MULTIPLE LAYER OUTSIDE WALL OF A BUILDING OR THE LIKE
Paul Jordan, Zahiringerplatz 2, Constance, Germany
Filed Apr. 15, 1970, Ser. No. 28,614
Claims priority, application to Switzerland, Apr. 18, 1969, 5,857/69
Int. Cl. E04b 1/62, 2/88
U.S. Cl. 52—235
23 Claims

ABSTRACT OF THE DISCLOSURE
A multiple layer outer wall for a building or the like which embodies an outer wall layer portion and an inner wall layer portion as well as an insulation skin arranged between both of the aforementioned wall portions. This insulation skin is constructed as a membrane consisting of an elastic elongatable, tear resistant and thermally insulating material which at least is primarily covered both towards the outside of the building as well as toward the inside of the building by the respective outer and inner wall layer portions. Furthermore, the insulation membrane or skin is free of interruptions defining parting lines or separation joints or at least possesses less separation joints or parting lines than one of both wall layer portions, and additionally, the inner wall layer portion is assembled from a plurality of substantially rectangular wall elements which are laterally arranged adjacent to another with horizontal spacing and/or vertical spacing.

BACKGROUND OF THE INVENTION
The present invention relates to a new and improved multiple layer outside or external wall for a building, structure or the like, which is of the type comprising an outer wall layer portion and an inner wall layer portion as well as an insulation skin or membrane arranged between both of the aforementioned wall portions.

Such type multiple layer outside walls for buildings are known to the art, for instance as described in the German article entitled "Nichttragende leichte Aussenwände-Vorhangwände," publication "Bauen mit Aluminium 1966/1967," Aluminium-Verlag G.m.b.H., Düsseldorf, Germany, December 1966/1967, pp. 8 to 22. With all external or outer walls which in cross section do not uniformly consist of "breathable" material, in other words are not formed of brick, rather possess a certain multiple layer arrangement or approximate such, it is desirable to arrange the thermal insulation layer generally as far to the outside as possible, whereas on the other hand, to arrange the layer with high water vapor-diffusion resistance, the so-called steam or vapor lock, as far as possible towards the inside, in order to avoid the danger of condensation of water vapor within the layer aggregation.

Yet, this tendency for constructing the outer wall in this manner—with large facade surfaces—is associated with several difficulties. Thus, for instance, it is difficult to construct the wall cross section at the expansion joints from a heat insulating, that is to say, porous non-compact material. Contrary, there is used throughout the entire depth of the cross-section a highly sturdy or solid, in fact generally a wear resistant, in other words compact, preferably metallic material. Apart from the foregoing, then, at the regions of the expansion joints the thermal installation short-circuit, the so-called heat bridge, is generally also therefore quite considerable, because there the metallic profile material tends to decisively appear in "pairs," for instance with groove and spring or resilient means. Thus, there appears a considerable accumulation of heat conducting material.

SUMMARY OF THE INVENTION
Accordingly, it is a primary object of the present invention to provide a new and improved multiple layer outer wall construction for a building or the like which no longer possesses the abovementioned drawbacks of the prior art constructions.

Another, more specific object of the present invention relates to an improved multiple layer outside wall for a building, structure or the like, which is relatively simple in construction, economical to manufacture, and easy to erect.

Now, in order to implement these and still further objects of the present invention, which will become more readily apparent as the description proceeds, the heretofore mentioned inventive multiple layer outer or outside wall for a building or the like is manifested by the features that the insulation skin is constructed as a membrane consisting of an elastic elongatable, tear resistant and thermally insulating material which is covered at least over its major part towards the outside of the building as well as toward the inside of the building by the aforementioned respective outer and inner wall layer portions. Furthermore, the insulation skin or membrane is free of joints or separations or at least possesses less interruptions defining such separation joints than one of both wall layer portions. Additionally, the inner wall layer portion is composed of a number of substantially rectangular wall elements which are arranged laterally adjacent another one another with horizontal and/or vertical spacing.

It has furthermore been found that for advantageous reasons of technology and economy, the vapor locking layer in the layer aggregation of the outer wall—in contrast to the previously explained tendency—can be arranged relatively far towards the outside. The insulation skin preferably functioning as a vapor locking layer is constructed from a membrane consisting of an elastically elongatable, tear-resistant and thermally insulating material. This membrane should be formed with as few joints or parting lines as possible and, because of expansion of the building and the facade, should be formed of an elastically elongatable material, plastic for instance.

Furthermore, the insulation skin should also fulfill the function of sealing off the inside from the outside at all locations where the layer aggregation of the wall, covering such insulation skin, towards the outside and/or towards the inside possesses expansion joints, because both of these layer complexes of the wall can be extensively non-elastic, for instance if they are formed of metal. As a result, the construction of the expansion joints can be considerably simplified and rendered more inexpensive.

Provision need only be made for a more or less "unintentional" self-aeration of the layer complex or aggregation disposed towards the interior of the building, especially its outer region; then there can be obtained a saving on any type of absorptive inner plaster or inner coating. The abovementioned layer aggregation, then, can be, for instance, formed throughout its entire cross-sectional depth from frame members formed of metallic profile
material. In so doing, that portion of the cross-sectional depth which otherwise would be used for the inner plaster or inner coating, becomes of advantage for the moment of inertia of the profile material-frame means, that is to say, its bending resistance or stiffness against wind pressure. This is the case if the layer aggregate or complex situated towards the interior of the building, which is of advantage, is the wall portion considered by itself with regard to static conditions or primarily for absorbing loads. Further advantages of the new outside wall of the building or structure, are for instance the following:

As the material for the outer layer complex covering the expandable plastic layer there can thus be chosen a highly corrosion and weather-resistant special aluminum alloy which can easily be eloxadized or anodised. On the other hand, for the layer complex serving as the covering towards the inside of the building there can be chosen such a metal alloy which, in the first instance, tends to readily fulfill the strength requirements.

The expandable and extensively jointless i.e. continuous membrane which, for instance, is welded together at the building site from webs of plastic into a larger unit, functions especially then as a considerable heat or thermal lock if this membrane is relatively thick or consists of a number of layers and/or its surfaces are mounted “hollow” at both sides. Additionally, its sound dampening action is also then relatively great.

A skin or membrane formed of plastic and having relatively few parting lines or separation joints, especially free of joints, permits the use of, for instance, two different metals at the wall layer portions disposed to both sides thereof, without fearing any electro-chemical corrosion, even if the position of the metal at the outer wall layer portion with respect to the electro-chemical series is considerably removed from the position of the other metal, in other words the metal used for the inner wall layer portion.

The presence of the insulation skin permits the use of steel profile material and/or steel sheet metal for the inner wall layer portion, and for the outer wall layer portion light profile material and/or light metal sheet material.

The outer building wall of the present invention is particularly suitable for such structures which, according to the static principle, consist of story or floor ceiling supports supported by struts (supports) in which the static loads are essentially taken up by a steel or steel concrete skeleton and not by massive walls. In fact, the outside wall for buildings of the present invention can be used as curtain-type or framed facades, especially such which can be prefabricated in the factory. Viewed from the outside of the building or structure, in all of the embodiments of the outer wall can be such that the struts and ceilings remain visible. Finally, it is also possible that the building outside wall of the invention hides behind it the entire supporting skeleton, that is to say the struts or columns together with the story ceilings, in that it surrounds the entire building in the manner of a skirt.

The feature of the invention that the inner wall layer portion is assembled from a plurality of rectangular wall elements arranged laterally adjacent one another with horizontal spacing and/or vertical spacing results in the fact that there is prevented a direct force-transmitting contact of the marginal portions with such neighboring wall elements. The direct contact can be eliminated for all separation joints or only for the vertical joints or only for the horizontal separation joints of the wall elements. As a result there are provided the following advantages:

(a) A considerable saving in weight and cost for the used profile rod material;
(b) A simplified support (anchoring) at the concrete or brick work insofar as the support need not be displace-

able (compare the publication entitled “Aluminum,” Dusseldorf (December 1965), special volume “Bauen mit Aluminium 1965,” picture 22 appearing at page 9 thereof);

(c) The outer building wall is absolutely “noiseless” because in its supporting layer, in other words at the inner wall layer portion there do not appear any displaceable joints or the like that is, there cannot occur any “noisy working” of the building outside wall with pronounced fluctuations of sun radiation and so forth;

(d) There is prevented a transmission of sound energy from sound sources within the building by means of the curtain wall or front wall and a radiation of this energy into other spaces or rooms of the building, because there does not exist any direct force-transmitting contact between the wall elements of the inner wall layer portion;

(e) There is prevented right from the outset the danger of a “continuous tearing” of the outside wall of the building with a crack or tear from a storm by virtue of the subdivision of the inner supporting wall layer portion into independent wall elements;

(f) Only slight demands are placed upon the expansibility of the insulation skin of the outside wall of the building by virtue of the aforementioned subdivision of the inner supporting wall layer portion; by virtue of this subdivision the expansion movements of those construction components, for instance bolts, which pass through the insulation skin or layer in order to support the outer wall layer portion are reduced to a minimum. The flexible insulation skin or layer can thus be fabricated from a material of, increased Shore Hardness Test and wear resistance, increased ruggedness and cheaper quality.

In many instances the subdivision of the inner wall layer portion into a plurality of similar wall elements further provides a rationalization of the building or construction operation, particularly since experience has shown that from year to year there must be taken into consideration larger tolerances in the dimensions of the building skeleton.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein there are depicted exemplary embodiments of inventive multi-layer building outer wall means, especially used for steel concrete skeleton-structures, and wherein:

FIG. 1 is a perspective fragmentary view of a first forwardly suspended or positioned outside wall of a building in which there are only shown mounted four wall elements of the inner layer wall portion consisting of a multiplicity of such wall elements;

FIG. 2 is a perspective fragmentary view of a second forwardly mounted outside wall of a building, with there being shown only mounted one slab element of the inner layer wall portion;

FIG. 3 is a fragmentary side view of the inner layer wall portion of a third forwardly mounted or preset outside wall of a building;

FIG. 4 is a sectional view of the outside building wall depicted in FIG. 3;

FIG. 5 is a fragmentary side view of the inner layer wall portion of a fourth preset outside building wall;

FIG. 6 is a sectional view of the outside building wall depicted in FIG. 5;

FIG. 7 is a sectional view of an attachment device for a forwardly positioned or preset outside building wall;

FIG. 8 is a sectional view of a further embodiment of attachment device for a forwardly suspended outside building wall;

FIG. 9 is a perspective cross-sectional view of the joint location of four wall elements of a further embodiment of outside building wall;
FIG. 10 is a fragmentary vertical sectional view of a multi-layered outside building wall in which the one outer layer wall portion is constructed via a bolt member with an inner layer wall portion;

FIG. 11 is a fragmentary vertical sectional view of a further outside building wall in which a distance or spacer bolt member is arranged between the outer and the inner layer wall portions;

FIGS. 12–14, inclusive, depict in cross-sectional view respective different types of coupling arrangements between a bolt member and the insulation skin or layer;

FIG. 15 is a perspective view of a further connection device between the outer and the inner layer wall portion;

FIGS. 16 and 17 depict in vertical section two adjusted outer building walls in which the wall elements of the inner layer wall portion is adjusted between parts of the building support constructions;

FIG. 18 is a perspective cross-sectional view of the joint location of a number of wall elements of a further embodiment of outside building wall;

FIG. 19 is a perspective cross-sectional view of a further embodiment of outside building wall, wherein the wall elements of the inner layer wall portion are inserted between the story or floor ceilings, beams and columns, and which possesses a cantilever support extending through the insulation skin and the outer layer wall portion;

FIG. 20 is a fragmentary vertical sectional view of a further outside building wall, the wall element of which is equipped with a heating installation; and

FIG. 21 is a vertical horizontal sectional view of a further embodiment of outside building wall, the wall elements of which possess vertically arranged heating installations.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1 and 2 illustrate in schematic, perspective view the support construction of a building or structure which is constructed as a steel concrete skeleton; this support construction is to be covered with a multi-layered outer building wall. Such multi-layered outer building wall is to be secured to the illustrated story ceilings 10 or other elements, such as columns, supports or the like, of the support construction.

In FIGS. 1 and 2 there have only initially been shown the wall elements 12 of the inner layer wall portion 14 of the building wall which is to be secured to the story ceilings 10. As will be described and illustrated in greater detail hereinafter, the external or outer building wall, however, further incorporates an outer or external layer wall portion 16 and an insulating skin or layer 18 arranged between both of the aforementioned wall portions 14 and 16.

Considering now the inner wall layer portion 14, it will be recognized that such, as illustrated, is subdivided into a multiplicity of wall elements 12, preferably possessing, in each instance, a frame member 19 which, in cross section, has a substantially U-shaped configuration, the legs of such U-shaped frame 19 at the end of the corresponding wall element 12 extending towards the outside. It is to be understood that these wall elements 12 can be constructed quite differently, depending upon the most varied type of functions assigned to them. For instance, they can be constructed as sound, or thermal insulating elements, or can possess openings for doors and windows, and so forth. In each case, they serve as the load absorbing component, in other words the so-called "supporting" component of the outside wall of the building or structure which, for instance, has to absorb the wind pressure. As far as the frame members 19 of the wall elements 12 are concerned, these are metallic profile frames. Such preferably consist of steel-profile material, the surface of which has been improved according to conventional techniques. The strength values, also the modulus of elasticity of the employed steel alloys and the moment of inertia of the employed frame cross-section are high enough in order to impart the previously described bending stiffness to the outer building wall against the pressure of the wind and, thus, to maintain the previously described load tolerances. As far as the insulating skin or layer 18, it will be understood that such is composed of an elastic, expandable membrane formed of plastic which hardly conducts heat. Such a membrane is, for instance, welded and/or adhesively bonded at the building site into a unitary structure which is free of joints and is formed from plastic webs delivered as rolled material. In so doing, the horizontal connection seams are preferably welded, whereas an adhesive can be used for the lengthwise seams between the individual webs. The skin, that is to say, the insulating layer, preferably extends without any joints all four sides of the building or structure and likewise again without joints from the foundation up to the roof. The insulation skin or layer is covered towards the outside of the building by the outer wall layer portion 16. In the case of windows the insulation layer is provided with openings or recesses at appropriate positions.

As for instance best shown by referring to FIGS. 4 and 6, the outer wall layer portion 16 preferably likewise is composed of individual elements 20 which advantageously correspond in their dimension or size and number to the wall elements 12. These elements 20 preferably also possess frame means 22 consisting of weather resistant and decorated eloxedized light metal profile members. The elements 20 furthermore can, analogous to the wall elements 12 of the inner wall layer portion 14, be appropriately constructed as window elements or insulating elements. In the exemplary embodiment of the invention outside wall for a building, structure or like as shown in FIGS. 1 and 2, there have only been conveniently illustrated four wall elements 12 of the inner wall layer portion 14, wherein each such wall element 12 is suspended or mounted at attachment devices 24. The wall elements 12 are not in mutual direct contact with one another, rather are separated from one another by expansion joints, specifically possessing a vertical spacing a and a horizontal spacing b, as best shown by referring to FIG. 1.

In FIG. 2 there is schematically illustrated the attachment of an individual suspended or forwardly arranged wall element 12 of the inner wall layer portion 14. To this end lower outer devices 28, the frame members 19 at the story ceilings 10, as shown, which support the load of the portion of the multi-layered outside building wall belonging to the wall element 12. Further attachment devices or members 24 are provided at the top of the depicted wall element 12, these attachment devices 24 not being loaded by the weight of the outer wall of the buildings. The top attachment devices together with the lower attachment devices 24 serve to absorb the load appearing through wind pressure and wind suction.

FIGS. 3 and 4 illustrate an embodiment of a forwardly placed multiple-layered outside building wall as viewed from the outside at an appropriate position, respectively. The inner wall layer portion 14 consisting of the wall elements 12 is connected via the attachment devices 24 with the door or story ceilings 10 of the building-support construction. The vertical dimension of the individual wall elements 12 practically corresponds to the height of a story. The individual wall elements 12 are preferably arranged in such a manner that they are more or less flush with the upper edge of the individual floor ceilings. The attachment devices 24, which have only been schematically illustrated, are constructed such that they perform a double function. On the one hand they support the wall element 12 of the inner wall layer portion 14 disposed thereabove and, on the other hand, retain the lower situated wall element 12 in position essentially only against wind pressure and wind suction. Continuing, it will be recognized that bordering from the outside against the
inner wall layer portion 14 are the insulation skin or membrane 18 and the outer wall layer portion 16. In the illustration, the insulation skin or membrane 18 and the outer wall layer portion 16 have been conventionally omitted. The outer wall layer portion 16 is also likewise subdivided into individual elements 20, the dimensions of which correspond to those of the wall elements 12 of the inner wall layer portion 14. As further shown in FIG. 7, the wall elements 12 of the inner wall layer portion 14 are arranged at a vertical spacing $b$ from one another and further at a horizontal spacing $a$ from one another.

FIGS. 5 and 6 depict a further outside wall of a building, structure or the like, in analogous showing to the arrangement of FIGS. 3 and 4. In contrast to the previously discussed embodiment, here the individual wall elements 12 and the elements 20 of the inner wall layer portion 14 as well as the outer wall layer portion 16 are not constructed to possess a height corresponding to that of a floor or story, rather are subdivided, as shown. Accordingly, skin or membranes 18. The inner wall layer portion 14 possess a vertical dimension which approximately corresponds to the free spacing between the story ceilings 10. On the other hand, a smaller wall element 12b possesses approximately a vertical dimension corresponding to that of a support member 25 provided for each floor ceiling. The elements 20a and 20b of the outer wall layer portion 16 once again correspond to the dimensions of the wall elements 12a and 12b, respectively, of the inner wall layer portion 14. Consequently, there is provided an irregular breakdown of the outside building wall which still coincides with the dimensions of the building-support construction and which almost reproduces such from the outside.

FIG. 7 depicts an attachment device or mechanism 24a, which, on the one hand, serves for supporting a wall element 12 of the inner wall layer portion 14 and, on the other hand, serves to retain a neighboring wall element 12 against wind pressure and wind suction. The attachment device 24a incorporates an anchoring portion 30 by means of which such attachment device is secured to the floor ceiling 10. In the exemplary embodiment under consideration, this occurs by threadably attaching the support from the outside to the end face of the floor ceiling. A vertically protruding holding or support member 32 merges with the anchoring portion 30 and upon which there is supported via a roller body member 34 the wall element 12 situated thereabove. The lower situated wall element 12 of the inner wall layer portion 14, that is to say, the wall element disposed at the lower level, is supported only against horizontally acting forces, such as from supporting walls 18 and is secured with elastic spacer members 36 at the vertical shoulders 38 of the holder or supporting member 32.

FIG. 7 furthermore depicts details concerning the construction of an outer or external wall layer portion 16 as well as further details of the arrangement of the insulating skin or membrane 18. The outer wall layer portion 16 possesses, for instance, a window element 20c which, in turn, incorporates a prefabricated double-glass arrangement 42 which is tight around its edges. The double-glass arrangement 42 is fixedly arranged in the frame unit 22. A further element of the outer wall layer portion 16 as an insulation plate member 50 arranged in the frame member 22. Insulation plate member 50 is covered towards the outside by means of a cover layer 52 formed of an anodized or eloxalized light metal. A displaceable cover member 54 bridges the gap between the two elements of the outer wall layer portion 16. Furthermore, it is to be understood that the attachment device 24a shown in FIG. 8 corresponds essentially in its structure to the attachment device 24b depicted in FIG. 7. However, in contrast to the latter, here the attachment device 24b is equipped for the attaching of an inner wall layer portion 18 and the outer wall layer portion 16 and additionally serves to secure an outside building wall in contrast to forwardly placing same, as such is possible with the attachment device 24a of FIG. 7. Here again, attachment device 24b possesses a support or holder member 32 which is secured by means of an anchoring portion 30 to the floor ceiling 10. The holder portion 32 is equipped with vertical downwardly directed substantially L-shaped shoulders 56 upon the horizontal legs 58 of which there are suspended the lower wall element 12 through the agency of roller body members 34. Furthermore, the holder member 32 is equipped with vertically upwardly directed shoulders 60 at which there are supported, against forces acting transverse to the wall surface, the upper wall element 12 through the agency of elastic spacer member 36.

FIG. 9 schematically illustrates in sectional view the outside building wall, and specifically the region at which the four wall elements 12 of the inner wall layer portion 14 as well as the four elements 20c and 20d of the outer wall layer portion. In order to provide clarity in illustration the individual components have been shown in exploded view in a direction away from the building-support construction. The wall elements 12 of the inner wall layer portion are mounted or retained at the attachment or securing devices 24. In so doing, the wall elements 12 can either be erected or suspended at such attachment devices. Accordingly, these attachment devices are either constructed similar to the attachment devices 24a of FIG. 7 or the attachment devices 24b of FIG. 8. The wall elements 12 of the inner wall layer portion 14 can additionally be equipped with attachment devices 24 at their vertical joints, which further serve to absorb forces acting transverse to the wall, such as for instance wind pressure or wind suction. Thus the wall elements 12 are supported at these attachment devices 24 by means of elastic spacer members corresponding to the spacer members 36 of the attachment devices 24a and 24b.

Continuing, it will be recognized that the attachment device 24 of the exemplary embodiment of FIG. 9 is secured, for instance to a vertical support 62 of the building-support construction, through the agency of the anchoring portion 30. The lateral attachment device 24 is not absolutely necessary. In most instances the lower and the upper attachment devices 24 for supporting the wall elements 12 are sufficient. The attachment of the outer wall layer portion 16 and the insulation membrane or skin 18 to the inner wall layer portion 14 will be described more specifically hereinafter. At this point it is mentioned that the outer wall layer portion 16 is connected with the wall layer portion illustrated in FIG. 7 and possesses a window element 20c and insulation element 20d. In order to cover the joints between the elements of the outer wall layer portion there are once again provided displaceable cover members.

The characteristic feature for the multi-layered outside building wall of the previously described type is that the wall elements 12 of the inner wall layer portion do not contact one another directly. The same is also preferably true for the elements of the outer wall layer portion 16. The separation joints between the wall elements of the wall layer portions can be optionally filled with a highly elastic or plastic material. It is also possible to bridge or close the joints with elastic, or as shown in the illustrated example, with rigid displaceable covering edges 54.

FIGS. 10–15 illustrate different types of connections of the outer wall layer portion 16 with the inner wall layer portion 14 while enclosing the insulating skin or membrane 18 therebetween.

Describing now more specifically FIG. 10, it will be recognized that for the purpose of retaining together the entire layer aggregation or complex of the outside build-
ing wall there is advantageously provided a suitable bolt member 64 which is piercingly inserted through a corresponding bore of the cover member 54, and which further penetrates the insulation skin 18 and is disposed between the frame members 19 of neighboring wall elements 12. The bolt member 64 which is constructed as a threaded bolt, for instance, is threaded into a flat metal portion 66 bearing from the inside against the legs of the frame members 19 of the wall elements 12. In order to space the cover member 54 and the flat metal portion 66 there is arranged therein between a spacer sleeve member 68 which is inserted through a suitable opening at the insulation layer 18. Instead of using the spacer sleeve 68, it is possible to equip the threaded bolt member 64 itself with a suitable shoulder or projection which, after tightening of the threaded bolt member 64, fixedly positioned at a certain distance the flat metal portion 66. By virtue of this arrangement there is insured that the insulation layer 18 is freely movable between the inner and outer wall layer portions 14 and 16, respectively. This type of spacer bolt member 64, as a general rule, does not absorb any vertical forces, rather serves only for preventing the misfiring of the outer wall layer portion 16 from the inner wall layer portion 14.

Now FIG. 11 shows the arrangement of the bolt member 64 as well as a further spacer bolt member 70 which, in the first instance, serves to absorb the vertical loads of the outer wall layer portions 16 prevailing from its own weight through the provision of suitable devices, such as, for instance adjustment screws 72, it is possible to undertake an adjustment of the outer wall layer portion 16 with respect to the inner wall layer portion 14. The connection between the outer and inner wall layer portions can also be undertaken in such a manner that at the regions where there is a sealing pressure between the outer and inner wall layer portions there is possible a clamping together of both wall layer portions.

FIGS. 12-14 depict different possibilities for sealing the bolt member 64 at the insulation layer 18. The requirements placed upon the bolt member 64 are likewise applicable in analogous manner for the spacer bolt members 70. According to the embodiment shown in FIG. 12 the insulation skin 18 possesses a suitable opening 74 having the diameter c which is considerably smaller than the diameter d of the bolt member 64. The material of the insulation skin member 18, because of its existing elasticity, enables a faultless spreading of the smaller opening 74 to the bolt cross-section d. The thus provided enclosing contact pressure seals the penetration point of the bolt members 64 through the insulation skin 18 against the penetration of moisture without requiring any additional measures.

FIG. 13 depicts, similar to FIG. 12, a penetration point which, in this instance, however, is constructed in such a way that the insulation skin remains freely movable. The throughpassage opening 74a provided at the insulation skin or membrane 18 is larger by the dimension e than the bolt diameter d. The insulation skin or membrane 18 is equipped at the region of the throughpassage opening of the bolt member 64a, preferably in vertical direction, and over the entire length of the layer with a continuous rib-like reinforcement 76. The throughpassage opening for the bolt member 64a is arranged at this reinforcement 76. A channel 78 extends to both sides of the throughpassage opening, this channel being sealed towards the throughpassage opening 74a by means of the sealing lips 80. Between these sealing lips 80 the bolt member 64a is equipped with a disc-like widened portion 82 extending into the channel 78 and directed substantially perpendicular to the lengthwise axis of the bolt member 64a. By virtue of this construction of the throughpassage location of the bolt member 64a through the insulation skin or membrane 18 a certain freedom of movement is therefore provided. On the other hand, the cooperation of the disc-like widened portion 82 of the bolt member 64a and the sealing lips 80 of the channel 78 insure for a sealing of one side of the insulation skin with respect to the other.

FIG. 14 illustrates a further variant of a throughpassage location of the bolt member 64 through the insulation skin or membrane 18. In this embodiment the insulation skin 18 is equipped with a rib-like reinforcement 84 at the region of the throughpassage location. This hoes-like reinforcement 84 advantageously extends in vertical direction over the entire length of the insulation skin 18. Consequently, this hoes-like reinforcement 84 can simultaneously be employed for the vertical stabilization of the insulation symbol membrane. The bolt member 64 itself is guided through the hoes-like reinforcement 84 of the insulation skin 18, so that there is provided a labyrinth-like seal between this bolt member 64 and such insulation skin.

FIG. 15 depicts a further embodiment of inventive apparatus 86 for connecting the outer wall layer portion 16 with the inner wall layer portion 14. FIG. 16 shows an angle piece 88 is mounted to the frame member 19 of a band element 12 of the inner wall layer portion 14. The free leg portion of the angle piece 88 is provided with an elongate hole or opening 90 through which there is guided a connection element 92 equipped with a barb or hook 94. This barb or hook 94 is directed to the outer wall layer portion 16, penetrates through the insulation skin or membrane 18 and engages with an elongate hole or opening 96 provided at the frame member 22 of the element 20 of the outer wall layer portion 16. By means of a suitable wedge 98, engaging with an appropriate elongate hole or opening 100 of the connection member 92, it is possible to draw the barb or hook 94 towards the angle piece 88, and therefore, to clamp the element 20 of the outer wall layer portion 16 to the inner wall layer portion 14. This wedge 98 can furthermore be constructed such that it is resilient, so that a uniform contact of both wall layer portions is achieved.

FIGS. 16 and 17 depict a further embodiment of multiple-layered outside building wall in analogous illustration to the embodiment of FIGS. 4 and 6. In the embodiment of FIGS. 16 and 17 the inner wall layer portion 14a is not continuous, rather subdivided or broken by components of the support construction of the building. The individual wall elements 12c rest upon portions of the support construction of the building. In the embodiment of FIG. 16 the wall elements 12c are supported at the lower end to the floor ceiling and at the upper end are secured to a heavy beam or girder 102. On the other hand, in the embodiment of FIG. 17 the support construction is equipped with a marginal support member 104 merging with the floor ceiling 10. The wall elements 12c, in this case, are secured to the marginal support 104 and can extend up to the lower side of the upper marginal support. However, it is also possible to support the wall elements 12c, at their upper ends laterally in a beam or girder 102. FIG. 17 shows an embodiment in FIG. 17 not as high requirements are placed upon the accuracy or exactness of the support construction, since the wall element has room for compensating for inaccuracies up to the underside of the marginal support 104.

The wall elements 12c can be either directly secured by means of their frame members 19 to the construction portion of the building support construction or can be thusly secured by further using a contact rail 106, as such will be more fully explained hereinafter. This embodiment not only provides the advantage that the attachment devices of the previously mentioned type can be dispensed with, rather it is also possible to secure at the building location the contact rails in such a way that the wall elements only have to be additionally inserted. Furthermore, the contact rails can be sealingly pressed against the relevant portion of the support construction, and therefore, provide a tight closure between the contact rail and the portion of the support construction. The
omission of the contact rail 106, that is to say, when directly mounting the frame 19 of the wall element 12 upon rails members of the support construction simplifies the construction of the support construction, yet, on the other hand, however, requires a larger expenditure during the mounting of the wall elements 12. It is to be decided from case to case which of both embodiments is more advantageous for the particular application under consideration.

The remaining components of the multi-layered outside building wall, that is to say, the insulation skin or layer 18 and the outer wall layer portion 16 can be constructed in the manner already heretofore described.

FIG. 18 illustrates in a manner similar to the illustration of the embodiment of FIG. 9, further details of the outer wall of the building of FIG. 17. The wall element 12c of the inner wall layer portion 14a bears upon the contact rail member 106 via an attachment device 24c, this contact rail member 106, in turn, being secured via ledges 108 to the marginal support means 104. These ledges 108 can be formed of elastic material in order, on the one hand, to compensate for unevenness and, on the other hand, for sealing the joints between the contact rail 106 and the marginal support means 104. The attachment device 24c is supported against the contact rail 106 through the agency of two angle members 110, of which one is secured to the contact rail 106 and the other to the other end of the attachment device 24c. The wall element 12b bears upon a roller body member 34a, the lengthwise axis of which extends parallel to the wall element. Both of the outer leg members of the frame 19 of the wall element 12c are supported via elastic spacer members 36 at the vertical shoulders or projections 38 of the support or holder member 32. The construction of the attachment device 24c renders it possible to displace, in the direction of the building support construction, the wall element 12c and therefore the multi-layered outside building wall. The roller body member 34a can be rotated through the angle α. This attachment device renders possible the transmission of horizontal as well as vertical forces from the wall element via the contact rails to the building structure. In so doing, it also particularly enables the outside building wall to perform expansion movements. In contrast to the attachment device 24c of FIG. 18, other more simplified connections between the frame 19 of the wall element 12c and the contact rails are possible. The construction of the multi-layered outside building wall is analogous to the previously described exemplary embodiments and therefore need not be repeated at this point.

FIG. 19 illustrates a further embodiment of a multi-layered outside building wall in which the wall elements 12c are supported at the floor ceiling 10 and secured to a beam or girder 102. Furthermore, in this embodiment of invention there is illustrated how the inner wall layer portion 14a is interrupted in vertical direction by supporting brackets 112 of the building support construction. Furthermore, attachment of the wall elements 12c to the vertical supporting brackets 112 can be achieved through the agency of contact rails 106.

In this embodiment the inner wall layer portion 14a is placed between the construction elements, that is to say, the beam or girder 102 and the supporting bracket 112, of the building support construction.

FIG. 19 depicts still a further especially advantageous embodiment of multi-layered outside building wall, wherein a cantilever support 114 extends laterally from the support construction of the building towards the outside, that is to say, in the present case extends from the girder or beam 102 towards the outside, and penetrates through the insulation skin or membrane 18 as well as the outer wall layer portion 16. Such cantilever supports 114 can be provided at different locations of the outside of the building and serve to accommodate different structural elements situated externally of the outside building wall. In the instant embodiment covering plate members 116 are secured to the cantilever support 114. Furthermore, balconies can be arranged in this manner at buildings equipped with multi-layered outside building walls of the aforementioned type. Furthermore, concrete embedded members, not shown in the drawing, can extend out of the throughpassage point at the cantilever beam 114, which then can be welded with the insulation skin or membrane 18. As a result, the penetration location of the cantilever beam 114 at the insulation skin 18 can be completely sealed. By utilizing this construction principle it is also possible to arrange the supporting elements of the building support construction externally of the facade of the building. In this instance the cantilever support would be a support member which penetrates through the insulation skin 18 and the outer wall layer portion and leads up to the carrier support.

Moreover, the multi-layered outside building wall can also be used at such structures which possess a facade projection or the like. In this case the cantilever skin 18 and the outer wall layer portions 16 can be guided about such facade projection.

FIG. 20 illustrates the arrangement of heating tubes or pipes 118 and heating plate members 120 in the wall element 12c of the inner wall layer portion 14. The heating plates 120 are situated at the region of the window elements 20c of the outer wall layer portion 16. The heating tubes or pipes 118, on the other hand, are arranged in the hollow space or compartment formed by the frame members 19 and the contact rail 106. The warm air flows upwardly through an opening 122 at the region of the window element 20c and, furthermore, flows through a further opening 124 at the upper frame portion until it escapes out of the wall element. The remaining structure of this embodiment corresponds to the already heretofore described exemplary embodiments.

FIG. 21 illustrates a further embodiment of a heating device for the inner wall layer portion 14 of the multi-layered outside building wall. There are illustrated the vertical components of the frame member 19 of two neighboring wall elements 12c. In the illustrated exemplary embodiment, the frame members which, in cross section, are of substantially U-shaped configuration, are interconnected with respect to the previously illustrated exemplary embodiments. It is to say, the heating tube is directed towards the inner space of the wall element 12c. This arrangement is especially advantageous since here the heating pipes 118 can be used as radiation pipes which transmit their heat over the entire height of the windows to the window region. It is also possible to have the tubes conduct hot air and to blow such laterally into the interior of the wall element 12c.

If the wall element of the inner wall layer portion is, for instance, equipped with a window railing or a parapet, then it is especially advantageous if the heating pipes are situated at the region of such railing and if such possess upwardly directed slot means through which the hot air can flow to the window region of a window element of the outer wall layer portion. If desired, it is advantageous to provide, instead of only a single heating tube operated with warm water, additionally an electrical heating plate at the wall element. The construction of a good and effective heating system in the outside building wall is of significance since the relative moisture content of the air is continuously increased for a number of reasons by the climatization in the building and therefore difficult condensation problems occur at the region of the windows. Since the coefficient of heat transmission is subjected to technological limits by the construction of the window panes, which do not prevent formation of condensation, it is necessary to resort for additional help upon a further heating unit. It is also necessary to withdraw any condensation which has formed out of the multi-layered outside building wall. To this end there can be provided suitable collecting troughs at appropriate locations.
The wall element of the inner wall layer portion can be constructed in such a fashion that it serves as a heat storage means. To this end it is advantageous to fill the frame means 19 with a material possessing a large heat storage capacity. As a result, in connection with an electrical heating unit it is possible to provide a heating system wherein, for instance, by using inexpensive evening current the wall element can be heated during the nighttime and during the daytime its stored heat can be delivered to the space or room.

Furthermore, the outer wall layer portion can be constructed in such a fashion that externally situated, lowerable sun louvers or shutters can be mounted which serve as protection against the sun.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims. Accordingly, what is claimed is:

1. In combination with a building or the like a multi-layered outside wall construction for said building, comprising an outer wall layer portion, an inner wall layer portion, a plastic barrier membrane disposed between said outer and inner wall layer portions, said barrier membrane being formed of an elastically elongatable, water-impermeable tear-resistant material possessing thermally and acoustically insulating properties, said membrane being covered by means of said outer wall layer portion and said inner wall layer portion but yet free to move independently of said inner and outer wall layers, said barrier membrane possessing substantially fewer interruptions defining separation joints relative to said inner and outer wall layer portions, said inner wall layer portion being composed of a plurality of laterally arranged substantially quadrangular wall elements which are freely spaced from one another, the spaces between said adjacent spaced wall elements of said inner wall layer portion defining respective compartments which are hollow throughout the total thickness of the inner wall layer portion, said hollow compartments remaining unfilled and at most receiving attachment devices for securing the wall construction.

2. A multi-layered outside wall construction for a building or the like as defined in claim 1, wherein said wall elements are horizontally spaced from one another.

3. A multi-layered outside wall construction for a building or the like as defined in claim 1, wherein said wall elements are vertically spaced from one another.

4. A multi-layered outside wall construction for a building or the like as defined in claim 1, wherein said wall elements are vertically spaced from one another.

5. A multi-layered outside wall construction for a building or the like as defined in claim 1, wherein said wall elements are horizontally spaced from one another.

6. A multi-layered outside wall construction for a building or the like as defined in claim 1, wherein at least the largest part of the horizontal spacing of the wall elements and at least the largest part of the vertical spacing of said wall elements of said inner wall layer portion are substantially equal to one another.

7. A multi-layered outside wall construction for a building or the like as defined in claim 1, further including means for moving said wall elements so as to be laterally movable with respect to one another.

8. A multi-layered outside wall construction for a building or the like as defined in claim 1, further including heating means arranged at said wall elements so as to be laterally movable with respect to one another.

9. A multi-layered outside wall construction for a building or the like as defined in claim 1, wherein the building possesses a support construction formed of structural components, said inner wall layer portion being arranged between said structural components of said building support construction.

10. A multi-layered outside wall construction for a building or the like as defined in claim 1, further including attachment means for suspending said wall elements of said inner wall layer portion.

11. A multi-layered outside wall construction for a building or the like as defined in claim 10, wherein said wall elements of said inner wall layer portion are suspended at said attachment means through an agency of roller body means.

12. A multi-layered outside wall construction for a building or the like as defined in claim 9, further including roller body means for supporting said wall elements of said inner wall layer portion.

13. A multi-layered outside wall construction for a building or the like as defined in claim 12, further including contact rail means arranged at said structural components of said building support construction and serving to support the wall elements arranged between said structural components of said building support construction.

14. A multi-layered outside wall construction for a building or the like as defined in claim 1, further including elastic spacer means for supporting said wall elements against forces acting transverse to the outside wall construction of the building.

15. A multi-layered outside wall construction for a building or the like as defined in claim 1, further including means for interconnecting said inner wall layer portion with said outer wall layer portion, said connecting means comprising bolt means penetrating through said insulation skin, and spacer means for retaining both of said wall layer portions at said distance from one another that said insulation skin is movably retained therebetween.

16. A multi-layered outside wall construction for a building or the like as defined in claim 1, further including means for interconnecting said outer wall layer portion, said outer wall layer portion being provided with an opening, said connecting means comprising a connecting element having a hooked member engaging with said opening of said outer wall layer portion, and wedge means cooperating with said connecting element for biasing said connecting element against said counter support.

17. A multi-layered outside wall construction for a building or the like as defined in claim 1, wherein each of said wall elements of said inner wall layer portion comprises frame means formed of a profiled material.

18. A multi-layered outside wall construction for a building or the like as defined in claim 17, wherein said profiled material possesses a substantially U-shaped cross section with the open side of said profile material being disposed along the end face of the associated wall element.

19. A multi-layered outside wall construction for a building or the like as defined in claim 17, further including heating means provided for said wall elements of said inner wall layer portion.

20. A multi-layered outside wall construction for a building or the like as defined in claim 19, wherein said frame means of each wall element comprises a horizontal portion, heating means arranged at said horizontal portion of said frame means, each of said wall elements being provided with an opening and said frame means being provided with an opening, whereby warmed air can move through said opening of each said wall element into the interior thereof and can escape through said opening of said frame means.

21. A multi-layered outside wall construction for a building or the like as defined in claim 19, wherein said
frame means of each wall element comprises a vertical side portion, vertical heating means arranged at said vertical side portion and which laterally deliver heat to the interior of said wall element.

22. A multi-layered outside wall construction for a building or the like as defined in claim 21, wherein the building possesses a building support construction having components arranged between said wall elements, a cantilever support arranged at least at one component of said building support construction, said cantilever support penetrating through said insulation skin and said outer wall layer portion and serving for the attachment of structural components situated externally of the outside wall construction of the building.

23. A multi-layered outside wall construction for a building or the like as defined in claim 22, wherein said cantilever support is provided with insulation skin components coupled with said insulation skin arranged between said inner wall layer portion and said outer wall layer portion.