June 26, 1962 C. O. STECK 3,041,219

THERMAL INSULATING WALL BOARD AND WALL CONSTRUCTIONS THEREOF

Filed April 6, 1959

3 Sheets-Sheet 1

Fig. 8.

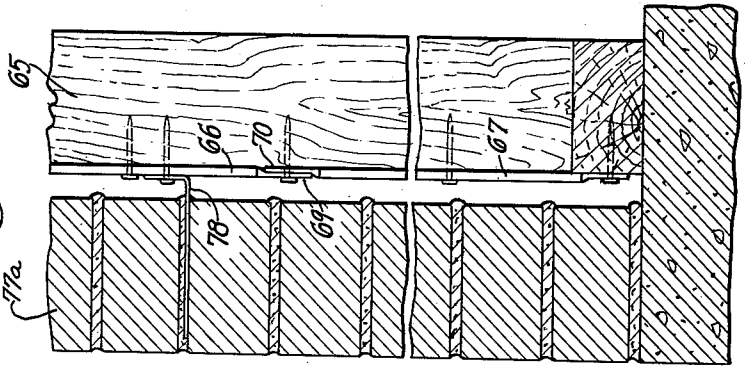


Fig. 3.

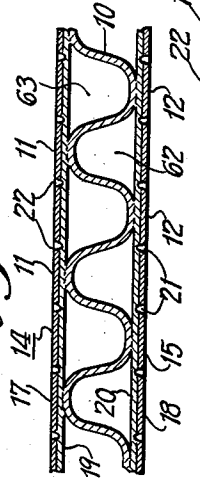


Fig. 5.

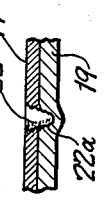


Fig. 4.

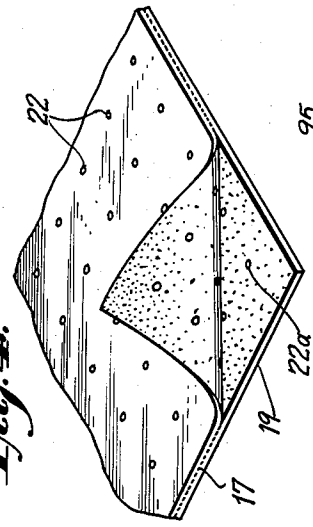


Fig. 11.

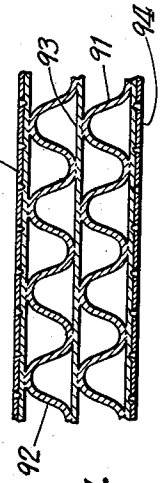


Fig. 1.

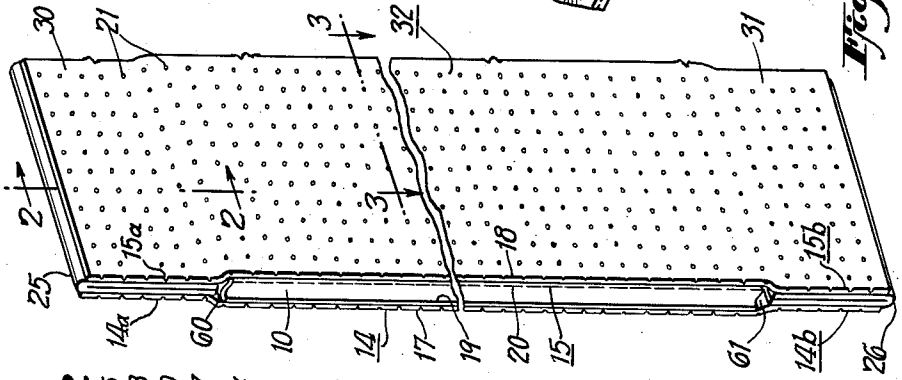
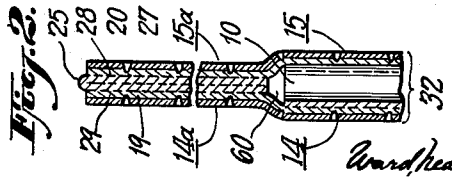


Fig. 2.



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THERMAL INSULATING WALL BOARD AND WALL CONSTRUCTIONS THEREOF

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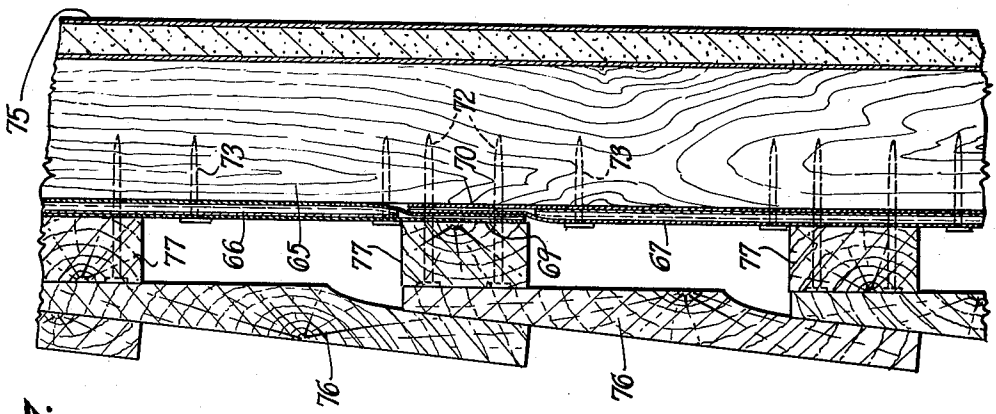


Fig. 7.

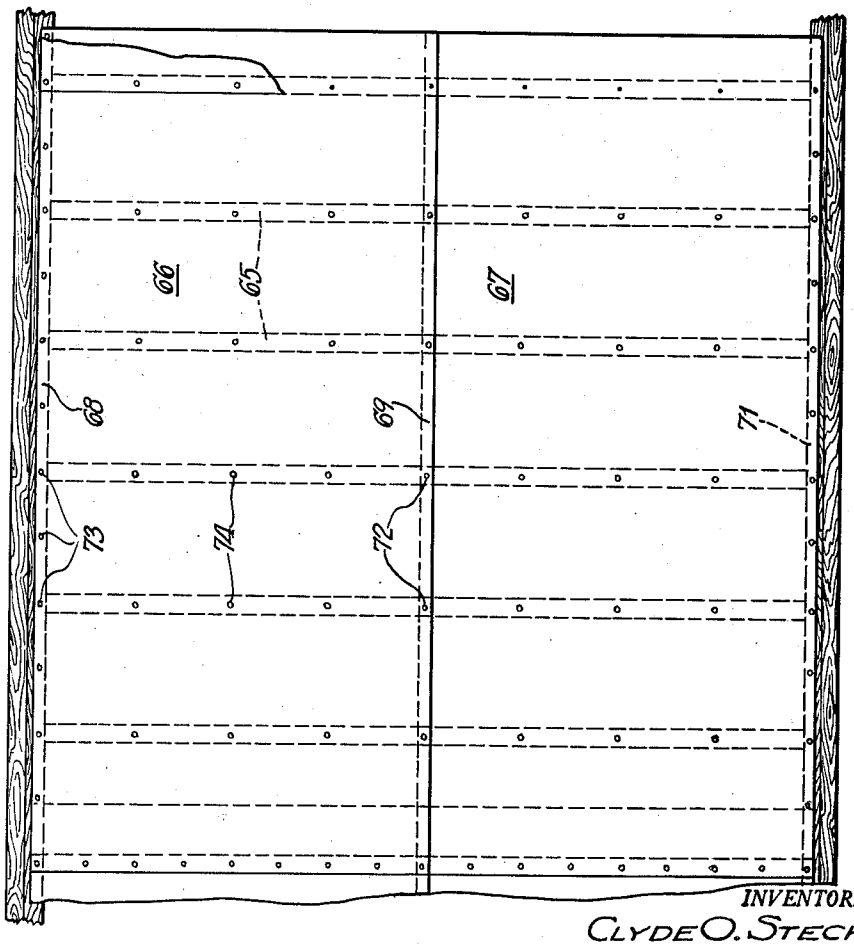


Fig. 6.

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June 26, 1962 C. O. STECK 3,041,219

THERMAL INSULATING WALL BOARD AND WALL CONSTRUCTIONS THEREOF

Filed April 6, 1959 3 Sheets-Sheet 3.

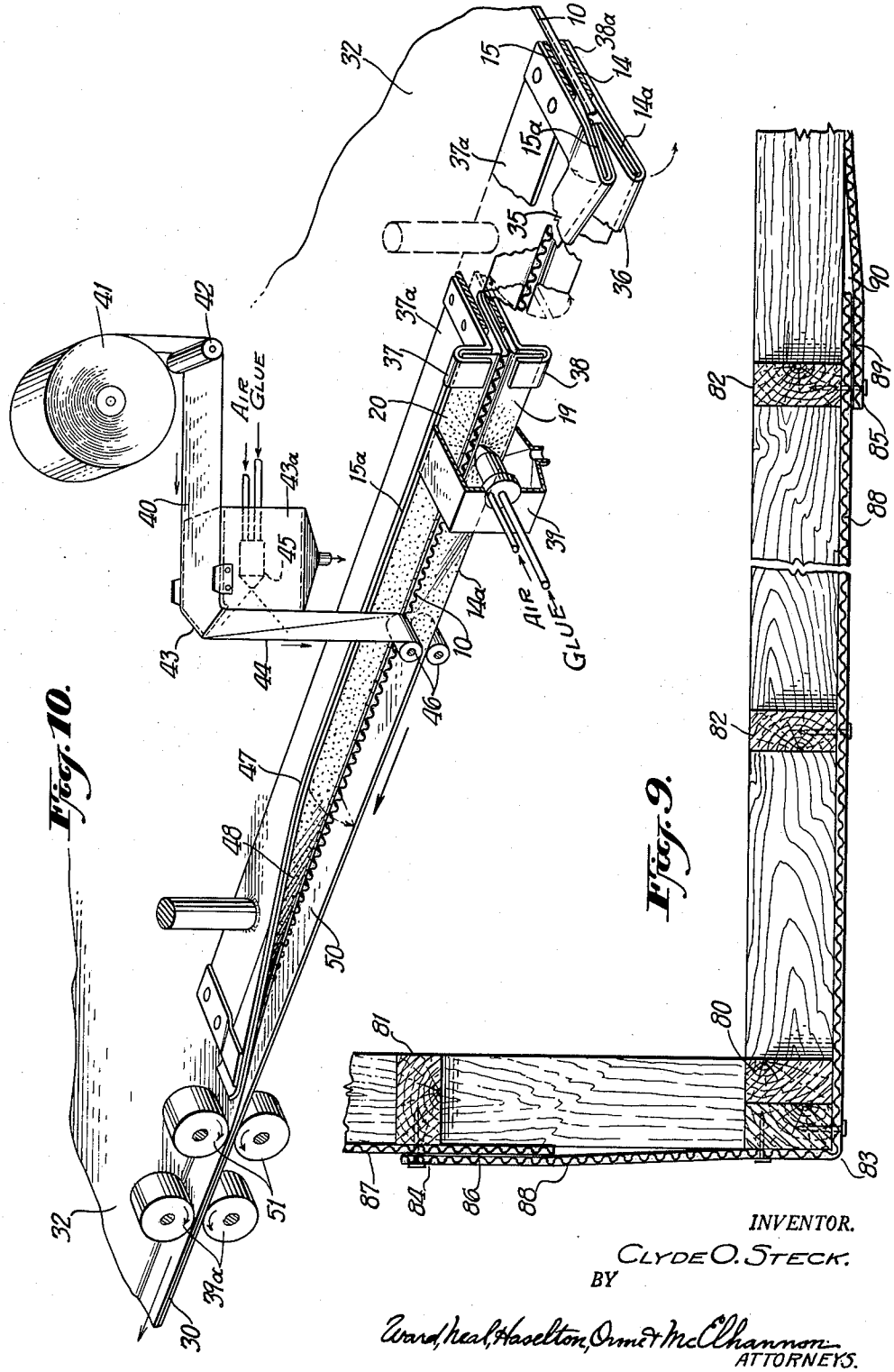


Fig. 10.

Fig. 9.

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THERMAL INSULATING WALL BOARD AND WALL CONSTRUCTIONS THEREOF

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Filed Apr. 6, 1959, Ser. No. 804,254
8 Claims. (Cl. 154—45)

This invention pertains to improvements in thermal insulating wall board particularly adapted for use as sheathing in building constructions, and to improved wall and building constructions incorporating the same.

Objects of the invention are to provide a wall board for use as sheathing, which is weatherproof, moisture and fire resistant and also resistant to fungus growth and attack by insects, which combines lightness in weight with ruggedness of construction, which is easily and quickly applied as a sheathing to buildings, and which above all possess superior and permanent thermal insulating properties of a character such as to prevent condensation of moisture thereon or therein, with resultant avoidance of the ultimate deterioration and destruction, such as characterizes many thermal insulating sheathing media heretofore known.

A feature of the thermal insulating wall board construction of the invention is that it has sufficient permeability to permit moisture laden air of a building interior to seep through sheathing formed thereof and thus escape to the outer atmosphere, but at a controlled and controllable rate, such as to prevent condensation and collection of the moisture content on or within the sheathing.

A further feature resides in the ability of the wall board of the invention to be bent without fracture or injury about the corners of buildings, whereby the corners may be lapped with the sheathing material and corner joints thus completely eliminated.

A still further feature of the wall board of the invention resides in the provision of attaching edges for attachment to a building frame, as by nailing, which are highly resistant to tearing resulting from building flexure during storms, etc., and which permit adjacent sheathing sections to be joined in a water-tight lap joint, without bulging or the necessity for taping.

In accordance with one of its embodiments, the wall board of the invention is a specially constructed type of double faced corrugated board, the facing plies of which are of laminated construction, consisting of a web of high wet strength fiberboard (such as kraft paper), incorporating a synthetic resin, such as melamine, at the beater stage, which web is laminated to a light and heat wave reflecting metal foil, such as aluminum, as by spraying with a waterproof adhesive or bonding agent, such as a polyvinyl resin, and thereafter feeding between pressure rolls.

In the process of laminating and for purposes discussed below, the foil is pierced at closely spaced intervals by passing the laminated web between a rubber backing roll and a metal roll covered with upstanding nibs of sufficient length to pierce the foil and penetrate the underlying fiberboard web but without piercing the latter.

Rolls of the laminated fiberboard and foil as thus prepared are utilized as facing plies in the production of double faced corrugated board in conventional manner, utilizing for the inner or corrugated web, a high wet strength fiberboard of the character aforesaid, the corrugations of which are adhered to the fiberboard plies of the laminates by means of a highly water resistant adhesive, such as a starch-resorcinol bonding agent, which on dehydration is rendered practically water insoluble. Fungicidal and insecticidal agents are added to the adhesive to prevent mold growth and vermin attack, such for

example, as sodium silicofluoride, an effective preparation of which is available on the market as "Dowicide G."

In producing the double faced corrugated board in the manner aforesaid, the corrugated web is, for purposes explained below, made from fiberboard of a lesser width than the laminated facing plies so that the latter extend beyond or overlap the corrugated ply along both lateral edges, to the extent, for example, of about an inch on each side. A lapped filler strip of high wet strength fiberboard, the lapped plies of which are adhesively bonded together, is fed between the overlapping edges of the facing plies which have been sprayed with an adhesive, and thence between pressure rolls to bond the edges to the filler strip, thereby forming a solid, tabbed, four-ply edge along each side of the corrugated board.

The tabbed edges so formed are preferably made approximately one-half the thickness of the wall board proper so that adjacent sheathing sections may be joined in a lap joint without bulging. They also form strong and tear resistant tabs for nailing the wall board to the building frame or studs. They also seal off the corrugation flutings at their opposite ends to prevent entry of water and to prevent their functioning as flues in the event of fire.

The wall board of the invention is preferably applied in elongated rectangular sheet or panel form to the outside of the wood studding of a building, with the tabbed edges of the sheets extending horizontally and hence with the corrugated flutings thereof extending vertically, and also with the tabbed edge of an upper sheet overlapping the tabbed edge of an adjacent lower sheet to prevent entry of water during a storm. Prior to joining, the lapped edges are preferably lacquered to form a water-tight joint.

As thus mounted, the wall board provides a sheathing disposed between the framework of the building and the brick or clapboard veneer which serves as the outer shell. This sheathing functions as a thermal insulating barrier of superior performance for two reasons. First, because of its hollow core, the cells of still air formed by the sealed off corrugation flutings, provide in and of themselves an excellent thermal insulating barrier. Secondly, the aluminum foil plies, by reason of their reflective surfaces, reflect incident light and heat waves back toward the source.

Thus, in the summer time, heat waves entering through the outer brick or clapboard veneer are reflected back by the outer foil film of the sheathing. In the winter time when heat waves are emitted from within the building, they strike the inner foil film of the sheathing and are reflected back to the building interior.

By reason of the fact that in winter time the moisture content inside the building is higher than that of the outer air, and also because a closed heated building has a slightly higher air pressure than that of the outer atmosphere, the moisture laden air in the building interior tends to escape to the exterior through available outlets. The purpose of the perforations in the metal foil laminae is to permit this moisture vapor to be dissipated to the building exterior without condensing on or within the sheathing. Thus if the perforations are omitted, the foil presents an impermeable and relatively cold barrier on which the moisture vapor condenses, the resulting condensate of which runs down the foil surface and collects in the wells formed between the studding, causing ultimate rotting at the base of the studding and thereby a weakening of the building itself.

By perforating the foil films, however, the wall board is made sufficiently permeable to provide an escape for the moisture laden air without condensing, for the reason that as the warm moisture laden air seeps through the perforations of the inner foil film and thence through the corrugated board and through the perforations of the outer foil film, it warms the sheathing sufficiently to prevent moisture condensation.

This circulation of warm air through the sheathing is of course prevented if the foil layers are unperforated, in consequence of which they tend to assume by conduction the much lower temperature of the outer atmosphere, and thereby form relatively cold metal barriers on which the moisture condenses with deleterious consequences as aforesaid.

The rate of moisture escape with the perforated foil construction of the invention, can be controlled as desired by proper selection of the size and spacing of the perforations. I have found as the result of extensive tests that perforations of about 1/32 inch in diameter spaced at about 1/8 inch intervals throughout the foil area give excellent results. I have further found that best results are obtained if the perforations do not pierce the fiberboard plies of the foil-fiberboard laminates, but extend only partially through the fiberboard plies in the form of pits.

The high wet strength fiberboard employed for the fiberboard plies must have sufficient permeability for the moisture to escape therethrough. For this purpose I have found a fiberboard produced according to the following formula to be satisfactory.

Melamine-formaldehyde or urea-formaldehyde resin is admixed with wood pulp at the beater stage and formed into fiber board by a wet web forming process, and the web thereupon dried to produce the finished fiberboard. The resin content so incorporated is such as to constitute about one to two percent of the final weight of the finished fiber-board, and such as to impart thereto a wet strength of at least about 20 to 35% of its dry tensile strength.

In a practical embodiment, 62 pound fiberboard per 1000 square feet, of the aforesaid type is laminated to 0.00035 aluminum foil and the foil perforated as aforesaid. For the corrugated web, 30 pound fiberboard per 1000 square feet of the type aforesaid is utilized.

I have found that wall board so constructed may be bent at a sharp angle either perpendicular or parallel to the corrugations without breaking or tearing and thus may be lapped around the corners of a building thus eliminating joints thereat. This is a decided advantage both as regards providing excellent weatherproof and thermal insulation properties throughout sheathing so applied.

Where greater rigidity and strength is desired, a double wall board construction may be employed, i.e., embodying two corrugated webs of fiberboard separated by an inner ply of fiberboard only, the metal foil being laminated only to the outer or surface fiberboard plies. The inherent porosity of the inner ply provides sufficient permeability for transmission of the moisture content of the air.

Having thus described my invention in general terms in its various aspects, reference will now be had for a more detailed description, to the accompanying drawings wherein:

FIG. 1 is a perspective view of a section of wall board constructed according to the first modification of the invention above described, namely, that employing a single corrugated web. FIG. 2 is an enlarged, fragmentary sectional view taken substantially at **2**—**2** of FIG. 1 and illustrative of the tab edge construction above described. FIG. 3 is an enlarged, fragmentary sectional view taken substantially at **3**—**3** of FIG. 1 and illustrating the wall board construction in longitudinal section. FIG. 4 is a perspective view of a portion of the foil-fiberboard laminates employed for the facing plies of the wall board, this view showing a portion of the foil rolled back from the fiberboard base of the laminate and also the foil perforations and aligned pits of the fiberboard base. FIG. 5 is a greatly enlarged, fragmentary sectional detail through one of the foil perforations showing the extent to which the underlying fiberboard ply is pitted.

FIG. 6 is a view in elevation showing the preferred mode of applying the wallboard of FIG. 1 as sheathing in a building wall construction. FIG. 7 is a view in transverse sectional elevation through a building wall having an outer clap board shell and sheathed on the outside of the studs with wall board according to the invention. FIG. 8 is a similar view of a wall board construction, the outer shell of which is of brick veneer. FIG. 9 is a sectional plan view of a corner of a building wall construction illustrative of the lapping of the wall board of the invention about the corner.

FIG. 10 is a perspective view illustrative of the manner and mechanism for forming the filler strip of the wall board tab edges and of further forming the tab edges therewith.

FIG. 11 is a fragmentary view in transverse section, similar to FIG. 3, but illustrative of the double wall board construction of the invention employing two corrugated webs separated by a ply of fiberboard only.

Referring to FIGS. 1–5 incl., and more particularly for the moment to FIG. 3, the corrugated web **10** adhesively bonded on its opposite sides, as at **11**, **12** to laminated foil-fiberboard facing plies **14** and **15**, respectively, each laminated facing ply comprising an outer layer of light and heat reflecting metal foil, such as aluminum, as at **17** and **18**, and an inner layer of high wet strength fiberboard as aforesaid, as at **19** and **20**. The foil layers are perforated at regularly spaced intervals in the manner aforesaid, as at **21**, **22**, by pitted cavities, which extend into but do not pierce the underlying fiberboard web, as at **22***a*, FIG. 5.

Referring to FIGS. 1 and 2, the corrugated web **10** is of a lesser width, as above explained, than the facing plies **14**, **15**, which latter extend beyond the corrugated web **10**, at both transverse extremities thereof, as at **14***a*, **15***a* and **14***b*, **15***b*, and have interposed therebetween a lapped strip of high wet strength fiberboard, as at **25** and **26**, the lapped plies of which strips are adhesively bonded to each other, as at **27**, FIG. 2, and the outer surfaces of which are in turn adhesively bonded, as at **28**, **29**, to the fiberboard plies **19** and **20**, respectively, of the foil-fiberboard laminates **14** and **15**, thus to form solid multi-ply tabs, as at **30**, **31**, which extend along the opposite lateral edges of the thus constructed wall board **32**.

These tabs are formed in the manner illustrated in FIG. 10. As the corrugated board **32** passes out of the corrugating machine of conventional design, the overlapping edges such as **14***a*, **15***a* of the laminated facing plies **14** and **15**, pass through a series of spreaders, as at **35**, **36** and **37**, **38**, mounted on parallel guide frames **37***a*, **38***a*, and which bend these edges at right angles to the corrugated web **10**, as shown, so that an adhesive may be applied to the fiberboard plies **19**, **20** thereof, by means of an air-glue spray gun as at **39**, for which purpose the corrugated board is fed forward in the direction of the arrow by driven pinch rolls, as at **39***a*.

To form the filler strip **25**, FIG. 1, a ribbon of high wet strength fiberboard of the type aforesaid, is fed from a roll **41** thereof, thence under a guide roll **42** and over the corner **43** of a stationary forming member **43***a*, thus to crease the fiberboard ribbon **40** along its centerline, as at **44**, at which point an adhesive is sprayed onto the creased inner surface of the ribbon by means of an air-glue spray gun, as at **45**. The ribbon is then lapped upon itself with respect to its creased centerline by passage between squeeze rolls **46**, which adhesively bond the lapped plies together, and also bond the same to the lower overlapping edge **14***a* of the surface ply **14** which likewise is fed between these rolls as shown. The overlapping edge **14***a* of the surface ply **15** travels beyond the rolls **46** along a guide **47** of frame **37***a*, which twists the edge **15***a*, as at **48**, back into a horizontal plane where it contacts the upper surface of the lapped ribbon strip **50**, and is adhesively bonded thereto by passage between pressure rolls, as at **51**, thereby to form the finished tab **30**. It will be understood that the opposite tab **31**, FIG. 2, is concurrently formed in the same way by a mecha-

nism corresponding to that of FIG. 10 mounted on the opposite side of the wall board **32**.

Reverting to FIGS. 1 and 2, it will be seen that the tab **30**, **31** so formed, seal off as at **60**, **61**, the ends of the fluted cavities, such as **62**, **63**, FIG. 3, formed between the corrugated web **10** and the surface plies **14**, **15**. Thus water cannot enter these cavities or cells in the presence of a rain storm, for example. Likewise, they cannot form flues which would otherwise increase fire hazard in the case of a fire. The tabs **30**, **31** likewise form a strong and tear resistant means of attaching the wall board to building studding in overlapping relation of adjacent wall board sections, as above explained. To this end it will be observed from FIGS. 1 and 2, that the tabs **30**, **31** are preferably about one-half the thickness of the wall board **32** proper so that overlapped tabs of adjacent wall boards will have the same over-all thickness as the wall board proper and thus eliminate bulging.

Referring now to FIGS. 6 and 7, the wall board is preferably made up in panels or sheets about 4 feet in width and 8 feet in length, and is applied to the outside of the wood studding **65**, of a building wall, in the manner shown at **66**, **67** for vertically adjacent wall board panels. From these views it will be seen that the panels **66**, **67** are applied to the studding **65** with their tab edges extending in the horizontal direction, as at **68–71**, incl., and with the lower tap edge **69** of the upper panel **66** overlapping the upper tab edge **70** of the lower panel **67**, in the manner shown more particularly in FIG. 7. The panels are nailed to the frame and studding along the tab edges and at intermediate points, as at **72–74**, incl.

In the FIG. 7 embodiment, the wall is finished off on the interior by means of any conventional type of wall board **75** applied to the inside of the studding, and on the outside by means of clapboard siding **76**, nailed to the studding by means of interposed furring strips **77**. The construction of FIG. 8 is similar to that of FIG. 7 except that the outer shell of the building wall consists of a brick veneer **77A** secured to the studding **65** by means of steel anchor strips as at **78**.

Referring now to FIG. 9, there is shown a corner of a building wall formed by a corner post **80**, and the studding rows **81**, **82** extending at right angles to one another. In accordance with one of the above-mentioned features of the invention, the wall board is lapped around the corner post **80** in the manner shown at **83**, by attaching one end of the wall board panel to the studding **81**, as at **84** and lapping it, as at **83**, around the corner post and attaching the other end thereof to the studding **82**, as at **85**. Thus joints between wall board panels at the corner post **80** are completely eliminated and a waterproof construction thus obtained at the corners of the building.

It will also be noted from FIG. 9, that the wall board panel sections are overlapped in the longitudinal direction thereof, as at **86**, for panels **87** and **88**, and as at **89**, for panels **88** and **90**. Thus a seam where the panels meet is avoided.

Referring to FIG. 11, the double wall board construction shown, comprises a pair of superimposed corrugated webs **91** and **92**, separated by an inner ply **93** of fiberboard only, with the foil-fiberboard laminates **94**, **95** applied only as surface plies, as shown.

What is claimed is:

1. As a new article of manufacture, weatherproof and thermal insulating board, comprising: a corrugated web made of a relatively rigid, water resistant, but moisture permeable, organic material, said web having adhesively bonded to the opposite sides thereof, a pair of laminated facing sheets, each consisting of a sheet of said organic material adhesively bonded to a sheet of light and heat reflecting metal, said metal sheets forming the exposed surfaces of said board, and being perforated at closely spaced intervals by holes of small aperture penetrating at least partially through the sheets of organic material bonded thereto, respectively, said facing sheets overlapping the opposite edges of said corrugated web in the direction of its corrugations, and having strengthening strips of organic material interposed therebetween and bonded thereto, respectively, to form attaching tabs extending along said edges and to seal the ends of the cavities formed between said corrugated web and said facing sheets.

2. As a new article of manufacture, weatherproof and thermal insulating board, comprising a pair of superimposed corrugated webs separated by a liner web adhesively bonded thereto, respectively, and a pair of facing webs adhesively bonded to the outermost convolutions of said corrugated webs, respectively, said webs being made of a relatively rigid, water resistant, but moisture permeable, organic material, each facing web having adhesively bonded to its outer surface a web of a light and heat reflecting metal, each metal web being perforated at closely spaced intervals throughout its area, by holes of small aperture which extend at least partially through the web of said organic material bonded thereto.

3. As a new article of manufacture, weatherproof and thermal insulating board, comprising a pair of superimposed corrugated webs separated by a liner web adhesively bonded thereto, respectively, and a pair of facing webs adhesively bonded to the outermost convolutions of said corrugated webs, respectively, said webs being made of a relatively rigid, water resistant, but moisture permeable, organic material, each facing web having adhesively bonded to its outer surface a web of a light and heat reflecting metal, each metal web being perforated at closely spaced intervals throughout its area, by holes of small aperture which extend at least partially through the web of said organic material bonded thereto, said facing webs overlapping the opposite edges of said corrugated webs in the direction of their corrugations, and having strengthening strips of organic material interposed therebetween and bonded thereto, respectively, to form attaching tabs extending along said edges and to seal the ends of the cavities formed between said corrugating webs and said liner and facing webs.

4. As a new article of manufacture, weatherproof, light and heat reflecting, thermal insulating wall board for sheathing buildings and the like, comprising in combination: corrugated board including a corrugated web having uncorrugated facing plies adhesively secured to the opposite sides thereof, said board being made of a high wet strength, synthetic resin treated fiberboard, said wall board having light and heat reflecting metal foil adhesively bonded to its opposite surfaces, respectively, and extending substantially throughout the surface area thereof, said foil being perforated at relatively closely spaced points throughout its area by relatively small diameter pits which extend partially into said facing plies to permit air and moisture to penetrate into and through said wall board.

5. As a new article of manufacture, weatherproof, heat reflecting, thermal insulating wall board for sheathing buildings and the like, comprising in combination: corrugated board consisting of a corrugated web having uncorrugated facing plies adhesively bonded to its opposite sides, said facing plies extending beyond said corrugated web in the direction of its corrugations and having interposed therebetween on each side, a multi-ply strip of organic material adhesively bonded to itself and to said facing plies to provide strengthened tabs extending along the opposite edges of said sheathing for reception of attaching nails, screws and the like, said board being made of a high wet strength, resin impregnated fiberboard, and being faced on its opposite sides with heat reflecting metal foil, adhesively bonded to said facing plies, respectively, said foil being perforated at relatively closely spaced intervals by pits extending at least partially

through said facing plies to permit air and moisture to penetrate through said wall board.

6. As a new article of manufacture, weatherproof and thermal insulating sheathing, comprising: a corrugated web of relatively rigid, moisture permeable, organic material, said web having adhesively bonded to each side thereof a sheet of said organic material, at least one of said sheets of said organic material having adhesively bonded to the outer surface thereof a sheet of light and heat reflecting metal foil, said metal foil thus forming an exposed surface of said board and being perforated at closely spaced intervals by holes of small aperture penetrating at least partially through the sheet of organic material to which said shseet of foil is bonded.

7. As a new article of manufacture, weatherproof and thermal insulating sheathing, comprising: a corrugated web of a relatively rigid, moisture permeable organic material, said web having adhesively bonded to each side thereof a pair of laminated facing sheets, formed of a sheet of said organic material and a sheet of light and heat reflecting metal foil bonded thereto, said sheets of metal foil forming the exposed surfaces of said board, and being perforated at closely spaced intervals by holes of small aperture penerating at least partially through the sheets of organic material to which said sheets of foil are bonded, respectively.

8. As a new article of manufacture, weatherproof and thermal insulating sheathing, comprising: a sheet of water resistant but moisture permeable, organic material, a corrugated web of relatively rigid, moisture permeable organic material adhesively bonded at one side thereof to one surface of said sheet, a laminated facing sheet consisting of a second sheet of said organic material adhesively bonded to the other side of said corrugated web, and a sheet of metal foil adhesively bonded to the outer surface of said second sheet of organic material, said sheet of metal foil being perforated at closely spaced intervals by holes of small aperture penetrating at least partially through the sheet of organic material to which said sheet of metal foil is bonded.

References Cited in the file of this patent

UNITED STATES PATENTS

1,189,518	Wood	July 4, 1916
1,236,829	Evans	Aug. 14, 1917
1,914,345	Roos	July 7, 1932
1,925,819	Putnam et al.	Sept. 5, 1933
2,030,668	Weyerhaeuser	Feb. 11, 1936
2,045,733	Spafford	June 30, 1936
2,222,572	Reger	Nov. 19, 1940
2,222,573	Reger	Nov. 19, 1940
2,264,961	Ward	Dec. 2, 1941
2,342,839	Byers	Feb. 29, 1944
2,397,388	Troedsson	Mar. 26, 1946
2,674,015	Mautner	Apr. 6, 1954
2,685,523	Cross	Aug. 3, 1954
2,729,560	House et al.	Jan. 3, 1956
2,881,304	Dobson	Apr. 7, 1959
2,940,557	Herbert	June 14, 1960