprise a 1" nominal mesh, that is say a mesh having openings 16mm x 10mm, the next four layers 5 comprise $\frac{3}{4}$" nominal mesh with openings 11mm x 7.5mm and the bottom five layers comprise $\frac{1}{2}$" nominal mesh with openings 9mm x 3mm. When the heat barrier is used to surround or partially surround a structure to be protected it is positioned so that the three topmost layers 4 lie on the side remote from the structure and the five layers 6 lie adjacent the structure.

By this means, when the temperature rises on the outside of the barrier the larger area of the openings in the top and middle groups of layers enables the heat to reach the bottom layers 6 more rapidly than would be the case if the layers all comprise the same

mesh, thus allowing intumescence of the various layers to occur substantially simultaneously and thus enable the whole barrier to intumesce much more quickly to provide a more effective barrier to the passage of heat than with a barrier comprising layers of the same mesh size.

Figure 1 illustrates the rate of temperature increase on the side remote from the heat source of a barrier as shown in Figures 2 and 3 and also the rate of temperature increase on the same side of a barrier comprising twelve layers of $\frac{3}{4}$" nominal mesh (i.e. the same as the middle 5 layers of the example according to the invention.

The Figures for the standard mesh form a curve A and the figures for the mesh of the example form the curve B. It will be appreciated that the rate of temperature rise is significantly lower for the mesh according to the invention than with the standard mesh and furthermore that the amount of heat passed through the barrier (represented by the area under the curve) is also reduced.

Whilst the temperature on the side of the barrier remote from the heat source will eventually rise to substantially the same level regardless of whether or not the barrier comprises standard layers of mesh or varying size mesh layers according to the invention, it is the delay in the temperature rise which is particularly significant as it will enable a barrier comprising fewer layers to replace a standard mesh barrier of a larger number of layers, thus reducing the quantity of materials involved and particularly the amount of intumescent material applied to the substrate meshes, the intumescent material being extremely expensive.

Where a heat barrier is required for example in a bulkhead, door or partition, where the fire or heat source might be located on either side, the barrier

will preferably comprise layers in which the size of the apertures decreases towards the centre of the barrier.

CLAIMS

1. A heat barrier which comprises a plurality of layers (2), each layer comprising a substrate in the form of an expanded metal mesh (3) coated with a heat actuated and resistive intumescent coating, characterized in that the layers of one side of the barrier(4) comprise substrate meshes having an aperture size greater than the aperture size of the substrate meshes on the layers of the other side of the barrier (6).

2. A heat barrier which comprises a plurality of layers (2), each layer comprising a substrate in the form of an expanded metal mesh (3) coated with a heat actuated and resistive intumescent coating, characterized in that the outer layers of the barrier comprise substrate meshes having an aperture size greater than the aperture size of the substrate meshes in the layers in the centre of the barrier.

3. A heat barrier according to claim 1 or claim 2, in which at least three different aperture size substrate meshes are used.

4. A heat barrier according to any of claims 1 to 3, in which a plurality of adjacent layers comprise the same aperture size substrate mesh.

5. A heat barrier according to claim 4, wherein a plurality of groups (4, 5, 6) of adjacent layers having the same aperture size substrate mesh are provided, each group (4, 5, 6) having a substrate mesh of a

different aperture size.

6. A heat barrier according to any of claims 1 to 5, wherein the substrates comprise an expanded metal foil mesh.

7. A heat barrier according to any of claims 1 to 5, wherein one or more of the layers having a larger aperture size substrate mesh comprise a substrate in the form of an expanded metal mesh of a gauge greater than foil.

8. A heat barrier according to claim 7, wherein the remaining layers comprise a substrate in the form of an expanded metal foil mesh.

9. A heat barrier according to claim 6 or claim 8, wherein the foil mesh is of aluminium.

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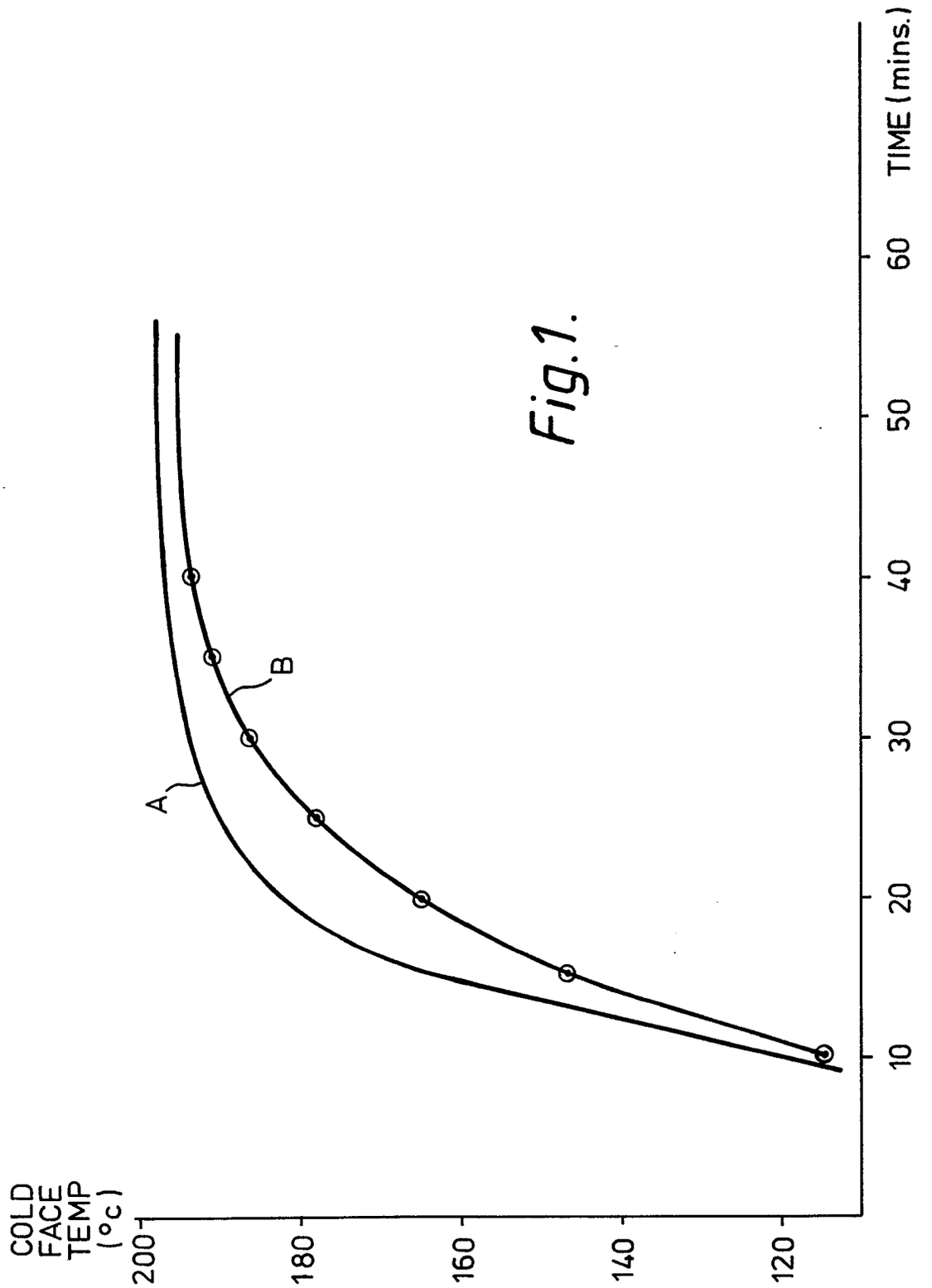

Fig.1.

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Fig. 3.

Fig. 2.