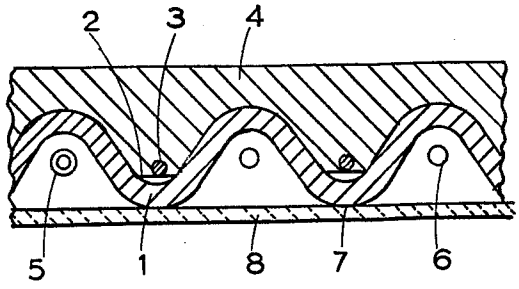
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MASSIVE REINFORCED CONCRETE FLOOR AND CEILING STRUCTURES

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# MASSIVE REINFORCED CONCRETE FLOOR AND CEILING STRUCTURES

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This invention relates to an improved massive reinforced concrete floor and ceiling structure.

It is known to make massive reinforced concrete floor and ceiling structures with a shuttering of light weight sheet material which is laid on the shuttering supports and when the concrete of the structure is set serves as a statically effective constructional element of the lower surface of the floor to which the plaster carrier is applied. It is known to make a shuttering of this kind of light weight bonded fibre sheet material, more particularly of sheets of pressed wood wool and cement. It has also been proposed to press suitably spaced strip-shaped depressions in the upper surface while pressing the remaining rib-like raised portions to a lesser extent so as to compensate for expansion and shrinkage during the uniting with the concrete. Finally it has also been proposed to form narrow grooves on the lower surface of such sheet material, offset with respect to the depressions in the upper side, so as to improve the adhesion of the plaster.

Provisions for fixing heating and ventilating tubes in contact with such known sheets of building materials and fixing rows of tubes between and in contact with two plane sheets of building material have also been suggested.

It is an object of the invention to provide a massive reinforced concrete floor and ceiling structure cast upon shuttering of light weight bonded fibre sheet material with the pipes of a ceiling radiant heating system or ventilative system, without any substantial increase in the thickness of the total structure over the dimensions determined by static requirements.

This object could readily be achieved by embedding the pipes of a radiant heating system in the massive reinforced concrete floor. It is known, however, that floors of this kind show a great heat inertia effect during the heating up and cooling down period and that the radiation in a downward direction is inefficient while considerable heat losses occur in an upward direction. These disadvantages can be overcome in a ceiling heating system in which sheet metal strips are arranged beneath the finished massive floor to form a substantial insulating air interspace. The sheet metal strips are heated directly by the heating pipes running through this air space and serve also to support the plaster carrier. This ceiling heating system is much more efficient thermally but entails a considerable increase in the thickness of the total floor and ceiling structure and thus reduces the height of the rooms.

According to the invention it is possible to retain the thermal advantages of the last mentioned radiant heating system while keeping the thickness of the floor and ceiling structure at the minimum value determined only by the current static requirements. For this purpose the light weight sheet material forming the shuttering is formed according to the invention with a lower surface which undulates in cross section in preferably regular waves, so that the ceiling lining, for example the plaster carrier, positioned beneath the shuttering defines a series of spaces within the waves extending longitudinally between the shuttering and the ceiling lining, and the pipes of a ceiling heating system and/or ventilating system extend longitudinally through these spaces.



Preferably the upper surface of the light weight sheet material is also corrugated in regular waves, so that the cross section of the material as a whole has the profile of a sine curve. The heating or ventilating pipes, referred to comprehensively herein and in the appended claims as "air conditioning pipes," which are linked up by cross pipes to form the total system, thus require no additional space for their accommodation within the floor and ceiling structure. Moreover, the air spaces formed within the waves pressed in the lower surface of the light weight sheets are large enough to ensure adequate air insulation of the pipes against any substantial loss of heat in an upward direction, whilst the efficiency of the downward radiation through the thin ceiling lining is good. The uniform wave profile of the light weight sheets is statically favourable, because no unduly large marginal stresses arise and compressional forces are taken up satisfactorily, because the ribs merge gradually into the other parts of the floor structure. Thus it is possible to make the floor and ceiling structure of a small thickness, which is not increased by the accommodation of the heating or ventilating pipes.

Preferably the pipes in the troughs of the waves in the lower surface of the light weight sheets are disposed at substantially the same height as the steel reinforcing elements disposed in the troughs of the waves in the upper surface of the light weight sheets. The cross-pipes joining the individual pipes can be arranged to run transversely of the waves and to be supported on the reinforcing elements, so that separate hangers are not required. The use of regularly corrugated light weight sheet results in a saving of steel of about 19% compared to an all-concrete floor and the saving in concrete is about 36%.

The annexed drawing shows a cross section through one embodiment of a floor and ceiling structure in accordance with the invention.

The corrugated light weight sheet 1 employed according to the invention is made in a suitable size of, for example, a pressed body of cement-bound wood wool or similar fibrous material and is supported in the manner conventional for shuttering on the outer walls and/or separate supports and/or intermediate walls. Suitably spaced transverse webs or lugs 2 are provided in the wave troughs. The steel ribs 3 or other reinforcing elements are laid on these webs. The concrete 4 is thus cast in conventional manner. When the concrete has set the light weight sheet 1 forms a load carrying component part of the floor; the load bearing properties of the sheet suffices to support the load of the concrete or other erection loads prior to the setting of the concrete.

Heating pipes 5 for a ceiling heating system or pipes 6 for a hot air heating system or for ventilating or changing the air of the associated spaces, with or without a supplementary insulation, are disposed in the troughs of the waves of the lower surface of the sheet. A conventional plaster carrier 8 is secured directly to the lower wave crests 7. As may be seen, the installation of the pipes and the application of the plaster carrier entails no difficulties and provides very favourable conditions for a ceiling radiant heating system or hot air heating system or other air exchange system mounted in the ceiling, without increasing the constructional height of the floor and ceiling structure.

What we claim is:

1. A massive reinforced concrete floor and ceiling structure, comprising a reinforced concrete floor cast upon a shuttering of light-weight, bonded fibre sheet material, said shuttering having a lower surface which undulates in cross section in waves, a ceiling lining positioned beneath said shuttering having only linear

contact with said waves and defining a series of spaces within said waves extending longitudinally between said shuttering and said ceiling lining, and air-conditioning pipes extending longitudinally through said spaces, the height of said spaces being higher than the outside diameter of said air-conditioning pipes which are positioned in such a manner, that no contact between the pipes and the wave-like shuttering and between the pipes and the ceiling lining is effected.

2. A ceiling structure according to claim 1, wherein said shuttering consists of sheets of pressed wood wool and cement.

3. A massive reinforced concrete floor and ceiling structure, comprising a reinforced concrete floor cast upon a shuttering of light-weight, bonded fibre sheet material, said shuttering being corrugated in cross-section in regular waves, reinforcing elements extending longitudinally through the concrete within the troughs of the waves in the upper surface of the shuttering, a ceiling lining positioned beneath said shuttering and defining a series of spaces within the waves in the lower surface of the shuttering extending longitudinally between said shuttering and said ceiling lining, and air-conditioning pipes extending longitudinally through said spaces at substantially the same height as said reinforcing elements.



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