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ROOFING

Filed August 29, 1925

Fig. 1

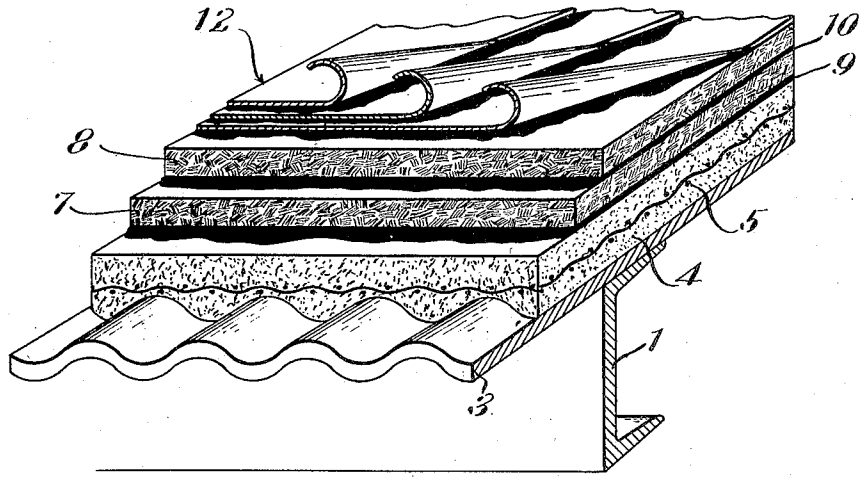
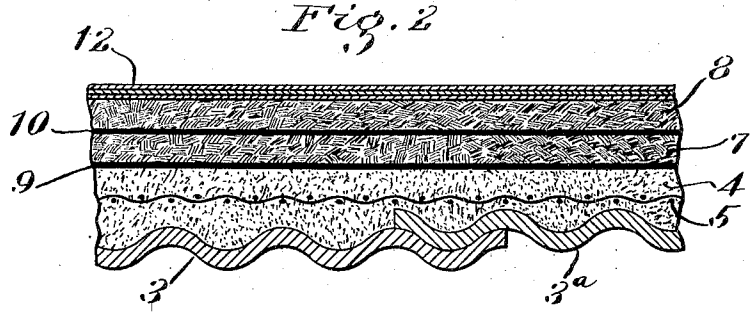



Fig. 2



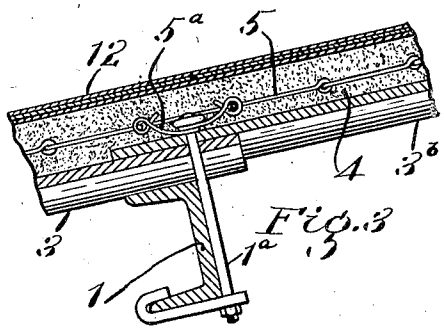




Fig. 3

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# UNITED STATES PATENT OFFICE.

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## ROOFING.

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An object of this invention is to provide a roofing adapted to miscellaneous manufacturing buildings, particularly such as are subjected to the destructive effects of moisture, acid vapors, or other corrosive agents. Locomotive round-houses, bleacheries, chemical works, paper mills, may be mentioned as examples. Another object is to provide a roofing which will produce a minimum of water-condensation on its inner surfaces, and thus eliminate as far as possible dripping from the roof upon machinery or goods within the building.

A roof, whatever be the character of its covering, requires a framework of some kind, and another object of this invention is to construct a covering which, while possessing the qualities favorable to the attainment of the previously mentioned objects, will be inherently stiff and strong, and capable of sustaining itself over large spans and areas between frame-supports, so that the spacing of roof frame members may be large, and the number of such members reduced. By this means the labor and expense of keeping the frame members protected, as by paints or cements, will be materially reduced. When, as in many cases, the frame members are of structural steel, reduction of their number will also minimize the inevitable condensation and dripping of moisture on and from such frame members.

To these ends, the roofing slab or sheet, according to our invention, comprises strata of materials which are all low conductors of heat (except for a reinforcement of metal which may be incorporated in one or more of the strata and thence be itself insulated from exterior sources of either heat or cold); one of these strata being of material inherently stronger than that of the others, and preferably corrugated or chorded to increase its stiffness and carrying capacity. The outer and inner exposed strata of the roofing are, moreover, composed of fire-proof or fire-resistant materials. That on the outer surface need be, for practically all situations, fire-resistant only; a laminated built-up sheet roofing of asbestos paper and asphalt will serve quite competently. The inner stratum, liable to be exposed to fire within the building, should be so refractory as to be classed with truly fire-proof material.

Except for the undermost supporting sheets, which are secured to the roof-frame in the usual manner, this roofing will be constructed on the building, in such manner that from the supporting sheets to the upper surface exposed to the weather, it will, when completed, be unitary and continuous over the whole area of the roof or roof-section.

In the drawings hereto annexed, which illustrate the invention,

Fig. 1 shows a roofing structure in perspective partly in section;

Fig. 2 shows, in section, a portion of the roofing at a joint when the supporting sheets are lapped, and

Fig. 3 shows a detail, in section, illustrating a mode of anchorage of the metal-reinforced layer of roofing.

The fundamental, load-supporting, part of the roofing comprises the corrugated sheet 3, composed of a non-metallic hard, mechanically strong, acid resisting, relatively low-conducting, and fire-proof material, such as a dense compressed concrete of asbestos fibres and cement. The article commercially known as "corrugated transite" is an example of material of this desired character, which, being produced by compressive formation from a concrete mixture, is structurally homogeneous or monolithic, and free from laminations, which would be liable to become receptacles for moisture. This kind of material may and preferably will be impregnated with a saturant which in itself is resistant to the vapors or gases which will, in the expected use of the building to be roofed, come into contact with the corrugated sheet. A hard, relatively heat-refractory, asphaltic material, such as gilsonite, will prove effective for this purpose. It should be noted that the sheet 3 unless made thoroughly resistant to water-penetration, should not comprise any metal reinforcement in its concrete body, for the reason that corrosion of such reinforcement, in such a concrete body disrupts it by local swelling of the formed oxide of the metal, produces receptacles for the lodgment of water, and thus invites further disintegration by frost action.

It will be found desirable to prepare the corrugated sheets, after they are laid and secured, by coating them liberally with a tacky, cementitious, water-resistant asphalt,

which seals the joints and laps, furnishes a protection against seepage of condensed moisture through the joints from the under side of the roofing, and provides an adhesive surface on which to deposit the porous and heat-insulating stratum, presently to be described.

The corrugated sheets 3 are laid upon and secured to the roof-frame, which may comprise rafters and stringers of structural steel, as indicated at 1, Fig. 1, these members being preferably spaced so as to utilize to the utmost practicable degree the load-carrying strength of the corrugated sheets themselves, with a reasonable factor of safety.

Corrugated sheets of this character may, in view of the weather protective character of the strata of materials to be laid upon it in the construction of this improved roofing, be laid on and fastened to the roof-frame without laps, but this is not to be recommended, since lapping the corrugated sheets, both at longitudinal and transverse joints, in the usual manner eliminates seams and gaps in the corrugated foundation which would be inevitable if the attempt were made to lay them in abutted relation.

The corrugated surfaces of the sheets 3 and the shoulders and edges where they are lapped, produce a base ill adapted to the reception of ready made weather-proof sheeting or sheet materials of a non-conductive character, such as felt, and therefore a stratum 4 of plastic cellular low conductive material, as for instance, and preferably, a concrete of gypsum, sawdust, and water, is molded upon the sheets 3, and smoothed to a continuous flat surface. The inclusion of sawdust makes the plastic layer light in weight and also cellular—therefore non-conductive of heat; gypsum itself, as is well known, may be rendered cellular and harden in that condition, and may thus supplement the cellular character of the included sawdust. If desired, some rigidity may be supplied in this plastic stratum as by incorporating in it a wire mesh reinforcement 5. This wire mesh reinforcement affords means for securely anchoring the stratum 4, and any strata superposed on it, in the manner illustrated in Fig. 3, where a section of sloping roof is shown, with a holding-down bolt $1^a$ which passes through two sections 3 and $3^b$ of the corrugated supporting sheets, and is headed or nut-fastened at the upper surface of the covering lap. The wire mesh-reinforce 5 having been laid in place, tie wires $5^a$, secured to the bolts (as $1^a$ are twisted into wires of the mesh-reinforce. Thus the material of the layer 4, while plastic, is poured through the mesh 5 and smoothed to a plane surface on top, thus embedding the mesh, which, when the plastic has set, being tied at frequent intervals to the holding-down bolts, anchors the layer 4 and prevents any creeping or slippage. The required properties for this plastic layer are porosity, and therefore light weight and low heat-conductivity; when molded in place its upper surface is made plane and substantially smooth, while its lower surface fills and accommodates itself to all the corrugations of the rigid, strong sheet 3, and to the irregularities caused by lapping edges.

Thus, although the foundation layer of the roofing consists of individual, assembled corrugated sheets, the covering layer 4 may and preferably will be, when hardened in place, substantially monolithic over the entire roof.

These two members, when cementitiously joined, form a roofing which requires only a waterproof covering layer. The supporting, corrugated sheet 3, though a better heat insulator than corrugated metal, is not so efficient in this respect as the superposed layer of plastic, porous material; but, by reason of its rigidity, strength, and structurally stiff configuration, it supplies the capacity to span large distances from one roof-frame member (such as the structural steel purlin 1) to the next. It is, moreover, quite retentive of condensed moisture, so that it will hold without dripping, much more condensation than metal or even wood material.

The porous heat insulating stratum 4, having a plane upper surface, is well adapted to serve as the basis on which to lay sheets of weather-proof roofing material, such as asphalt impregnated asbestos paper laid in hot asphalt. Such weather-proofing may be laid directly on the porous stratum 4, if a practicable thickness of the latter supplies all the heat-insulation the situation requires. If further heat insulation be desired, this may be provided by laying one or more strata (as 7, 8) of porous, light weight, felted insulating material, such as for instance compressed bagasse-felt, which should be laid in an adhesive waterproof cementing material (9, 10) of which asphalt is a good example. If desired, such felt layers can be further secured to the underlying molded layer 4 by pins, nails, or staples, as 13 (Fig. 2) driven into the layer 4.

The outer weather-proof stratum 12 is preferably a composite sheet of fibrous, preferably fire-proof, material, like asbestos paper, and asphalt; built-up sheet roofing of this character is too well known to require detailed description.

A roof covering made as above described, and presenting in its irreducible essentials a foundation portion comprising a supporting sheet of refractory, moisture-proof, structurally chorded dense material, surmounted

by a plastic, porous, heat insulating layer molded to the supporting sheet and presenting a plane upper surface, and having a fire-resistant weather-exposed sheathing, provides, in and by the covering itself. a roofing which, consistently with being fire-resistant, heat-insulating, moisture and vapor-proof or resistant, affords a maximum of self-sustaining roof covering and a corresponding minimum of indispensable roof-framework. It furnishes a roofing-specification adapted to serve in a large variety of situations without more variation than may be involved in the addition of more or less heat insulating material, such as bagasse-felt sheeting upon the heat insulating plastic layer comprised in the foundation portion. The employment of such light weight heat insulating layers, as at 7 and 8, which are in themselves not classifiable as fire-proof or fire-resistant materials, does not detract from the fire-resistant quality of the composite roof-covering as a whole, since they are included between and protected by the fire-resistant or fire-proof foundation portion and weather-proofing portion. Sheets such as 7 and 8 are moreover elastic, and furnish a cushioning protection for the more friable and vulnerable plastic stratum 4.

Metal fastenings such as $1^a$ (Fig. 3) or 13 (Fig. 2) do not pass through the composite roofing, and thus can not serve as conductors of heat from one side of the roofing to the other. For instance, in very cold weather, a metal through-fastener is liable to conduct heat from the interior rapidly enough to congeal deposited moisture and form icicles; the insulation of the embedded head of a fastening bolt, such as $1^a$ suffices to prevent such an occurrence.

We claim:

1. Composite roofing material, comprising assembled foundation sheets of corrugated compressed asbestos-cement concrete, a heat insulating layer of porous plastic material molded to and completely covering the assemblage of corrugated sheets and substantially plane on its upper surface, and asphalt-laid felted weatherproofing over said heat-insulating layer.

2. Composite roofing material, comprising assembled foundation sheets of corrugated compressed asbestos-cement concrete, a cellular heat-insulating layer comprising gypsum molded to and completely covering the assemblage of the corrugated sheets and substantially plane on its upper surface, and asphalt-laid felted weatherproofing over said heat-insulating layer.

3. Composite roofing material comprising assembled foundation sheets of corrugated compressed asbestos-cement concrete saturated with a water-resistant impregnant, a cellular heat-insulating layer comprising gypsum molded to and completely covering the assemblage of the corrugated sheets and substantially plane on its upper surface, and asphalt-laid felted weather-proofing over said insulating layer.

Signed by us at New York this 24th day of August 1925.

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