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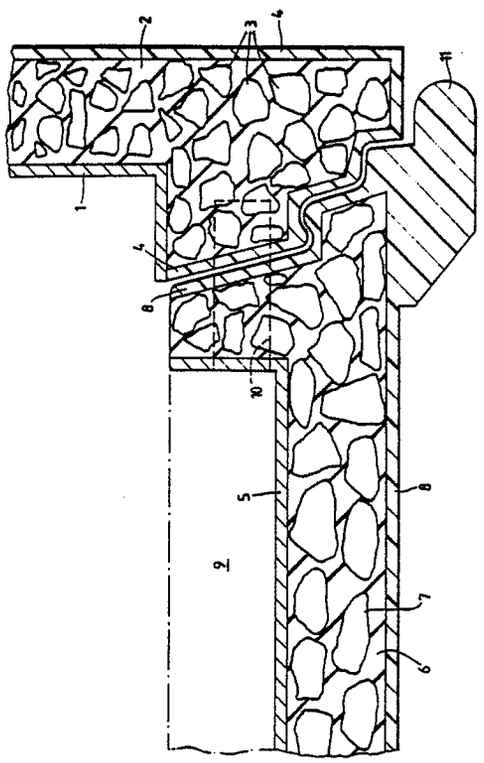
(54) Security receptacles.

(57) The body and door of a safe or similar security receptacle are constructed with a security barrier layer comprising an elastomer material 2,6 reinforced with elements of hard material 3,7. Onto this barrier is cast an outer elastomer layer 4,8 which is moulded to define the external profile of the structure. The outer elastomer layer 4,8 replaces the steel skin of traditional safe manufacture and avoids security and cost problems associated with the latter. It is also preferably formulated to intumesce into a non-combustible char under fire conditions to enhance the fire-resistance of the structure.



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SECURITY RECEPTACLES

The present invention relates to safes and the like security receptacles, including doors, body structures and wall panels for use in safes, safe-deposit lockers, cash-dispenser enclosures, strong-rooms and the like.

More particularly, in one aspect the invention relates to security receptacles the barrier structures of which comprise an elastomer material. Elastomers, and more especially polyurethane elastomers, have been proposed as a class of material useful for resisting burglarious attack upon safes and the like in United Kingdom patent specification nos. 1427033 and 1513609 and German patent specification no. 3241526. The toughness and resilience of such materials make them difficult to penetrate using percussion-type tools, they have the tendency to clog and render ineffective the bits of abrasive tools, including the diamond drill, and they are known to render thermal attacks difficult particularly by the generation of thick and noxious fumes when burnt. Their natural vulnerability to edge-cutting tools can be overcome by incorporating the elastomer as the binding matrix in a composite barrier containing nuggets of an extremely hard material, such as sintered or fused alumina or zirconia.

While the above-mentioned prior art specifications recognise at least in part the attributes of this unconventional material for use as a barrier in security receptacles, in other respects the safes which they describe are manufactured in a traditional manner, particularly in that the exposed surfaces of the safes, both internal and external, are clad in sheet steel, between which the elastomer barrier is disposed.

The presence of steel at the outside of the receptacle and the double thickness of steel at the mating edges of the door and body can, however, facilitate certain methods of attack. For instance if the barrier is attacked by drilling, the outer steel provides for the attachment of the widely available and convenient to use electromagnetic -base drill stand. Furthermore during attacks with thermal tools, with the oxy-acetylene torch for instance, additional heat can be generated by combusting the steel. This steel combustion also produces an iron oxide which may assist penetration to the interior and access to the contents. The intense local heat and iron oxide fluxing can be exploited particularly in attacks along the door/body closure.

The traditional process of manufacturing a safe or the like with steel skins is also expensive and labour intensive, particularly in relation to that part of the skin at the door/body junction of the receptacle. The mating surfaces of a safe door and body are usually formed with a series of steps or other profiles the purpose of which is to prevent access to the door bolts with burglary tools and also to inhibit heat transfer around the door to the interior of the safe in the event of fire. The manufacture of these edge portions of each door and body thus involves the steps of bending steel strip to the required profile, welding strips together to form a continuous frame, straightening the fabrication to eliminate thermal distortions, and grinding the frames of each door and body pair to mate within the required tolerance. Alternatively, these edge portions can be made by a deep-drawing process which produces the mating surfaces repeatably and without the need of hand-finishing, but the tooling costs of deep-drawn profiles are very high and only economic where high volume production can be guaranteed.

One aim of the present invention is to provide a security receptacle having the attributes of an elastomer barrier but which can be produced more simply and economically than the elastomer safes known heretofore and can avoid the security weaknesses associated with an outer steel layer.

Accordingly in one aspect the invention resides in a door, body structure or wall panel for a safe or other security receptacle which includes an inner security barrier layer comprising an elastomer material reinforced with elements of hard material, and an outer layer cast onto the security barrier layer, which outer layer comprises an elastomer material moulded to define the external profile of said door, body structure or wall panel. In the case of a safe body or door said outer layer is in particular moulded to define the profiled surface thereof which mates with the door or body (as the case may be).

The form of construction provided by the invention has several advantages. Firstly, the moulded outer elastomer layer replaces the outer steel skin of the traditional form of construction and avoids the expense and security weaknesses inherent in the use of outer steel as discussed above; the adherence of the outer elastomer layer to the inner barrier may also make its delamination in an attack upon the receptacle more difficult than in the case of a traditional steel skin. Useful savings in the weight of the finished product may also be achieved by the elimination of the outer steel. Furthermore, the double-layer construction technique embodied in the invention permits considerable flexibility in the choice of the inner and outer elastomers to meet a range of different requirements.

For example, for optimum thief-resistance a grade of elastomer may be chosen for the inner layer which is softer and tougher than that chosen for the outer layer, which latter will be formulated to provide a durable outer surface resistant to scuffs, scratches and indentations and hence in this case needs to be somewhat harder than the inner elastomer. In such an example the inner elastomer may typically have an elongation in a range up to 450% and a hardness in the range of 75-100° Shore A while the outer elastomer has a minimum elongation of 100% and a minimum hardness of 50° Shore D; (it should be noted here that in this specification all expressed elongations and tensile strengths are as measured generally in accordance with BS 903 Part A2 1971 using a dumb bell test piece type I and a strain rate of 50mm/minute; all expressed tear strengths are as measured generally in accordance with BS 903 Part A3 1982 method 'C' using a nicked crescent test piece and a strain rate of 50mm/minute; and all expressed hardnesses are as measured in accordance with ASTM D2240). On the other hand, in some embodiments the same elastomer may be chosen for both inner and outer layers. Even in this case where the same formulation of elastomer is used throughout the thickness of the finished wall there are specific advantages in adopting the double-layer construction technique of the invention. For example, if the whole wall was cast in one some means, such as internal steel cage, would be needed to contain the hard inclusions during casting and prevent them spoiling the external surface of the finished product, thus increasing the capital cost and possibly inhibiting the flow of elastomer during casting. Air bubbles expelled from the interstices between the hard inclusions during casting may also come to the surface and spoil its appearance. Polyurethanes and other elastomers cure exothermically, which means that with relatively thick layers considerable thermal distortion of the surface may also occur. By casting a separate, relatively thin outer layer of "straight" elastomer onto the main barrier layer, however, any surface imperfections on the inner layer arising from any of the above causes will be covered, and it is unnecessary to take special steps to eliminate them when casting the inner layer.

When using the same or a similar formulation of elastomer for both layers we believe that the following represents an optimum specification for its physical properties to meet the requirements of both reasonable thief resistance and surface finish, namely a hardness in the range of 50-75° Shore D; elongation in the range of 250-400%; tensile strength in the range of 20-40 N/mm^2; and tear strength in the range of 60-110 kN/m.

Another quality which is most desirable for receptacles intended for the safekeeping of money or valuables is fire-resistance. That is to say its structure should be able to retain its integrity and resist ignition or sustained combustion to save its contents from damage under the conditions likely to be encountered in a building fire (which can be distinguished from the local, high intensity thermal conditions of a torch attach). In the case of an elastomer-clad receptacle this implies the choice of a sufficiently high melting point material not to melt and run away under these conditions. However, it has also been found that by judicious addition of known flame suppressants and char promoters (typically organophosphorous and bromine-or other halogen-containing compounds) to certain elastomer formulations the cured material can be induced to intumesce under fire conditions to form a thick, non-combustible char which acts both as an insulator and as a barrier to combustion. It is therefore preferred to use an elastomer having this quality at least for the outer layer of structures according to the invention. By way of example, a polyester-based polyurethane elastomer has been formulated for this purpose having the physical properties specified immediately above and which is self-extinguishing within the prescribed period when fire tested in accordance with BS 5852 Part 2 1982 using a No 7 crib. The intumescent properties of elastomer materials could not, of course, be so readily exploited for the purpose of fire-resistance in a security receptacle structure of the traditional kind where the barrier material is encased within an outer steel skin.

This intumescent, fire-resistant quality of elastomers is an important feature of the invention in the protection of security receptacles and it may be found of value to provide such a material as the finishing layer around security barriers of all kinds - both thief and fire-resistant. Accordingly, in a second aspect the invention also resides in a door, body structure or wall panel for a safe or other security receptacle which includes an inner security barrier layer (which need not comprise an elastomer itself but in the case of a thief-resistant receptacle could be any of the known kinds of penetration-resistant barrier used in the security industry, such as security-formulation concretes, stainless steel or composites comprising cast aluminium or copper containing hard nuggets, or, in the case of a primarily fire-resisting receptacle, any of the known kinds of thermal barrier materials used in the industry such as cast gypsum, urethane foams, silicate plates and "phase-change" materials, or combinations thereof), and an outer layer cast onto the security barrier layer, which outer layer comprises an elastomer material moulded to define the external profile of said door, body

structure or wall panel and which is adapted to intumesce into a non-combustible char when exposed to fire conditions. Such a structure will have enhanced fire-resistance in addition to the cost and security advantages (where appropriate) previously discussed in relation to the elimination of the traditional outer steel layer.

The invention will now be more particularly described, by way of example, with reference to the accompanying drawing, which is a sectional view of the door/body junction region of a safe made in accordance with the invention.

The body of the illustrated safe comprises an inner skin 1 of, say, steel or glass-reinforced plastics onto which is cast a first elastomer layer 2 containing hard nuggets 3 of e.g. Aloxite (alumina) or ZAC (Zirconia alumina ceramic), and around which is moulded a second elastomer layer 4 to form the external surface of the body and the profiled surface around the door opening. The door of the safe is constructed similarly, comprising a pan 5 of steel or glass-reinforced plastics onto which is cast a first elastomer layer 6 containing hard nuggets 7, similar to the layer 3/4 of the body, around which is moulded a second elastomer layer 8 to form the external surface of the door and the profiled surface which mates with the profiled surface of the body around the door opening. The space 9 defined inside the pan 5 is destined to accommodate the locks and boltwork for the door.

In preferred embodiment, the elastomer of the outer layers 4 and 8 in the body and door is an enhanced fire-resisting formulation of a polyester-based polyurethane to provide a durable finish to the receptacle and having the quality of intumescence under fire conditions. The elastomer of the inner layers 2 and 6 in the body and door may be the same as in the outer layers, or may be a softer and tougher grade formulated to optimise its own thief-resisting properties.

To manufacture the body of the safe, the complete inner skin 1 is fabricated and assembled with a mould form to define the desired shape of the inner elastomer layer 2. The mould is filled first with loose hard nuggets 3 and then the elastomer 2 is poured in from a suitable mixing nozzle, to which the polyol and isocyanate components which make up the material are supplied in accordance with known polyurethane production techniques. When sufficiently cured, the assembly is removed to a second mould form to define the desired shape of the outer elastomer layer 4, and the second elastomer is cast in this mould around the layer 2.

Suitable polyester-based polyurethanes for layer 2 have been found to exhibit strong adherence to a mild steel inner skin 1; if, however, further resistance to delamination of this elastomer layer is required the skin 1 may be provided with anchor members (not shown) extending from the skin into the mass of the layer 2, or the skin may be coated with a suitable adhesive primer.

The external profile of the outer layer 4, including that around the door opening, is accurately and repeatably set by the appropriate mould form and no finishing of this layer should be required, except for painting if desired. Painting may be achieved by conventional external spraying techniques or by an in-mould coating technique where the paint is sprayed onto the mould for the outer elastomer layer before the latter is injected. Alternatively, the polyurethane of layer 4 may be suitably pigmented to render any surface finishing unnecessary.

The door can be manufactured by a moulding process similar to that described above for the body. In either case, suitable cores will be included in the moulds if required to form guides and detentions for door bolts (e.g. as indicated at 10 in the drawing) and such passages in the door as may be required to take keyways, combination lock dial shafts or the like. Lugs 11 may be moulded on the door to take a hinge pin and corresponding lugs (not shown) may be moulded on the body.

Instead of the two-mould process described above, a single respective mould may be used for the body and door configured to the required external profile and the respective outer elastomer layer formed by in-mould coating; that is to say, the outer elastomer would be sprayed onto the surface of the single mould before filling the same with the hard nuggets and inner elastomer.

Although the invention has been described above in an embodiment in which inner steel or other skins 1,5 are still used, to lend rigidity to the overall body and door structures, it may be possible in other embodiments to dispense with these skins altogether to leave the structures composed wholly of the respective elastomer materials.

Claims

1. A door, body structure or wall panel for a safe or other security receptacle which includes an inner security barrier layer comprising an elastomer material (2,6) reinforced with elements of hard material (3,7), characterised by an outer layer cast onto the security barrier layer which comprises an elastomer material (4,8) moulded to define the external profile of said door, body structure or wall panel.

2. A construction according to claim 1 wherein the elastomer of said inner layer (2,6) has an elongation in a range up to 450% and a hardness in the range of 75-100° Shore A and the elastomer

of said outer layer (4,8) has an elongation not less than 100% and a hardness not less than 50° Shore D.

3. A construction according to claim 1 wherein the elastomer of said outer layer (4,8) has a hardness in the range of 50-75° Shore D and an elongation in the range of 250-400%.

4. A construction according to claim 3 wherein the elastomer of said outer layer (4,8) has a tensile strength in the range of 20-40 N/mm^2 and a tear strength in the range of 60-110 kN/m.

5. A construction according to claim 3 wherein the elastomer of said inner layer (2,6) has a hardness and elongation in the same ranges as specified for the elastomer of said outer layer (4,8).

6. A construction according to claim 4 or claim 5 wherein the elastomer of said inner layer (2,6) has a tensile strength and tear strength in the same ranges as specified for the elastomer of said outer layer (4,8).

7. A construction according to any preceding claim wherein at least the elastomer of said outer layer (4,8) is adapted to intumesce into a non-combustible char when exposed to fire conditions.

8. A construction according to any preceding claim wherein the elastomer of said inner (2,6) and/or outer (4,8) layer is a polyester-based polyurethane.

9. A door, body structure or wall panel for a safe or other security receptacle which includes an inner thief or fire-resistant security barrier layer (2/3,6/7) and an outer layer (4,8) cast onto the security barrier layer, characterised in that said outer layer comprises an elastomer material moulded to define the external profile of said door, body structure or wall panel and which is adapted to intumesce into a non-combustible char when exposed to fire conditions.