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(71) Applicant: **Masonite Corporation**
Tampa, FL 33609 (US)

(72) Inventors:
- **Horsfall, Andrew**
  Middleton, leeds (GB)
- **Groves, Stuart**
  Staincross, Barnsley S75 6PD (GB)

(74) Representative: **Findlay, Alice Rosemary**
Lloyd Wise
Commonwealth House,
1-19 New Oxford Street
London WC1A 1LW (GB)

(54) Fire door

(57) A fire door comprises a perimeter frame and first and second door facings secured to opposing sides of the perimeter frame. A core (10) is positioned within the perimeter frame, and disposed between the first and second door facings. The core (10) has a first end (12), a second end (14), and at least one tubular opening (28). At least one brace (30) extends through the tubular opening (28) proximate the first end (12). A braced core (10) and method of forming a fire door are also disclosed.

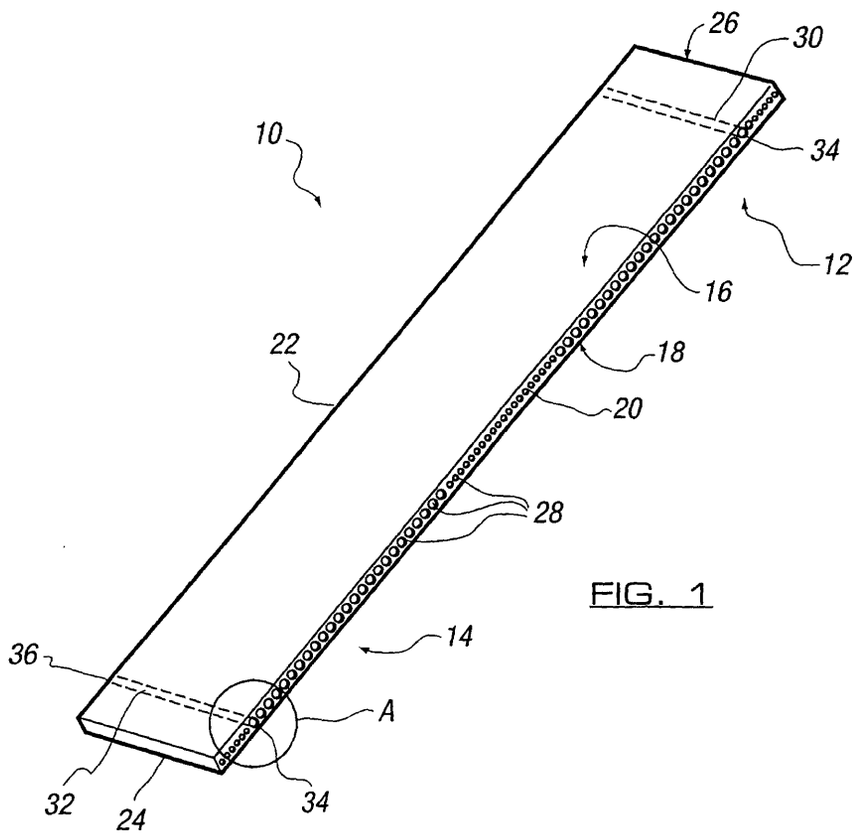

FIG. 1

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Description

[0001] The present invention relates to a fire door, a core for such a door and a method of forming a fire door using the core.

[0002] Solid core entry doors are desirable for various reasons, including aesthetics, security, and ability to withstand fires. A fire door rating indicates how long the door assembly can withstand heat. Various tests have been designed for testing the ability of a door to resist fire.

[0003] A door may be evaluated according to tests specified in the British Standard BS 476, including a preliminary ignition test, a fire penetration test and a spread of flame test. In these tests, the door is exposed to intense heat, such as that generated by fire in a burning building. The door should maintain its integrity and resist fire for a specified period of time in order to comply with BS 476. A door is rated as a 30-minute fire door if it resists fire and maintains its integrity for ½ hour.

[0004] A fire door typically has a core, which itself must have good integrity during exposure to fire. That is, it must resist heat transfer, burning, melting, spalling, cracking, bowing or deteriorating such that the transfer of heat from the fire-exposed side of the door to the unexposed side is deterred, and the integrity of the unexposed side is maintained. Otherwise, ignition and possible spread of fire may result from premature charring or burning of the combustible veneer or door facing of the unexposed side on the door.

[0005] During exposure to fire, the core should remain relatively stable and resist warping or shrinking to the extent that it remains in contact with the stiles and rails around its perimeter. Separation from the banding may cause the combustible components to burn away prematurely, allowing fire to penetrate the opening.

[0006] In order to resist warping or shrinking, additional rails are often required. In a conventional solid core door having a core, a perimeter frame is provided having stiles along each side of the core, one rail along the intended upper edge of the door, and one rail along the intended bottom edge of the door. This configuration of the perimeter frame is often unacceptable for fire doors because the core tends to warp or shrink away from the frame. Due to heat transfer or thermal expansion, a door tends to expand toward the heat source.

[0007] A second set of rails is often required for fire doors to provide additional resistance to bowing or shrinkage caused by such thermal expansion. The fire door therefore includes two rails along the intended bottom edge of the door, and two rails along the intended upper edge of the door. However, this substantially increases manufacturing cost given additional material is used. In addition, the second set of rails must often be installed manually, which increases labor costs. As such, fire doors are often relatively expensive and complicated to manufacture.

[0008] In one aspect of the invention, a fire door comprises a perimeter frame and first and second door facings secured to opposing sides of the perimeter frame. A core is positioned within the perimeter frame, and disposed between the first and second door facings. The core has a first end, a second end, and at least one tubular opening. At least one brace extends through the tubular opening proximate the first end.

[0009] In another aspect, a core component for a fire door comprises a first end, a second end, and at least one tubular opening. At least one brace extends through the tubular opening proximate the first end.

[0010] In a further aspect, a method of forming a fire door is also disclosed. A core is provided having a first end, a second end, and at least one tubular opening. A brace is inserted into the tubular opening. The resulting braced core is positioned within a perimeter frame. First and second door facings are secured to opposing sides of the perimeter frame.

[0011] The invention will now be further described by way of example with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a core component according to an embodiment of the present invention;

Figure 2 is an exploded view of portion A of Figure 1;

Figure 3 is a fragmentary side view of a core component according to the first embodiment showing a tubular opening and a brace; and

Figure 4 is a perspective view of a fire door according to the present invention with stiles, rails and braces shown in phantom.

[0012] A core component 10 for a fire door according to an embodiment of the present invention is best shown in Figure 1. Core component 10 includes a first end 12 and a second end 14. Core component 10 may include opposing first and second major surfaces 16, 18 that are substantially flush. Alternatively, core component 10 may include routed or depressed portions, which may correspond to contoured portions in a door facing when forming a paneled door. First and second longitudinal side surfaces 20, 22, and first and second transverse side surfaces 24, 26, are disposed between first and second major surfaces 16, 18.

[0013] A plurality of tubular openings 28 extend through core component 10, extending from first longitudinal side surface 20 to second longitudinal side surface 22. Preferably, tubular openings 28 are parallel to each other, and parallel to transverse side surfaces 24, 26. Tubular openings 28 may be equally spaced from each other. Tubular openings 28 may all have diameters that are substantially equal, or they may have differing diameters. As best shown in Figures 1 and 2, core component 10 may include tubular openings 28 having three different diameters.

[0014] At least one brace 30 extends through a tubular opening 28 proximate first end 12. A second brace

32 may extend through another tubular opening 28 proximate second end 14. Braces 30, 32 may be polygonal, though other configurations may also be used. Each brace 30, 32 includes opposing first and second ends 34, 36. Braces 30, 32 may extend through a tubular opening 28 having a larger diameter than other tubular openings 28 in core component 10. Tubular openings adjacent transverse side surfaces 24, 26 may have relatively small diameters compared to other tubular openings 28, and braces 30, 32 may extend through the first tubular opening proximate ends 12, 14 that have relatively large diameters, respectively.

[0015] Braces 30, 32 may be formed from wood, such as European whitewood or pine. Preferably, the wood used displays relatively uniform charring properties when exposed to heat, so that braces 30, 32 retain their integrity for a maximum period of time. Ash, another wood species, is less desirable due to its charring characteristics. Braces 30, 32 may also be formed from medium density fiberboard, hardboard, particleboard, or other composite materials. Braces 30, 32 should not be formed of plastic materials, which would tend to melt. Likewise, metal conducts heat, and therefore metal inserts are not suitable for bracing a fire door. Aside from braces 30, 32, other portions of core component 10 may be formed from a composite of extruded wood fiber particles and resin binder, such as urea formaldehyde resin binder.

[0016] Ends 34, 36 may be square, as best shown in Figures 2 and 3. Ends 34, 36 are preferably flush with longitudinal side surfaces 20, 22. Alternatively, ends 34, 36 may be slightly recessed from longitudinal side surfaces 20, 22.

[0017] Preferably, opposing edges 38, 40 extend outwardly toward first and second major surfaces 16, 18. In this way, any knots that may be present in wood braces 30, 32 do not affect the structural integrity of braces 38, 40. If the faces F of braces 30, 32 were parallel to first and second major surfaces 16, 18, a smaller distance is provided across which heat must transfer. As best shown in Figure 3, the distance d1 between edges 38, 40 is greater than the distances d2 or d3 between opposing faces F. Thus, orienting edges 38, 40 outwardly toward first and second major surfaces 16, 18, so that faces F are not parallel to major surfaces 16, 18, increases the distance through which heat must transfer. In this way, core component 10 (and a door including core component 10) maintains its integrity for a relatively long period of time.

[0018] Preferably, braces 30, 32 have a relatively snug fit within openings 28. For example, a brace 30 having a thickness measured from edge 38 to edge 40 (i.e. distance d1) of about 22 mm may be inserted into a corresponding tubular opening having a diameter of about 22 mm. Wood braces 30, 32 should be inserted into a tubular opening 28 so that they do not rattle or shift within openings 28.

[0019] A fire door 50 having core component 10 is shown in Figure 4. Core component 10 is positioned within a perimeter frame. The perimeter frame comprises first and second stiles 52, 54, and first and second rails 56, 58. First and second door facings 60, 62 are secured to opposing sides of the perimeter frame, so that core component 10 is disposed between facings 60, 62.

[0020] Braces 30, 32 preferably extend between, and are perpendicular to, stiles 52, 54, and parallel to rails 56, 58. Preferably, ends 34 of braces 30, 32 abut stile 54, and ends 36 abut stile 52.

[0021] Fire door 50 may have flush door facings 60, 62. Alternatively, one or both of facings 60, 62 may include contoured portions, such as paneled doors, if desired by the consumer. If a contoured door is desired, a corresponding recessed portion may be formed or routed in core component 10. In addition, one or both of facings 60, 62 may include a decorative layer secured to the exterior surface 64 of facings 60, 62. Hardwood lippings may be secured to exteriorly disposed edges of the perimeter frame for additional support.

[0022] Fire door 50 is relatively inexpensive to manufacture because a standard perimeter frame may be used around core 10. Core component 10 may be formed from an extruded timber fiber particle tube board core, such as manufactured by Sauerland Spanplatte GmbH & Co.KG. The tube board core may be either a single component. Alternatively, several components of tube board may be used, such as two pieces of relatively equal size.

[0023] When manufacturing core component 10, brace 30 is inserted into a tubular opening 28 proximate first end 12, and brace 32 is inserted into another tubular opening 28 proximate second end 14. As noted above, braces 30, 32 should fit snugly within openings 28. In order to provide sufficient strength to door 50 for achieving a 30-minute fire rating, only one brace 30 proximate the top portion T of door 50 is required. However, there is no "top" when manufacturing core component 10. Hence, braces 30, 32 are provided in order to assure that there is a brace proximate what will be top portion T of door 50. Top portion T of door 50 tends to bow more than the lower portions of door 50 proximate rail 58 on exposure to heat. It has been found that a bottom brace (i.e. brace 32) is not needed, but for manufacturing convenience, we provide two braces 30, 32.

[0024] Core component 10 is positioned within a perimeter frame, and first and second door facings 60, 62 are secured to opposing sides of the perimeter frame. Door facings 60, 62 may be formed from medium density fiberboard, hardboard, particleboard, plywood, or some other wood composite. However, facings 60, 62 should not be plastic or metal, given such materials are not suitable for fire doors, as noted above.

[0025] The resulting fire door 50 has a 30-minute fire rating pursuant to British Standard BS 476 testing. As such, door 50 maintains its integrity, and resists bowing and shrinking for at least ½ hour. Testing of door 50 has

been done by Warrington Certification Limited (WCL) Certifire Scheme, pursuant to WCL's "Rules for Certification of Fire Protection Products", Issue 4, January 2002.

[0026] Fire door 50 is relatively inexpensive to manufacture, with a substantial cost savings compared to manufacturing costs for conventional similarly rated fire doors. Brace 30 prevents early deflection of door 50 when exposed to heat, and negates the necessity of using two rails at the top of a door and two rails at the bottom of the door. Stiles 52, 54 and rails 56, 58 of the perimeter frame of door 50 may be secured together using butt joints, which are less expensive than other joining methods.

Claims

1. A fire door, comprising:

a perimeter frame;
first and second door facings secured to opposing sides of said perimeter frame;
a core positioned within said perimeter frame and disposed between said first and second door facings, said core having a first end, a second end, and at least one tubular opening; and
at least one brace extending through said tubular opening proximate said first end.

2. The fire door of claim 1, wherein said brace is polygonal.

3. The fire door of claim 1, wherein said brace is formed from a material selected from the group consisting of wood, medium density fiberboard, hardboard, and particle board.

4. The fire door of claim 3, wherein said brace is formed from a wood selected from the group consisting of whitewood and pine.

5. The fire door of any preceding claim, wherein said perimeter frame comprises first and second stiles and first and second rails.

6. The fire door of claim 5, wherein said core comprises a first side surface adjacent said first stile and a second side surface adjacent said second stile.

7. The fire door of claim 6, wherein said brace includes a first end substantially flush with said first side surface and a second end substantially flush with said second side surface.

8. The fire door of claim 7, wherein said first and second ends of said brace are square.

9. The fire door of claim 8, wherein said square ends include first edges extending toward said first rail and second edges extending toward said second rail.

10. The fire door of any one of claims 5 to 9, wherein said tubular opening extends substantially parallel to said rails.

11. The fire door of any one of claims 5 to 9, wherein said core includes a plurality of tubular openings.

12. The fire door of claim 11, wherein said tubular openings extend substantially parallel to said rails.

13. The fire door of either claim 11 or claim 12, wherein at least two of said tubular openings have differing diameters.

14. The fire door of claim 13, wherein said tubular openings proximate said first and second ends have a diameter less than the diameter of tubular openings extending through an intermediate portion of said core.

15. The fire door of claim 14, wherein said brace extends through a tubular opening proximate one of said first and second ends.

16. The fire door of claim 13, wherein said brace extends through a tubular opening having a diameter larger than at least one other tubular opening.

17. The fire door of any preceding claim, wherein at least one of said door facings includes a contoured portion.

18. The fire door of claim 17, wherein said core includes a recessed portion corresponding to said contoured portion.

19. The fire door of any preceding claim, wherein at least one of said door facings is a flush door facing.

20. The fire door of any preceding claim, wherein at least one of said door facings includes a decorative layer secured to an exteriorly disposed surface.

21. The fire door of any preceding claim, wherein said core is an extruded timber fiber particle tube board core.

22. The fire door of any preceding claim, further comprising a lipping secured to an exteriorly disposed edge of said perimeter frame.

23. The fire door of any preceding claim, wherein the door has a 30 minute fire door rating pursuant to

British Standard 476 testing.

24. A core component for a fire door, comprising:

a first end;
a second end;
at least one tubular opening; and
at least one brace extending through said tubular opening proximate said first end.

25. The core component of claim 24, wherein said brace is polygonal.

26. The core component of either claim 24 or claim 25, wherein said brace is formed from a material selected from the group consisting of wood, medium density fiberboard, hardboard, and particle board.

27. The core component of claim 26, wherein said brace is formed from a wood selected from the group consisting of whitewood and pine.

28. The core component of any one of claims 24 to 27, wherein said core includes opposing first and second side surfaces.

29. The core component of claim 28, wherein said brace includes a first end substantially flush with said first side surface and a second end substantially flush with said second side surface.

30. The core component of claim 29, wherein said first and second ends of said brace are square.

31. The core component of any one of claims 28 to 30, wherein said tubular opening extends substantially perpendicular to said first and second side surfaces.

32. The core component of any one of claims 28 to 30, wherein said core includes a plurality of tubular openings.

33. The core component of claim 32, wherein said tubular openings extend substantially parallel to each other.

34. The core component of either claim 32 or claim 33, wherein at least two of said tubular openings have differing diameters.

35. The core component of claims 24 to 34, wherein said core is an extruded timber fiber particle tube board core.

36. A method of forming a fire door, comprising the steps of:

providing a core having a first end, a second end, and at least one tubular opening;
inserting a brace into the tubular opening;
positioning the braced core within a perimeter frame; and
securing first and second door facings to opposing sides of the perimeter frame.

37. The method of claim 36, comprising the further step of securing a decorative layer to an exteriorly disposed surface of at least one of the door facings.

38. The method of claim 37, comprising the further step of securing a lipping to an exteriorly disposed edge of the perimeter frame.

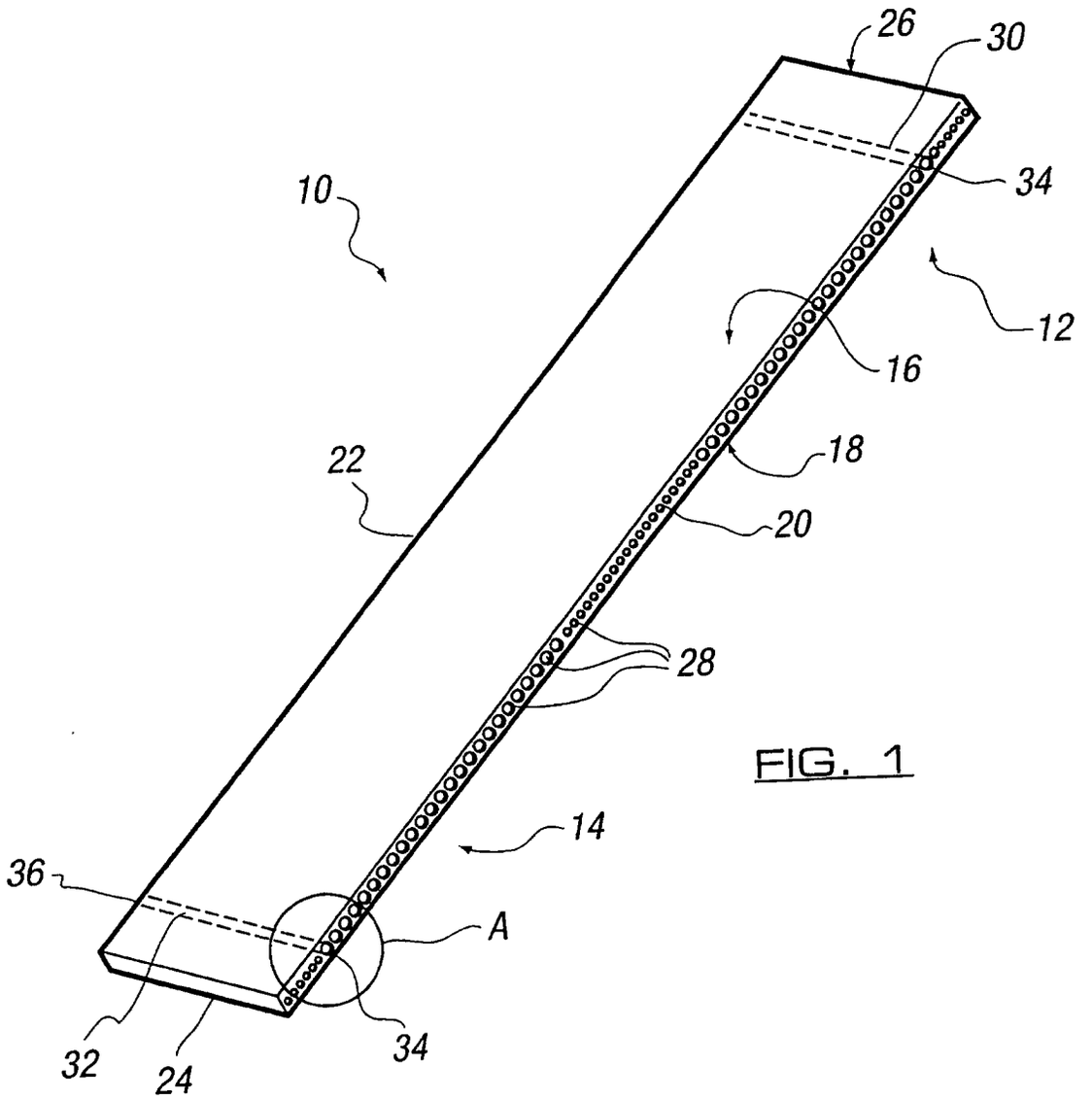

FIG. 1

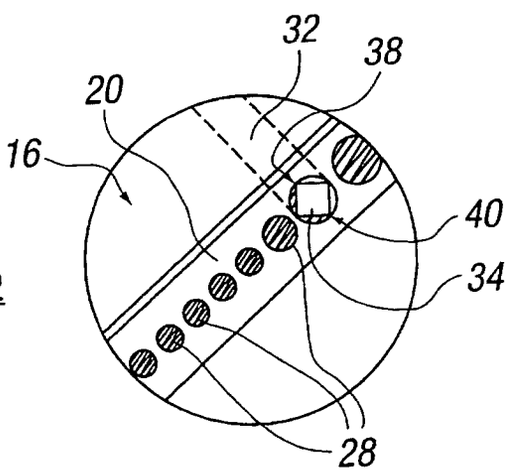

FIG. 2

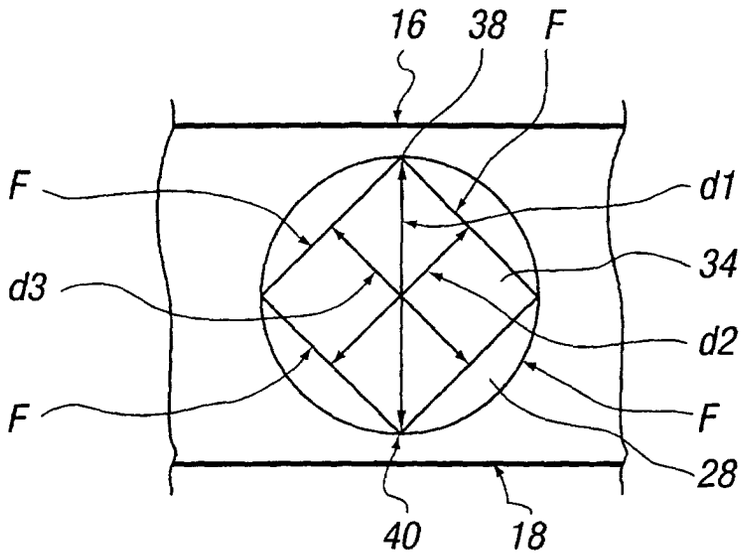

FIG. 3

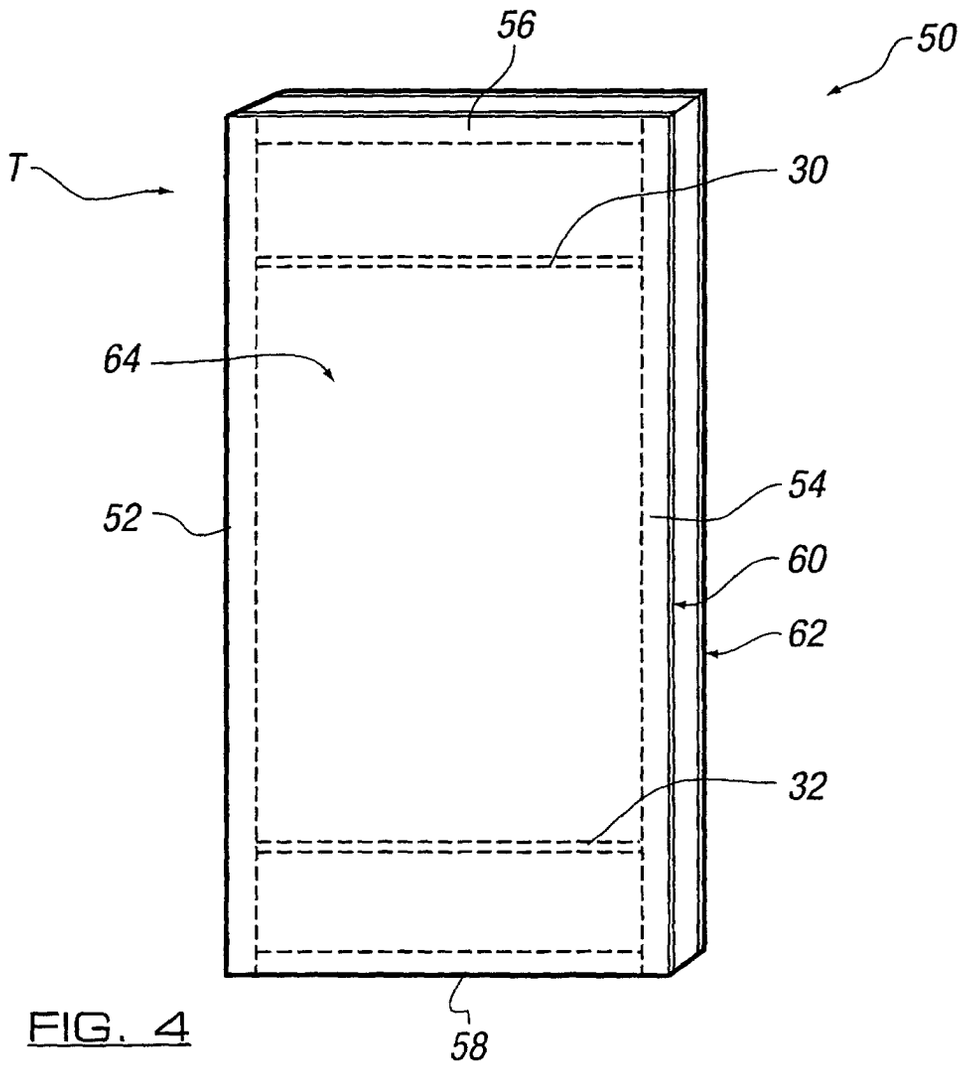

FIG. 4