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(54) **Security door.**

(57) A security door is described which has several inventive features. Firstly, the door (34) is composed of a core which includes at least lateral stiles (16, 17) and transverse rail members (18, 19, 14) with a central core (11), the core (11) being sandwiched between two facing layers (12), for example of plywood. As a second feature, one or more glazed openings are formed in the door, the or each opening is formed by cutting an aperture (24) in the door (34), forming a rebate (20) around the outer face of the door (34) in register with said aperture (24), placing a sheet of glazing material (27) with its edge portions within the rebate (20) and securing the glazing sheet using fasteners (29) preferably rivets or non-return screws, the peripheral portion of the glazing sheet (27) and the rebate (20) being covered by a planted moulding (30). Further, in order to strengthen connections between a door (30) and a door frame (35), potential areas of weakness such as hinges (44) and lock (39) are supplemented by pairs of reinforcing members (41, 43, 47, 48) one of which is on the inside of the door frame (36), one of which is on the outer side of the door frame (36), the two reinforcing members (41, 43, 47) being secured together by fasteners (49), these structures serving to spread any bursting force over a larger area of the frame (36). In connection with this latter provision, a selected hinge of the door, for example an uppermost hinge, can be provided with said plates but unconnected so as to provide a weak point to allow entry by police or fire officers in an emergency. As a further aid to this possibility the door frame at that location, or over its entire length can be made from a stile member (56) which is composed of two parts (59, 60) which are adhered or otherwise secured together to provide a part line of weakness. There is also described a fastener arrangement for a security door which includes internal and external handles, a latch bolt and a locking bolt, the arrangement being that operation of the handle on the interior of the lock can cause movement of both the latch bolt and the locking bolt from their closed to their opened conditions. This allows rapid egress from a door fitted with such a fastener assembly.

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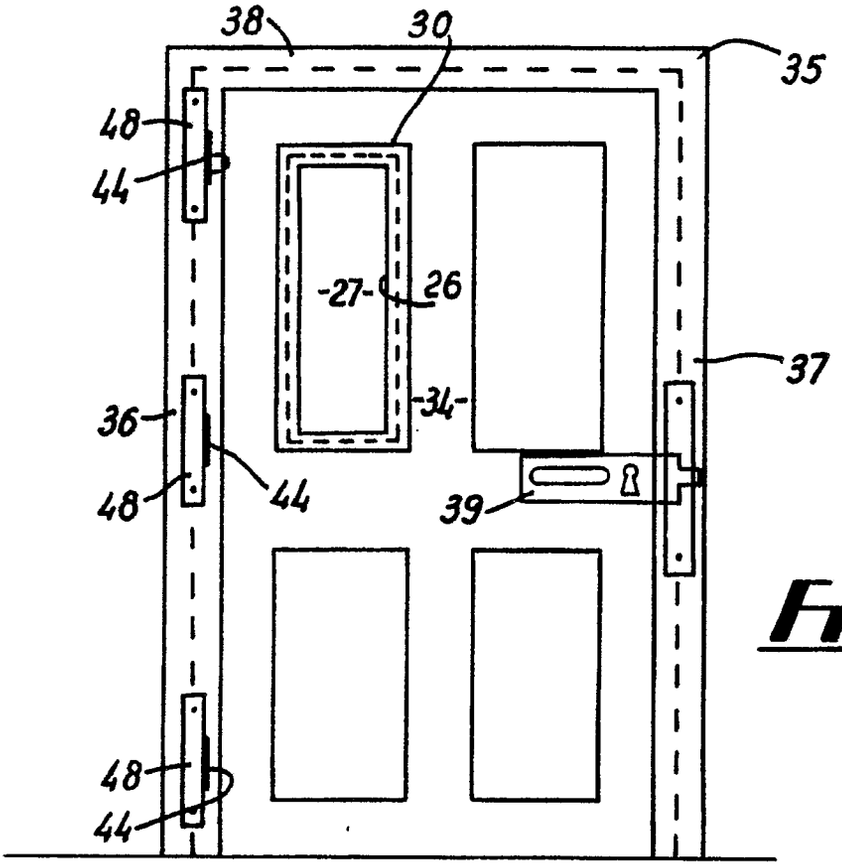

FIG. 5

A SECURITY DOOR

This invention relates to a security door for use in premises which may be liable to forcible entry. It is an object of the present invention to provide a security door which fulfills all the normal functions of a door, but is additionally secure against forcible entry.

As a first aspect of the invention there is provided a door which includes a core and a pair of cover sheets overlying the core, characterised in that the core includes a body and a frame.

The body can be of wood.

The body can be of hardwood.

The wood can be in the form of strips.

The frame can include stiles along the longer edges of the door and upper and lower rails. A lock rail can be provided if required.

The width of the stiles and rails can be such that after manufacturing a door blank, the size thereof can be significantly reduced without reducing the strength of the frame. To this extent the stiles and the rails can be a minimum of 100mm in width, preferably 125 or 150mm.

In order to reduce the possibility of warping each stile/rail can be made from a single piece of timber which has been longitudinally cut, and the halves turned and re-adhered together in order to create a piece of timber with minimal tendency to warp.

The facing sheets can be of exterior quality plywood.

The facing sheets can have a facing ply of a decorative hardwood.

Each door can be made in the form of a blank 6' 9" by 2' 10" (2057 by 864mm). Such a door can be reduced in size right down to a minimum length of 77" and a minimum width of 29" (1956mm by 737mm).

A door as aforesaid can be formed with glazed lights and/or a panelled effect if desired.

As a second feature of the invention there is provided a security door including a light formed by cutting an aperture in the door, forming a rebate around the door on an outer face thereof, placing a toughened sheet of light transmitting material with its edge engaging inside the rebate and covering the aperture, securing edge portions of said sheet to the material of the door by fasteners passing through the sheet into the material of the door, and positioning cover strips to overlie the peripheral portions of the light.

Preferably, the peripheral portions of the sheet are secured by non-releasable fasteners, for example non-release screws, barbed nails, or rivets engaging within the door or passing through the door. Edge portions of the sheet can be bedded in a sealant for weatherproofing. Edge portions of the aperture in the door can also be lined with a frame to improve the appearance thereof. In register with the light comparable frames can be applied to the inside of the door to improve its appearance.

The cover mould can be in the form of a frame surrounding the sheet of translucent material and can entirely cover that part of the sheet which overlines the rebate.

The sheet of light transmitting material can be transparent or can be translucent. The sheet can be of reinforced glass and/or plastics material, or can be of laminated construction.

The invention also provides a security doorway including a door and a frame, the door having hinges on one edge thereof and a fastener at an opposite edge thereof, said hinges and said fastener (in its closed condition) forming a connection between the respective edge of the door and the frame, characterised in that the or each said hinge/fastener has associated therewith reinforcement including a member on one side of the frame secured to the frame to resist destruction of the frame by said fastener and/or fasteners of said hinge when stress is applied to said door from the opposite side of said frame.

Said reinforcement can comprise a member on said one side of the frame extending above and below said fastener and secured to said frame.

Desirably, however, said member is secured to a further member on the outside of said frame and secured thereto by means passing through the frame.

Such a member can comprise a metal plate on the inside of the frame and a comparable metal frame on the outside of the frame. The fasteners can be bolts or the like passing through the door. Preferably, the ends of the fasteners on the outside of the frame are adapted to be either concealed and/or inoperable from that side of the door. Fasteners on the inside of the frame can be screws and/or nuts.

Preferably the reinforcement plates on the outside (and less importantly the plates on the inside) are disposed so as to be clearly visible and to serve as a warning to potential intruders.

In the case of a door which has an upper and a lower hinge on one edge and a single fastener (i.e. door handle/bolt combination) on its other edge, it is desirable that an upper one of said hinges is not provided with said reinforcement in order that in the event of fire within the premises access can be obtained rapidly by fire authorities. In order, however, to deter potential intruders, it is desirable that when said external members are disposed on the

frame to be prominent, said non-reinforced hinge is provided with an external dummy reinforcement member comparable to the members adjacent the other hinge(s) and the fastener. In the event of fire within the room closed by the door (which might be a single entrance dwelling in a block of flats) fire personnel can obtain rapid access by use of a sledge hammer adjacent the upper hinge.

To further assist entry in the aforesaid situation, it can be desirable to construct at least that part of the door frame adjacent the "weak" hinge to be of two part construction, the joint between the two parts lying, for example, level with the normal rebate on the door. Thus, in the event that force has to be applied adjacent said hinge to cause rapid destructive entry to the premises the door frame will, under said load, split at the part line rather than the hinge fasteners (such as screws) having to cause the splitting of the frame material.

As a further feature of the invention, there is provided a security door which has a fastener assembly at one edge thereof, the fastener assembly including a body, a latch bolt operable by handles on each side of the door, and a lock bolt operable by a key from the exterior of the door and by a key or other means from the inside of the door, the interconnection between the two bolts and the pair of handles being such that when the locking bolt is in its secured position operation of the handle on the exterior of the door has no effect on the locking bolt, but operation of the handle on the inside of the door is capable of moving both the latch bolt and the locking bolt from their secure to their inoperative conditions.

This ensures that in an emergency egress from the house can easily be obtained, despite the fact that the door is locked and bolted against ingress.

To this intent, the lock mechanism can include a locking bolt disposable in a secure condition and a retracted condition, activation of the handle on the inside only of the door causing said bolt to move to its inoperative condition.

The locking bolt can be spring loaded towards its retracted position, and said movement of the interior handle can be such as to cancel retainment of the bolt in its secure condition by the lock mechanism.

The invention will be described further, by way of example, with reference to the accompanying drawings, wherein:

Fig. 1 is a front elevation (with one facing sheet removed) of a preferred door of the invention;

Fig. 2 is a cross-sectional view on the line II-II of Fig. 1;

Fig. 3 is a front view of a door illustrating how it may be panelled;

Fig. 4 is a fragmentary enlarged cross-sectional view illustrating how the door of the invention can be glazed;

Fig. 5 is a schematic front elevation of a door and its frame in accordance with the invention;

Fig. 6 is an enlarged cross-sectional view illustrating the door and frame of Fig. 5;

Fig. 7 is a still further enlarged fragmentary cross-sectional view illustrating an alternative to the structure shown in Fig. 7;

Fig. 8 is a view comparable to that of Fig. 7, but illustrating the frame structure of Fig. 6 in rather more detail;

Fig. 9 is a cross-sectional view through a lock of the door of the invention.

Fig. 10 is a side elevation of a known door reacting to an internal fire;

Fig. 11 is a front elevation of a further preferred door of the invention; and

Fig. 12 is an enlarged cross-sectional view on line C-C of Fig. 11.

DOOR BLANK

Referring now to Figs. 1 and 2, it will be seen that a preferred door 10 of the invention includes a core 11 and two facing sheets 12. The facing sheets 12 will normally be of exterior quality plywood, for example having a final laminate of a decorative hardwood such as mahogany. However, any other convenient facing material such as plastics laminate or other weather-resistant and stable material can be used. The core 11 comprises a main central body 13 which can be in two parts 13a, l3b in the case that the door includes a lock rail 14 or otherwise can be unitary. The body 13 can be made up of a plurality of individual strips of wood, preferably hardwood indicated by reference numeral 15. The strips are adhered together. Around its edges, the body of the core 11 is provided with stiles 16, 17 and upper and lower rails 18, 19. Lock rail 14 is of comparable material and is optional. The rails and stiles are the same thickness as the body 13 and are united with the facing sheets 12 by means of adhesive. In order to reduce any tendency of the door to warp, each stile/rail is made from a single piece of material. A division is indicated by a dotted line in Fig. 1. Referring, as a specific example, to the stile 16, it will be seen that the stile 16 is made from a single length of hardwood timber which may be 100 to 150mm wide. This piece of timber is cut down the centre to produce two parts 16a and 16b. After cutting, one part is turned through 180° longitudinally and laterally relative to the other and then is re-adhered to that other piece. Thus, any tendency of that original piece of timber to warp is reduced. Upon change in moisture content in use, any ten-

dency to warp in a particular direction by one of the pieces 16a, 16b is counteracted by a contrary tendency in the other piece 16b or 16a. It has been ascertained that such a construction gives a minimum warp in use.

The sizes of the rails and stiles are chosen so that after a blank has been made of a maximum required door size, portions can be cut from the top and bottom edges of the door to reduce it to fit smaller openings without significantly reducing the strength of the door.

This basic structure of door gives a door which is of particular strength and has very great resistance to structural destruction, for example delaminating or breaking at the fittings or around glazing. Decorative material can be added to the surface of the sheets 12 by way of planted mouldings or comparable items. Glazing can be applied by a method as later described.

GLAZING

A second feature of the present invention (described in particular in relation to Figs. 3 and 4) relates to the way in which the door is glazed. Fig. 3 shows the general outline of the door 20 which can have four panels, the lower panels being designated 21 and the upper panels 22. The lower panels can be simulated by using planted moulding, for example as illustrated at 23 in Fig. 4. Upper panels 22 can be glazed. In order to construct glazing which is particularly resistant to entry an aperture is first formed in the door in the desired shape of the light. Such an aperture may correspond to the shape of the panel illustrated at 22 in Fig. 3, but is not hereinafter shown in any detail. One edge of such an aperture is indicated at 24. At the junction between the edge 24 and the outer surface 25 of the door 20 a rectangular rebate 26 is formed all around the aperture. Translucent or transparent glazing sheet 27 is bedded in sealant 28 and secured to the material of the door 20 by fasteners shown as screws 29. It should be emphasised here, however, that screws are possible but are not the preferred method of securement. Because screws can be removed once any cover mould has been removed, it is desirable that either non-extractable screws, barbed nails or other fasteners are used. It has been found that rivets are desirable. Rivets passing completely through the door and clenched on the inside of the door are particularly useful. The glazing sheet itself can be of wire-reinforced glass, tough plastics material and/or reinforced plastics material, or a laminated glass/plastics material. The glazing material can be completely transparent or be translucent, frosted or of other decorative form or design.

Externally of the door, moulding 30 is planted to cover the sealant 28 and the edge of the sheet 27. Such moulding is secured to the door in conventional manner.

As the edge 24 is likely to be unsuitable for forming an observable surface, the interior of the aperture in the door can be framed with lining strips 31. The structure can be finished off on the inside of the door with a decorative planted moulding 32.

The glazing construction of the invention is particularly resistant to forced entry. The sheet material is itself chosen to be resistant to hammer and like blows. Short of completely destroying the glazing sheet any person wishing to gain entry could first remove the mould 30 quite simply, but would then be faced with the fasteners 29. In the case of the non-return screws, rivets or the like, removal of those fasteners would be very difficult.

The glazing system of the present invention is superior to known glazing systems.

INTERFACE REINFORCEMENT

Referring now to Figs. 5, 6, 7 and 8, further advantageous features of the door assembly of the invention will be described. When an intruder is faced with a door of the type which has been described above, he will often cease to try to destroy the door itself and will try to destroy the union between the door and its frame. Conventionally, although a door may be very strongly constructed, it is usually only connected to its frame by hinges (normally connected to the frame by screws) and by its lock. An intruder will often attack the lock by means of a crowbar or similar instrument. If the lock fails to yield to these attentions the hinges will usually receive some treatment. For use in such security situations locks of a solid construction are usually used, and therefore an attack on such a lock with a crowbar is not usually successful. Thereafter, it is not unusual for a potential entrant to attack the lock and/or the hinges with a sledgehammer. It will be best seen in Fig. 6 that the connection between a door and its frame is not particularly secure in this situation. A blow directed along the direction of arrow 33 can easily cause a bolt 34 to burst at the frame. Similar considerations apply at the hinge end.

In accordance with this further feature of the invention, a combination of a door 34 and a frame 35 having uprights 36, 37 and cross piece 38 is modified in so far as the lock side of the door is concerned by the provision of reinforcement of the frame adjacent the lock 39. The lock 39 has its bolt

34 engaging within the usual recess in the frame member 37. It will be seen that a blow in the direction of 33 could easily cause breaking of the frame member 37 as indicated at the line 40. To try to prevent this, a reinforcing member in the form of a steel plate 41 is secured to the interior of the door frame and by means of fasteners 42 is connected to a comparable steel plate 43

The left half of Fig. 6 illustrates a comparable situation which exists at the hinge 40. A blow in the direction of arrow 45 could cause the frame member 36 to split at the line 46. To discourage this each hinge 44 is reinforced by a structure which comprises an internal plate 47, an external plate 48 and a connecting member 49. Thus, again, any blow in the direction of arrow 45 adjacent a hinge is now borne by the plate 47 and transmitted to the entire door frame rather than to the small area adjacent screws 50. Fig. 8 shows the above construction in a little more detail. It will be seen that the external plate 48 has secured thereto a stud 51 which is screwedly engaged within a threaded tube 52. Securing the plate 47 is a set screw 53 which also is screwedly engaged within the tube 52. It will be appreciated that there is considerable overlap of the set screw 53 within the tube 52. This arangement allows a fastener assembly 49 to be used with door frames of varying sizes. The stud 51 can be loose within the plate 48 or can be secured thereto as by welding.

Fig. 7 shows how a door frame member 56 can be modified in order to make it particularly suitable for use as the top hinge in a door/frame combination to facilitate emergency entry. In the cross-sectional view of Fig. 7 it will be seen that the plates 57, 58 adjacent an upper hinge 56 are secured to the frame 56 by short spikes or nails. Of course, the attachment should be sufficiently strong to prevent easy manual removement of the plates.

The door frame upright 56 either along its entire length or on a short portion adjacent the top hinge is constructed from two pieces of wood 59, 60. At their junction the two pieces of wood have been previously formed with a castellated profile as indicated at 61 and adhered together with a relatively weak adhesive. The junction between the two pieces 59, 60 is sufficient to withstand normal wear and tear and a certain degree of excessive force. However, when a sledgehammer is applied in the direction of the arrow 45 adjacent the top hinge the line of junction 61 provides a convenient part line of weakness at which the upright 56 splits to allow ingress.

LOCK

As a further feature of the invention is a door fastener which is suitable for use in connection with the security door aforesaid. Normally, a fastener assembly will include a latch bolt that is operable by handles on each side of the door and a lock bolt which is operable by a key from an exterior and either by a key or by other means from the inside. With such a secure door, rapid egress from a building is rather difficult if the lock is of the type which requires a key to secure it on the inside. Any person trying to leave the building rapidly would need to find the key and operate it to get out of the door. Without leaving a key dangerously close to the door such a situation can lead to danger.

Therefore, in accordance with the invention a fastener assembly is provided wherein the lock mechanism so interconnects the latch bolt and the lock bolt that when the locking bolt is in its secured position operation of the handle on the exterior of the door has no effect on the locking bolt but operation of the handle on the inside can move both bolts simultaneously to the opened condition to allow rapid egress.

This is achieved by the internal and external handles being separately pivotable and pivoting of the internal handle when the door is locked serving to activate a mechanism to retract the locking bolt or to trigger a spring urging the locking bolt to its retracted position.

Referring now to Fig. 9 it will be seen that a lock 65 of the invention is generally conventional having a latch bolt 66 and a locking bolt 67 which is spring-loaded (not shown) to which retractor position (to the right in Fig. 9). Latch bolt 66 can be operated by a split spindle 68. Spindle 68 has two parts. A first part exends out of the plane of the paper in Fig. 9 and carries an interior door handle (not shown). The other part of the spindle 68 extends into the plane of the paper and carries an exterior handle (not shown). The two parts of the spindle pivot about a common axis but are rotationally connected. Each spindle part carries an arm 69. The arm 69 which is visible is connected to the part of the spindle which carries the interior handle. Arm 69 can engage a rod 70 which can withdraw the bolt 66 which is loaded to its left by its spring 71. A second rod 70 (not shown) is connected to an arm comparable to arm 69 but on the exterior portion of the spindle 68. The rod 70 has a slot which engages an end of a connector arm 72. The two rods including the rod 70 are interconnected so that rotation of the spindle on the outside of the door cannot move the rod 70, whereas rotation of the spindle part on the inside of the door can move the rod 70 to operate connector arm 72.

The lock bolt 67 is under the control of a conventional lock mechanism 73 which will not be

described in detail. However, lock 73 can be operated in conventional manner by insertion of a key into keyhole 74. Connector arm 72 is interconnected with a coupler 75 which connects with the lock mechanism 73.

When the internal spindle portion 68 is turned and the locking bolt is in its extended, locked, position the rod 70 is moved to the right and entrains the connector arm 72 which pivots and via the coupler 75 frees the lock mechanism 73 allowing the spring loaded locking bolt 67 to be retracted.

Thus, a person wishing to leave a room in an emergency does not need to find a key before egress can be effected.

The invention includes, of course, a security door fitted with the fastener assembly as aforesaid.

Figures 10 to 12 illustrate a further inventive feature of a door of the invention. Referring to Figure 10 it will be seen that a door 80 in a frame 81 can warp in the event of fire 82. This creates gaps at 83 which can allow combustion oxygen to reach the flames and increase the velocity thereof. A door which warps in this way does not meet British Standards for flame resistance.

In accordance with a further preferred embodiment of door of the invention (Figure 11) this disadvantage is overcome by the provision on the door of at least one heat sensitive member which, upon reaching an elevated temperture extends outwardly of the door and interacts with the frame to resist warping of the door relative to the frame. Desirably such a member does not engage with the frame so strongly as to resist breaking of the door for exit purposes or for entry by rescuing personel. The junction between the expanding member and the door frame should be such that even with the member in position a person within the building could fairly easily shoulder the door open.

In the preferred embodiment shown in Figure 11, two temperature reactive assemblies 84 are provided one at the top and one at the bottom of the door on the bolt side. On the hinge side 85 of the door 86 any such warping is resisted by the hinges.

One of the assemblies 84 is shown in detail and in Figure 11 and it will be seen that the assembly 84 is accommodated within a cylindrical aperture 87 in the door 86. The assembly includes a housing 88 of sheet metal which has an opening 89 at one end within which is a guide 90 for a bolt 91 carried by a piston 92. A spring 93 urges the piston and bolt 91 to the right in Figure 12. Space between the piston 92 and the guide 90 is filled with a wax 94. Wax 94 is chosen to have a melting point which is such that in the event of fire it will melt and allow the piston 92 and bolt 91 to move to become operational but will not be effected by strong sunlight, central heating or any combination of these factors. A melting temperature of about 112° C has been found appropriate, although many temperatures at about this value are possible.

The assembly 84 is arranged so that the bolt 91 is in register with a groove 96 in frame member 95. This frame member 96 is filled with intumescent material 97. Thus, during normal use the groove is filled and has a pleasant and unobtrusive appearance. In the event of fire, the intumescent 97 swells and expands out of the groove 96 to become a fire resistant brittle foam. This brittle foam is very easily broken by the bolt 91 which can enter into the groove 96 and exert resistance on the door against warping as shown in Figure 10. This is a particularly neat solution to the problem of providing a receptacle for the bolt 91. Using the groove for the intumesant material, no special receptacle has to be provided and the degree of grip is sufficient to prevent warping of the door under the influence of fire, but is not so much as to prevent forcing of the door in the event that forced exit has to be made.

Any other member can, of course, be used which would extend from the door and lock with the frame to prevent warping in the event of fire. For example, a pivoted lever or other item could be provided. The projection could be on the frame and extend into the door rather than extending from the door into the frame.

All the various features of the invention can be used in unison on a security door, or selected ones thereof can be used together or alone.

Claims

1. A door which includes a core and a pair of cover sheets overlying the core, characterised in that the core includes a body and a frame.
2. A door as claimed in claim 1 wherein the core is in the form of wood strips.
3. A door as claimed in claim 1 or 2, wherein the width of the stiles and rails is such that after manufacturing a door blank, the size thereof can be significantly reduced without reducing the strength of the frame below a predetermined minimum.
4. A door as claimed in claim 8, wherein the stile minimum width is 125 or 150mm.
5. A door as claimed in claim 1, 2, 3, or 4 and made in the form of a blank 6'9" by 2'10" (2057 by 864mm) to be capable of being reduced in size down to a minimum length of 77" and a minimum width of 29" (1956mm by 737mm).
6. A security door including a light formed by cutting an aperture in the door, forming a rebate around the door on an outer face thereof, placing a

toughened sheet of light transmitting material with its edge engaging the rebate and covering the aperture, securing edge portions of said sheet to the material of the door by fasteners passing through the sheet into the material of the door, and positioning cover strips to overlie the edge portions of the sheet.

7. A door as claimed in claim 6, wherein the edge portions of the sheet are secured by non-releasable fasteners.

8. A door as claimed in claim 6 or 7, wherein edge portions of the aperture in the door are lined with a frame to improve the appearance thereof.

9. A door as claimed in claim 8, wherein in register with the or each light a comparable frame is applied to the inside of the door.

10. A security doorway including a door and a frame, the door having hinges on one edge thereof and a fastener at an opposite edge thereof, said hinges and said fastener (in its closed condition) forming a connection between the respective edge of the door and the frame, characterised in that the or each said hinge/fastener has associated therewith reinforcement, including a member on one side of the frame, secured to the frame to resist destruction of the frame by said fastener and/or said hinge when stress is applied to said door from the opposite side of said frame.

11. A door as claimed in claim 10, wherein said reinforcement comprises a member on said one side of the frame extending above and below said fastener and secured to said frame.

12. A door as claimed in claim 11, wherein the member is a metal plate on the inside of the frame and a comparable metal frame on the outside of the frame.

13. A door as claimed in claim 11 or 12, wherein ends of the fasteners on the outside of the frame are either concealed and/or inoperable from that side of the door.

14. A door as claimed in claim 11 or 12 and having an upper and lower hinge on one edge, wherein said upper hinge is not provided with said reinforcement in order that in the event of fire within the premises access can be obtained rapidly.

15. A door as claimed in claim 14, wherein to deter potential intruders, said non-reinforced hinge is provided with an external dummy reinforcement member comparable to the other reinforcement members.

16. A door as claimed in claim 14 or 15 wherein to further assist entry in the aforesaid situation, at least a part of the door frame adjacent the unreinforced hinge is of two-part construction to facilitate splitting of the frame.

17. A fastener assembly for a security door, the fastener assembly including a body, a latch bolt operable by handles on each side and a lock bolt operable by a key from an exterior side and by a key or other means from the inside, interconnection between the two bolts and the pair of handles being such that when the locking bolt is in its secured position operation of the handle on the exterior side has no effect on the locking bolt, but operation of the handle on the inside is capable of moving both the latch bolt and the locking bolt from their secure to their inoperative conditions.

18. A security door having at least one heat sensitive member which, upon reaching an elevated temperature extends outwardly of the door and engages with the frame to resist warping of the door relative to the frame.

19. A security door as claimed in claim 18 wherein the engagement with the frame is weak enough not to resist breaking the door.

20. A security door as claimed in claim 18 or 19 wherein each assembly includes a member urged outwardly of the door but restrained by heat sensitive means.

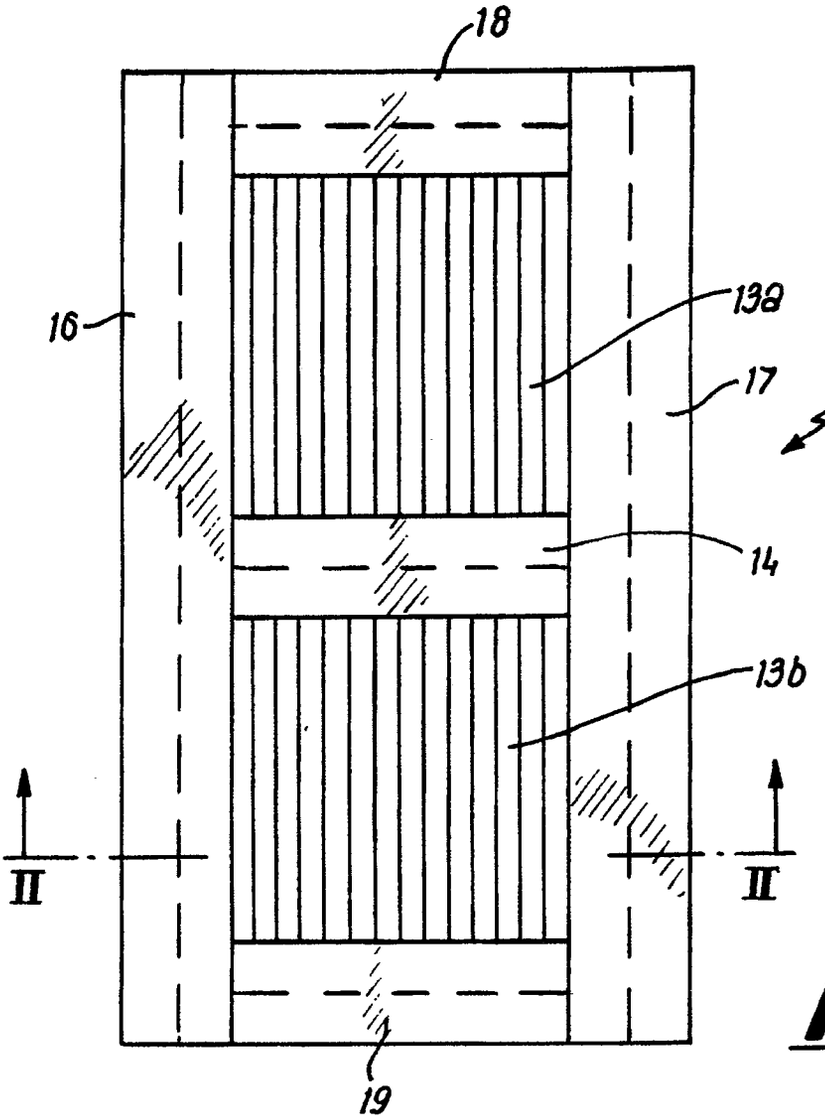

FIG. 1

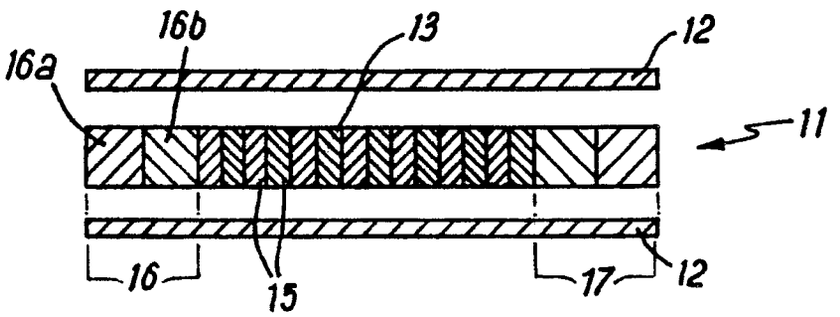

FIG. 2

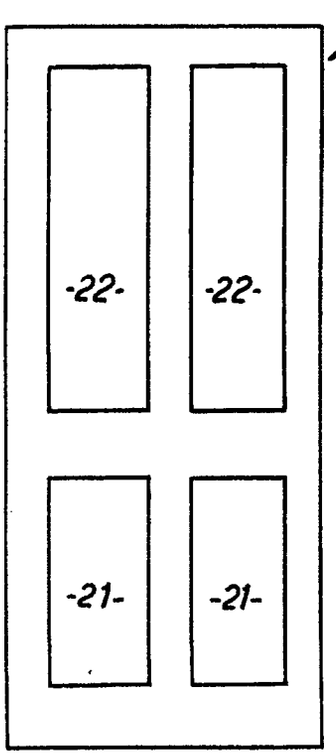

FIG. 3

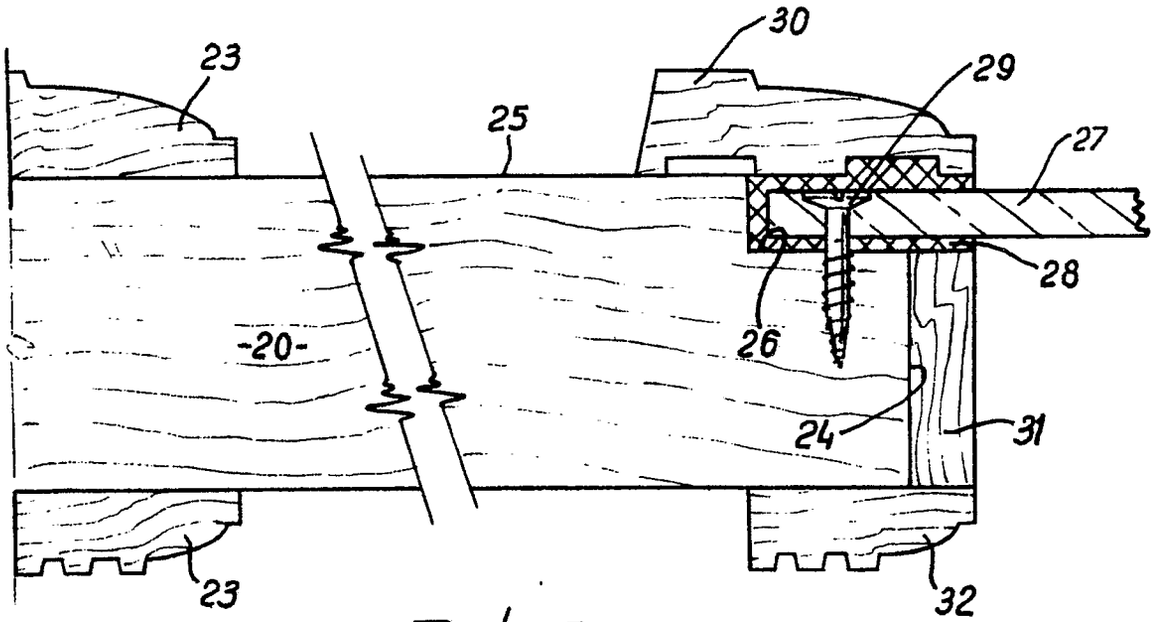

FIG. 4

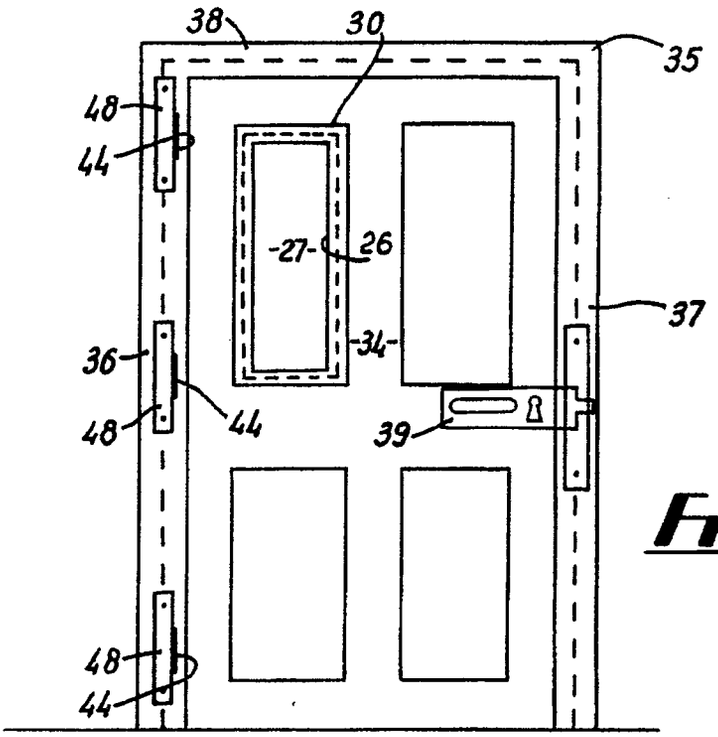

FIG. 5

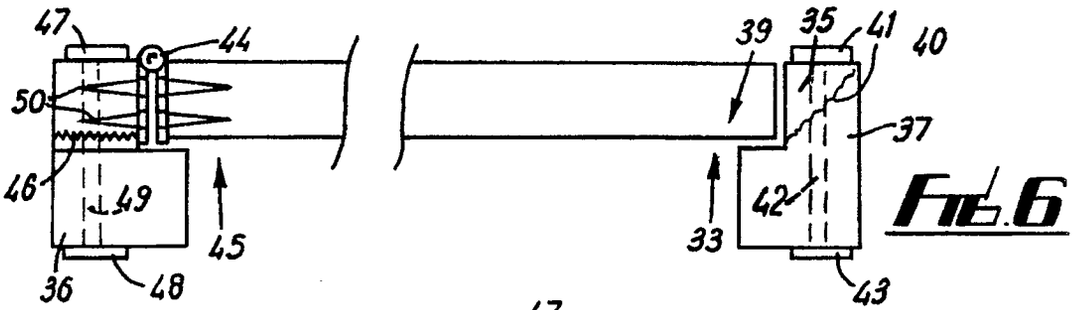

FIG. 6

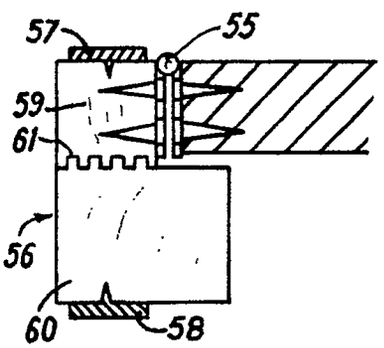

FIG. 7

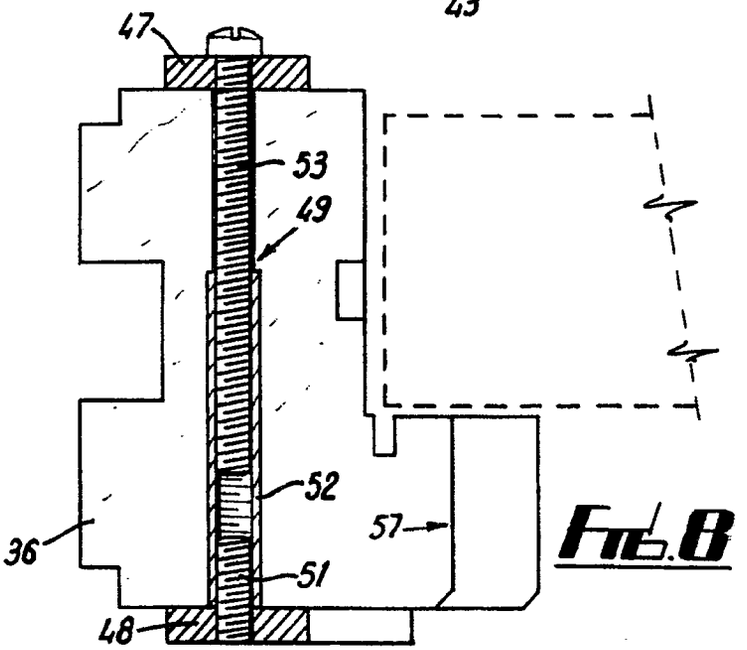

FIG. 8

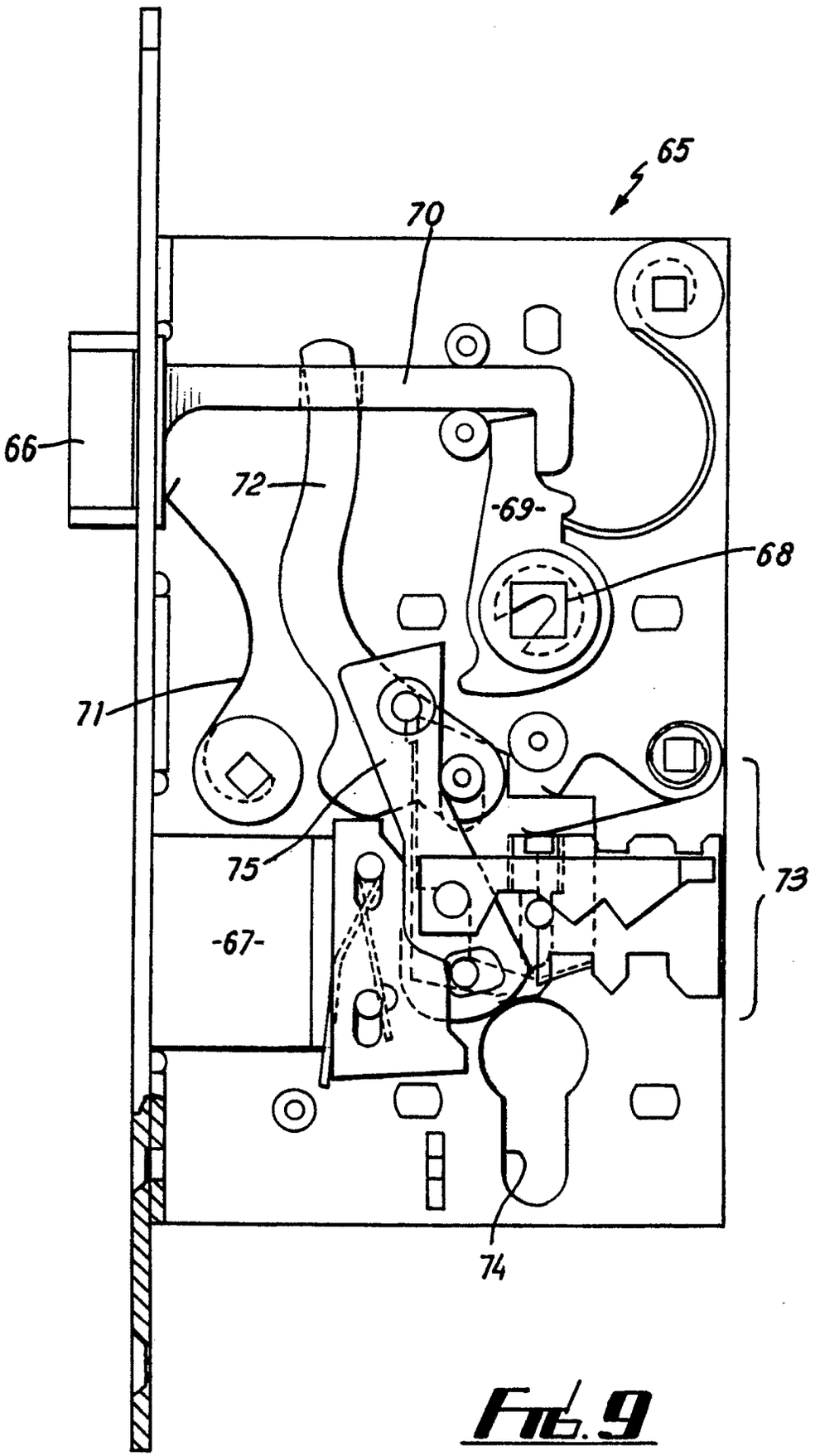

FIG. 9

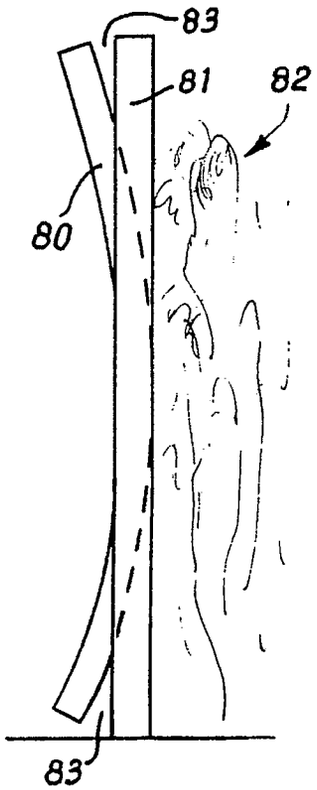

FIG. 10
(Prior Art)

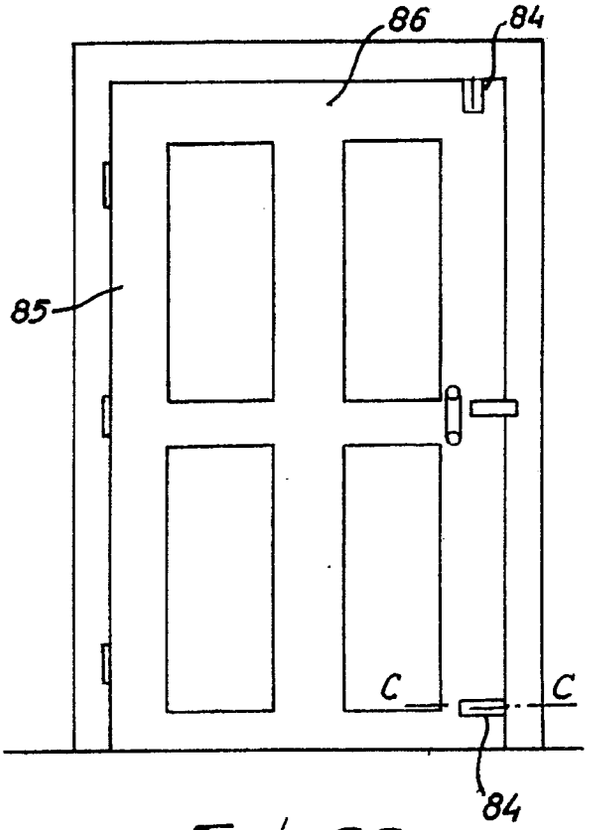

FIG. 11

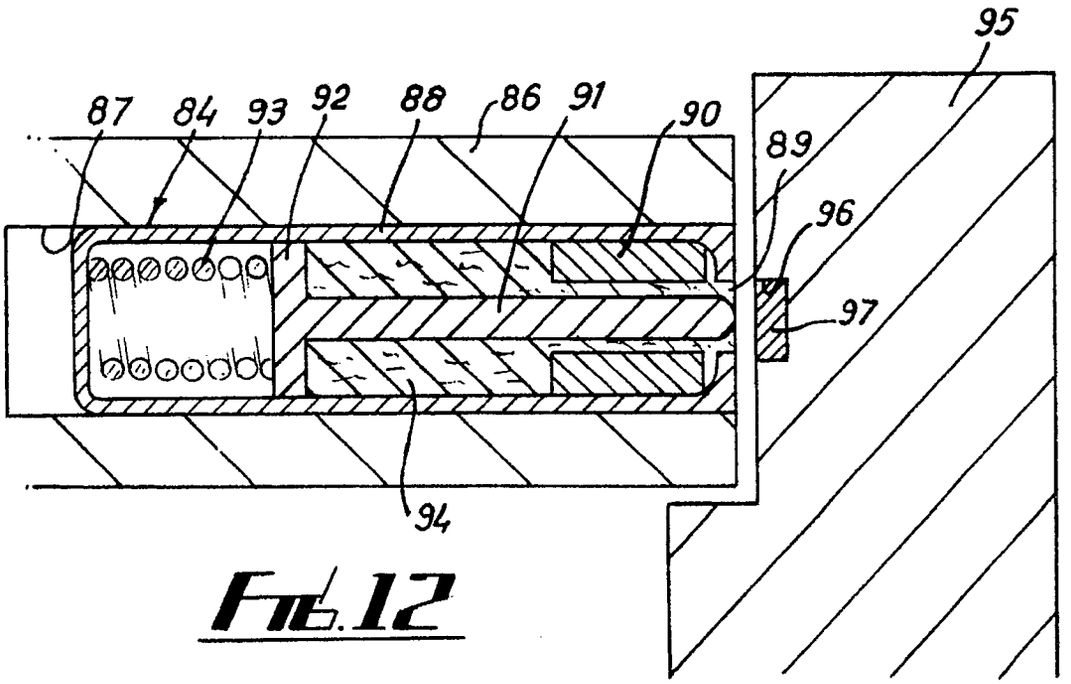

FIG. 12