Sept. 4, 1973 R. G. BELLAMY 3,756,895

VENTED ROOF SYSTEMS EMPLOYING MICROPOROUS MEMBRANES

Original Filed Aug. 26, 1968

Fig. 1.

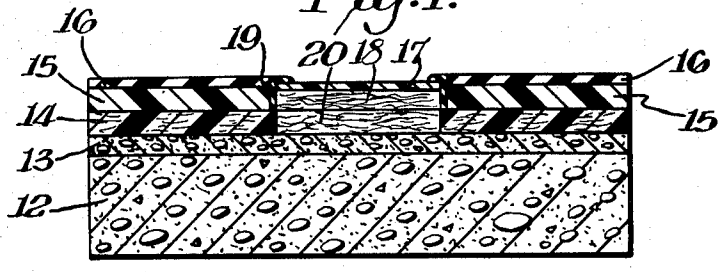


Fig. 2.

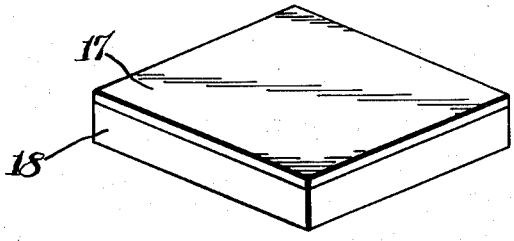
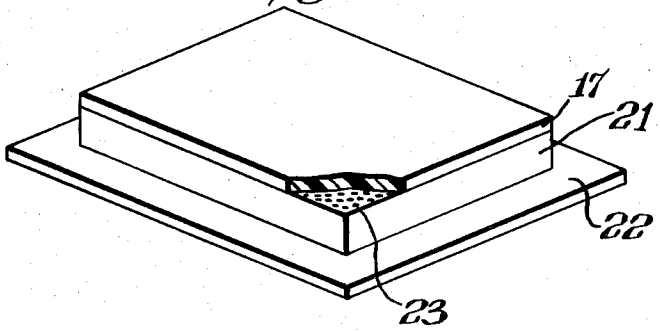


Fig. 3.



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3,756,895

VENTED ROOF SYSTEMS EMPLOYING MICROPOROUS MEMBRANES

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Int. Cl. B32b *31/00;* D06n *5/00;* E04b *13/16*

U.S. Cl. 156—257 2 Claims

ABSTRACT OF THE DISCLOSURE

Traffic bearing and nontraffic bearing roof systems comprising a substantially vapor impermeable structural substrate and a waterproof, substantially vapor impermeable protective top layer vented with a microporous membrane to relieve vapor pressure from within the system thereby preventing blistering, cracking and eventual destruction of the weatherproof protective top layer.

CROSS-REFERENCE TO RELATED APPLICATION

This application is a divisional of Ser. No. 755,199, filed Aug. 26, 1968, now Pat. No. 3,598,688.

FIELD OF THE INVENTION

This invention relates to traffic bearing and nontraffic bearing roof systems (e.g., flat roofing and promenade decks) wherein a microporous membrane (e.g., a membrane of natural, ceramic, polymeric or metallic material) is integrally bonded to the overlaying protective top layer to relieve pressure by venting vapor (e.g., water vapor and air) from within the roof structure thereby peventing blistering, rising and destruction of the top protective layer, said microporous material being substantially waterproof but vapor permeable. The invention also relates to a process for venting such roof structures and a vent material therefor.

DESCRIPTION OF THE PRIOR ART

The conventional manner of rendering a roof (flat or pitched) impervious to the elements is to place on its supporting substrate one or more sheets or layers of material which together provide a continuous waterproof protective top layer. This layer is commonly placed upon concrete, wood or steel supporting substrates. Typical of such structures are the so-called built up roofs which comprise a series of felt layers impregnated and/or coated with an asphaltic or bituminous material to adhere the individual layers together and impart resistance to moisture. Normally, asphalt is first applied to the supporting substrate followed by alternate applications of roofing felt and asphalt usually three to five layers. Another system is the so-called coating system wherein one or more synthetic polymer layers, preformed, painted or troweled, are applied to impart waterproofness. Typical of such polymeric coatings are neoprene and/or chlorinated polyethylene.

Such roof systems may employ one or more layers of insulating material between the protective layer intended to provide the waterproof properties and the roof supporting substrate. The system may be a bonded system wherein the protective top layer is bonded directly to the substrate beneath it (e.g., the structural substrate or an intermediate insulating layer) or the system may be unbonded in that the protecting layer merely overlays the substrate beneath it but is not bonded thereto.

In addition to the waterproof properties imparted to the roof, the top protective layer commonly forms a vapor impermeable layer. The supporting substrate is also normally vapor impermeable either due to its inherent nature or by the provision of vapor barriers on one or both sides

of the substrate. Where moisture has been introduced or has accumulated under the protective layer or in the insulating layers which make up a conventional roof, blistering or rising of the roof system occurs.

This is normally attributed to the formation of water vapor between the vapor impermeable supporting substrate and the waterproof and vapor impermeable top protective layer. Since the exterior edges of the system are sealed—particularly in flat roofs and decks, this vapor cannot normally escape and pressure is built up within the roof structure. Even in those roof systems wherein the protective layer and/or supporting substrate has some permeability, the permeability may not be sufficient to release the vapor pressure as fast as it is generated. Blisters, wrinkles and air pockets are formed between the supporting substrate and the protective layer which eventually can lead to complete impairment of the integrity of the roof particularly where the roof is traffic bearing.

Additional sources of gas in conventional roofing systems include moisture released by the supporting substrate particularly where the substrate is concrete. The commonly employed insulating materials and adhesives employed to bind the various layers of a roof together also are a cause of vapor pressure. Insulating materials normally comprise cellular or fibrous structures containing a content of occluded air and/or water. The water may be inherent in the insulating material or may be a result of exposure to rainfall prior to being incorporated into the roof and the hygroscopic nature of the insulating material.

In the normal environment of conventional roofing systems, the temperature on a summer day may rise to in excess of 160° F. due to solar radiation. This causes an expansion of the air in the insulating material and a vaporization of the moisture to form definite pressure between the supporting substrate and the vapor impermeable top protective layer. At these relatively high temperatures the protective layer (e.g., asphalt and bitumen) may soften and loss its internal strength. Distortion, blistering, separation of the layers, cracking and destruction of the roof integrity result.

Numerous methods of relieving the gas pressure generated in roofing systems by venting the vapors generated within the roofing structure have been suggested. A typical method is to employ a vapor conducting material between the vapor permeable substrate and vapor impermeable top protective layer or to provide a layer whose structure comprises a network of air-moisture conveying channels—typically a waffle pattern—communicating with the outer boundary of the roof. The hope is that the vapor generated will be transmitted laterally through the porous material or along the channels and ultimately escape from the edges of the roof. Systems of the above-described type are typically represented by U.S. Pats. 3,053,716 issued Sept. 11, 1962 and 2,192,458 issued Mar. 5, 1940.

Since these systems depend upon the lateral travel of the generated vapor along the length and breadth of the roof structure, problems commonly arise due to the distance which the vapor must travel and blockage of the vents or channels either in initial application of the roof structure or to obstructions occuring during use (typically in a traffic bearing deck).

In an effort to solve such problems other proposals have been put forth including the use of individual mechanical vents at predetermined locations on the roof. By employing such vents, the distance which the vapor must travel before reaching the atmosphere is substantially shortened. Such vents commonly employ a metallic tube extending above the roof and having a metallic flange end inserted under the waterproof and vapor impermeable protective layer. The cross-sectional area effec-

tively vented by this arrangement depends to some extent on the cross-sectional area defined by the flanged end. The tube is commonly bent into an inverted U-shape or is covered in some other manner so that rain will not enter the tube and seep into the roofing structure. Mechanical venting systems of this nature are described for example in U.S. Pats. 3,135,069 issued June 2, 1964, 2,833,229 issued May 6, 1958 and 1,931,066 issued Oct. 17, 1933.

Mechanical venting systems of the above-described type are relatively expensive and result in an unsightly appearance due to the necessity for mechanical structures to extend above the roof line. Particularly in traffic bearing decks the employment of such mechanical venting systems is undesirable, if not impossible, due to the physical appearance of such systems and their impedance to traffic.

SUMMARY OF THE INVENTION

It is an object of the present invention to vent roof structures of the type illustrated above and comprising a substantially vapor impermeable top protective layer overlaying a substantially vapor impermeable supporting substrate, with or without intermediate insulating material, which will prevent pressure substantially greater than atmospheric from being generated within the structure between the supporting substrate and the protective layer whereby the formation of cracks, blisters and eventual destruction of the roof integrity is avoided. It is another object of the present invention to provide an integral weather-resistant roof which is adequately and completely vented, the venting being unaffected by traffic or age and which may be constructed in all types of weather, inclement or otherwise. Another object of this invention is to economically and conveniently relieve vapor pressure from within a roof system in either the initial construction of the roof or in roof systems which are already in place. A further object is to avoid the necessity to employ specially structured insulation or channeling layers. An additional object of this invention is to provide such a venting system without the employment of mechanical structures which are expensive, unsightly and a hindrance to traffic and to provide an attractive, essentially flat roof line. A further object is to provide a vent easily adaptable for use in constructing new roofs or for placement in existing roof structures. Other objects of the invention will become apparent as the description proceeds.

In accord with the present invention a venting system has been discovered which achieves all of the above objects and comprises a microporous membrane or sheet extending through and the edges of which are integrally bonded to a water and substantially vapor impermeable top protective layer of a roof system, said microporous membrane providing direct communication between the exterior of the roof structure and a vapor generating or containing substrate. The microporous membrane is typically of polymeric—natural or synthetic, metallic or ceramic constitution. It is located at predetermined positions in the top protective layer of roofing structure whereby adequate venting of the entire roofing system is assured without dependence upon a long lateral distance of travel for vapor (e.g., air and water vapor). The microporous membrane is permeable to vapor to allow venting but is also waterproof in order to protect the underlying substrate from moisture. To take full advantage of the invention, the microporous membrane is preferably located substantially flush with the outer surface of the top protective layer and hence unsightly mechanical structures which are a hindrance to traffic on said roof or decks are avoided. In areas of heavy traffic, the vent membrane may be protected by a structurally strong porous material for example a flush metallic grate. The invention finds particular use in roof systems applied over concrete supporting substrates wherein the protective layer is unbonded.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of a roof system with the vent of the present invention in place. FIG. 2 is a pictorial view of one embodiment of a vent structure according to the invention. FIG. 3 is a pictorial view part of which is broken away of another embodiment of the vent according to the invention.

DETAILED DESCRIPTION

Vented roofing systems according to the invention may be applied to any structural substrate which is substantially vapor impermeable such as concrete slabs, wood or steel. The structural substrate may include a vapor barrier on its upper or lower side, for example, a polymeric film or tarred paper.

The structural substrate may be associated with an insulating material such as felt, plasterboard, porous cement, expanded plastic, wood, bagasse, ground wood, flaxstraw, fiber board, gypsum block, laminated insulation board, fiberglass or numerous other suitable insulating materials well known in the art. One or more such layers may be employed and may be impregnated or adhered together with suitable adhesives.

In unbonded roofing systems the structural substrate is commonly associated with a divorcing or release layer capable of rupture when subjected to stress or a preformed asphalt saturated felt. Suitable examples of such divorcing layers and systems vented by the present invention can be found in U.S. Pats. 3,364,058 issued Jan. 16, 1968 and 2,771,824 issued Nov. 27, 1956.

A top protective layer forming a water and substantially vapor impermeable top cover, commonly comprising one or more layers of felt or other material impregnated with asphalt or bitumen in a built up roof system, is next applied. Alternatively, coating layers of polymeric material may be applied to provide waterproofness. The asphalt and bitumen or polymeric material imparts waterproof properties to the roof system and at the same time renders the top layer substantially vapor impermeable. The waterproofing protective layer may be topped with one or more additional layers of decorative material or material to improve resistance to traffic. These layers may comprise a hydraulic cement-latex system (e.g., cement-neoprene, cement-acrylate, cement-polyvinyl chloride—such systems are described for example, in U.S. Pats. 2,768,563 issued Oct. 30, 1956, 2,733,995 issued Feb. 7, 1956, 2,311,233 issued Feb. 16, 1943 and British Pat. 523,349 issued July 12, 1940) or coarse mineral or aggregate particles e.g., slag particles, gravel or other material embedded in asphalt or bitumen. Hereafter the term "protective layer" refers to the layer imparting waterproofness to the roof structure as well as any additional decorative and/or wear resistant layers thereon.

To avoid destruction of the roof integrity caused by vapor pressure generated between the supporting substrate and the top protective layer, a microporous membrane, typically in the form of a thin sheet extends through and is incorporated into the protective layer at predetermined locations to allow free communication between a vapor generating or containing substrate and the exterior of the roof.

The protective layer is provided with (or, in the case of repairing already existing roof systems, a suitable area is cut) an open area extending through so much of the protective layer as forms the top, substantially vapor impermeable layer. Within this open area is placed the microporous sheet or membrane. Alternatively the vent membrane is first located on top of the desired substrate and the remaining roof layers including the protecting layer are built up around the vent. In any even, the edges of the vent membrane are integrally bonded to the top protective layer by employing a suitable, waterproof cementing or adhesive material whereby the top protective layer retains its essentially continuous, weatherproof

properties. Suitable waterproof cementing or adhesive materials include natural and synthetic rubber cement (e.g., a solution of rubber-natural or synthetic—in a hydrocarbon-gasoline or benzene), asphalt, pitch, caulking compounds, polyester cements, epoxy cements, etc. Any of the well-known hydrophobic sealants may be employed. The porous nature of the venting material helps to increase the adhesion and insure an integral structure.

The underside of the venting membrane contacts and provides free communication with the substrate beneath it, commonly insulating material, the supporting substrate or the divorcing layer. Since the microporous membrane is normally thinner than the protective layer and since the top of the membrane should preferably be flush with the top of the protective layer, one or more layers of a porous or vapor permeable material e.g., glass fiber, glass wool, burlap, etc. may be inserted to support the microporous membrane at the desired level. In this embodiment the venting membrane is preferably preformed by cutting to the desired size and shape, applying a layer of vapor permeable material to the underside and bonding this material around the edges of the membrane by employing cements or adhesives for example of the above-described type or thin metallic clamping devices. The thickness of this backing material can be varied to compensate for the particular thickness of the protective layer or the backing may be reasonably compressible so that the vent membrane can be used in varying protective layer thicknesses.

The microporous membrane may be of metallic, ceramic or polymeric composition—either natural or synthetic. Suitable porous metals in sheet form are commercially available from Union Carbide Corporation, Stellite Division, Kokomo, Ind. The metals may be pure metals or alloy combinations such as copper, nickel, silver, iron, stainless steel, etc. and are commercially available in a wide variety of porosities, structures and thicknesses. Both single and muti-layered microporous metal membranes may be used.

Microporous membranes which are vapor permeable and waterproof can also be produced by coating a suitable substrate with a polymeric solution having as essential constituents a hygroscopic solvent and a polymer formed by chain extending the reaction product of at least one polyalkyleneether glycol and at least one diisocyanate with at least one compound having two active hydrogen groups as disclosed in U.S. Pat. 3,000,757 issued Sept. 19, 1961. Alternatively a laminated structure can be employed comprising two or more bonded layers with spaced deposits of bonding material between layers as disclosed in U.S. Pat. 3,251,727 issued May 17, 1966. Other waterproof and gas permeable microporous membranes may be employed which are produced by distributing granules of thermoplastic resin between two resilient fibrous sheets and compressing and sintering the assembly for example, between hot plates as disclosed in U.S. Pats. 3,262,834 issued July 26, 1966, 3,067,469 issued Dec. 11, 1962 and 3,349,046 issued Oct. 24, 1967. Other microporous membranes suitable for use according to the invention are disclosed in U.S. Pats. 3,100,721 issued Aug. 13,1963, 3,261,796 issued July 19, 1966, 3,238,055 issued Mar. 1, 1966, 2,773,286 issued Dec. 11, 1956, 3,208,875 issued Sept. 28, 1965 and 3,242,819 issued Feb. 1, 1966. Other methods of producing microporous materials include admixing a polymeric material with particles of a leachable material (normally water soluble such as polyvinyl alcohol or starch), forming the desired sheet and leaching out the material to form pores as described in U.S. Pats. 2,542,527, 2,256,483 and 2,676,929.

Naturally occurring microporous membranes such as leather may also be employed in the present invention. While such materials are naturally porous, they must normally be treated by various known methods in order to impart waterproof properties to them. Such processes include chrome treatment and treatment with various water repellant silicones. With any of the above-listed materials, if the inherent waterproof properties are not sufficient, they may be suitably rendered waterproof by treatment with well-known waterproofing substances such as silicon resins (organosiloxane polymers e.g., dimethyl silicone and diethyl silicones), hydrocarbon waxes, chlorinated paraffin, waterproofing salts, etc. Such waterproofing substances are commercially available materials.

Microporous ceramic materials are also commercially available, for example, so-called microporous porcelain filter media comprising a hard, rigid porous body consisting essentially of oxides of silicon, aluminum, potassium and sodium with traces of the oxides of iron, calcium and magnesium. The material is made essentially by high temperature sintering of selected starting ingredients and is available in various porosities ranging, for example, from 27 to 58% volume of capillaries and said capillaries having an average radius of 25 to 0.22 microns (10^{-4} cm.). Suitable microporous ceramics are available from Selas Flotronics, Spring House, Pa. The microporous ceramic may be rendered waterproof by any suitable waterproofing treatment such as mentioned elsewhere in this application.

As can be seen from the above description, numerous microporous membranes are suitable for use in the present invention. The specific method of making these microporous materials is not part of this invention and many usable materials are illustrated in the above-cited patents, which patents are incorporated herein by reference. Suitable synthetic poromeric materials are commercially available such as Corfam sold by E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.

The essential features of the microporous membrane for use in the present invention are vapor permeability whereby vapor contained or generated within the roof system is vented to the exterior of the structure and substantial water impermeability whereby the microporous membrane when integrally bonded to the overlaying roof surfacing material provides a continuous waterproof protective layer. In those instances wherein the roof is traffic bearing, the microporous material, where not otherwise protected, must have sufficient strength and resistance to abrasion to withstand traffic and the ability to retain its waterproof properties despite being subjected to traffic.

The degree of porosity depends upon the particular roof system employed. The upper limit is not critical except insofar as the necessity for the microporous membrane to retain its waterproof properties. If the degree and/or size of the pores is too high, it may be difficult to impart sufficient waterproofness to the membrane. The minimum porosity is dictated generally by the amount of water and/or air expected within the system and the temperatures expected during normal use. The membrane must transmit sufficient water vapor such that the formation of blisters, distortion, etc. is avoided. While the porosity may vary widely, it has been found generally that the membrane advantageously should transmit at least .002 gram/square centimeter/24 hours water vapor. If the membrane will transmit water vapor, it also will transmit other gases normally generated within the roofing system.

The venting membrane may be any size provided the surface area and degree of porosity are sufficient to adequately relieve the pressure. The external configuration and thickness of the membrane are dependent only on cost of material and installation provided the venting requirements are met. Indeed, it is a distinct advantage of this invention that the vent may actually become a part of the overall decorative scheme of the roof rather than an unattractive detraction therefrom. By suitable choice of size, configuration, color and location the vent may be integrated into any roofing design. Normally the thickness of the membrane will be between about 1/64 and 1/2

inch and will be of a rectangular or square shape providing about 2 to 40 square inches of effective venting area per vent. The membrane can be laid in strips, circles or any geometric shape deemed necessary or esthetic.

The location of the vent in the roof is a matter of choice dependent upon the particular roof structure. The exact location and distance between vents is easily ascertained by one skilled in the art from routine experimentation and/or knowledge of the particular roof system. Where the vent membrane is employed in a completely bonded roof system and contacts the supporting substrate, there is little opportunity for lateral flow of the vapor under the protective layer and the vents should normally be located relatively close together. With concrete substrates it is generally recognized that moisture vapor will travel laterally for about three feet. Thus in this case, the vents normally would be placed on at least six foot centers.

In roofing systems which are unbonded or where the vent communicates with porous material and/or specially constructed intermediate channeling material such as described in the earlier cited patents, the vents may be spaced apart at greater distances. This is due to the ability of the vapor to travel laterally, without building up substantial pressure, until it reaches the vent and is transmitted out of the roof system.

Where the venting system according to the invention is employed for repairing existing roof systems, the location of the vent is easily determined by the existing areas of blistering, cracking, etc. In this embodiment, the cracked and blistered area is removed from the roof—the protective waterproof and water inpermeable layer being completely removed. In some instances it may only be necessary to remove only so much of the protective layer as provides room for the vent. In other instances, larger areas may be removed and both the vent(s) and replacement protective layer inserted.

In order to more fully explain the invention, reference is made to the accompanying drawing wherein like reference numerals refer to like elements. FIG. 1 shows a cross-sectional view of a roof system employing a vent membrane according to the invention. The supporting substrate **12** comprises a common structural concrete base of 3000 p.s.i. compressive strength. Layer **13** overlies the supporting substrate and comprises a divorcing layer of nonblocking cement as disclosed in Example 1 of U.S. Pat. 3,364,058. Alternatively asphalt impregnated felt may be employed.

Layer **14** comprises a glass mat (or burlap) layer which is impregnated or overcoated with a chloroprene latex (an aqueous emulsion of 2-chlorobutadiene-1,3-polymer-neoprene latex 571 sold by E. I. du Pont de Nemours & Company, Inc. having a 50–52% solids content diluted with water to a 42% solids content) to impart waterproof properties to the system. Area **20** directly under the vent, comprises the glass mat of layer **14** but is free from emulsion so that it retains its vapor permeability. Layer **15** is a wear coat of a cement-chloroprene system containing aggregate which imparts wear resistant properties to the roof. Layer **16** is a pigmented acrylic resin water base emulsion paint which is applied for decorative and wear resistant properties.

Layer **18** comprises a glass mat similar to that employed in layer **14** and free from the chloroprene emulsion. The mat is fibrous and vapor permeable and acts to support layer **17** at the desired level. Layer **17** is a microporous membrane which is waterproof but vapor permeable. This membrane is square in configuration, measuring six inches per side and 1/16 inch thick. The membrane transmits .027 gram/square centimeter/24 hours water vapor. The edges of the microporous membrane are integrally bonded to layer **14** by employing an adhesive of chloroprene latex (neoprene latex 571) thereby forming bonding material **19** which insures a waterproof system.

The microporous membrane comprises a nonwoven web of polyester fibers impregnated and coated with a polyurethane. The membrane was Corfam 216 sold by E. I. du Pont de Nemours & Company, Inc. Other suitable membranes include that produced by Example V of U.S. Pat. 3,000,757 as well as the examples of the previously identified patents.

FIG. 2 represents a preformed vent according to the instant invention. Layer **18** is a vapor permeable glass mat or burlap which is bonded to layer **17**, the microporous membrane. Such preformed vents are easily made in advance of the roof construction or repair. Since supporting layer **18** is compressible to some extent, it can be employed with varying protective layer thickness. Layer **18** may be bonded to layer **17** with any suitable waterproof cement or adhesive such as those described earlier.

FIG. 3 is another embodiment of a preformed vent according to the invention. In this embodiment, microporous membrane **17** is bonded to a rigid support member **21** of suitable material such as wood, metal or plastic (e.g., aluminum, stainless steel, polyvinyl chloride, polyethylene, etc.). The supporting member is inherently vapor permeable or, in the case of, for example, aluminum contains holes **23** to provide ability to transmit vapor. Needless to say, any suitable method may be employed to render supporting member **21** vapor permeable and it may partake of any structure necessary for supporting membrane **17**, particularly in traffic bearing roofs. Flange **22** is bonded to supporting member **21** and comprises any suitable material such as metallic or plastic sheet which is vapor permeable at least beneath membrane **17**. Again, permeability may be inherent or added to layer **22** by punching out holes, etc. Flange **22** makes insertion of the vent somewhat easier and eases the formation of an integrally bonded structure.

The embodiments according to FIGS. 2 and 3 represent the preferred positioning of the microporous membrane (i.e., said membrane is maintained flush with the top of the protective layer). Alternatively, the membrane may be maintained at a level below the top level of the protective layer and protecting structural member may be placed on top of the membrane, flush with the top of the protective layer. This is not preferred since water, for example, from rainfall can collect above the membrane and may eventually destroy the membrane and/or cause leakage through the integral bond of the membrane to the protective layer.

The vent system according to FIG. 1 was put in place as follows. First glass mat or cloth was laid over supporting substrate **12** and divorcing layer **13**. This cloth had a thickness of approximately 1/16 inch. The desired area **20** where the vent was to be installed was marked out. A chloroprene emulsion was coated on all areas of the glass cloth except area **20** where the vent was to be placed, to form waterproofing layer **14**. A preformed vent according to FIG. 2 was placed over the marked areas with its edges contacting the still unset chloroprene emulsion thereby forming a preliminary cementing. After setting of the chloroprene, the edges of the vent were integrally bonded by applying adhesive **19** of chloroprene latex (neoprene 571) around all edges, approximately ½ inch of each side of the vent being covered with the adhesive. Layer **15** was next troweled around the vent to a depth of approximately 1/8 inch. The layer comprised a chloroprene-cement mixture of aluminous cement, said aggregate and chloroprene emulsion (neoprene 571). Layer **15** was then topped with a pigmented acrylic emulsion system to provide the final decorative and wear resistant surface.

Throughout the application of layers **15** and **16**, care was taken not to cover membrane **17** except to the extent that the bonded edges were covered to avoid unsightly appearance.

From the above description it is clear that many variations of the invention are possible and the above example

is merely illustrative thereof. Layers **14** through **16** may, for example, be replaced by a typical built up protective system comprising alternate layers of roofing felt and bituminous material. Layer **14** may comprise any woven or nonwoven fibrous material including textile fiber—synthetic or natural such as polyolefin fiber, polyester fiber, wool, cotton, etc. impregnated or coated with a suitable polymer to impart water proofness such as polyvinyl chloride, polyethylene, etc. Backing layer **18** may also comprise woven or nonwoven fibrous material such as burlap, felt, glass fiber, etc. as above illustrated with respect to layer **13** in addition to rigid supporting members.

As microporous sheets, any of the above-described materials may be employed. Such materials are described in the cited patents and are commercially available under numerous trade names.

Layer **14** may extend up and over the edges of the microporous membrane to insure a tight, waterproof seal when adhesive is applied. Alternatively a substantial distance between the microporous membrane and the waterproof layer may be filled with hydrophobic adhesive, cement or caulking compound provided a waterproof, integral bond is formed.

It is equally obvious that the vent in FIG. 2 may be modified by the addition of a flange member such as in the vent of FIG. 3. Alternatively, layer **18** may extend beyond the edges of membrane **17** to form a flange. If desired, membrane **17** may extend beyond the edges of supporting layers **18** or **21**. In this manner, the edges of the membrane may be bonded directly on top of waterproof layer **14** or may be inserted under said layer to form the desired seal.

Divorcing layer **13** may comprise a composition having as the major constituent an inorganic cementitious material, and containing an inorganic filler and a release agent. The cementitious material may comprise, for example, calcined gypsum, lime and/or hydraulic cement. The release agent may comprise an organic material such as surface active agents, paraffin waxes, polymer emulsions such as polyethylene and silicones. Suitable fillers include fine said, silica flour, calcium carbonate, etc. Materials suitable for use in the divorcing layer are further described in U.S. Pat. 3,364,058. Alternatively the divorcing layer may be asphalt saturated felt or other suitable sheeting.

Layer **16** may comprise any suitable decorative resin composition such as vinyl resins (e.g., copolymers and polymers of vinyl chloride and vinylidene chloride), epoxy resins, polyurethane resins, acrylic resins and the like. Such resin compositions may contain pigments, fillers and plasticizers. In addition to decorative effects, the top coat provides a smooth finish and acts as a seal.

I claim:

1. In a composite roof structure, a method of venting vapor from between a substantially vapor impermeable supporting substrate and a substantially vapor impermeable and waterpoof protective top layer overlaying said supporting substrate comprising providing in the protective top layer an open area extending through so much of the protective layer as provides substantial vapor impermeability, closing said open area with a vent comprising a microporous membrane and integrally bonding the periphery of said microporous membrane to the top protective layer to provide a waterproof system.

2. A method according to claim **1** wherein an existing composite structure is repaired by removing an area of the existing protective top layer through so much of the layer as provides substantial vapor impermeability and closing said open area by integrally bonding the periphery of a microporous membrane to the top protective layer.

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ALFRED L. LEAVITT, Primary Examiner

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U.S. Cl. X.R.

52—199, 305; 156—94, 268, 306; 161—92, 93, 147, 236; 260—2.5 AY