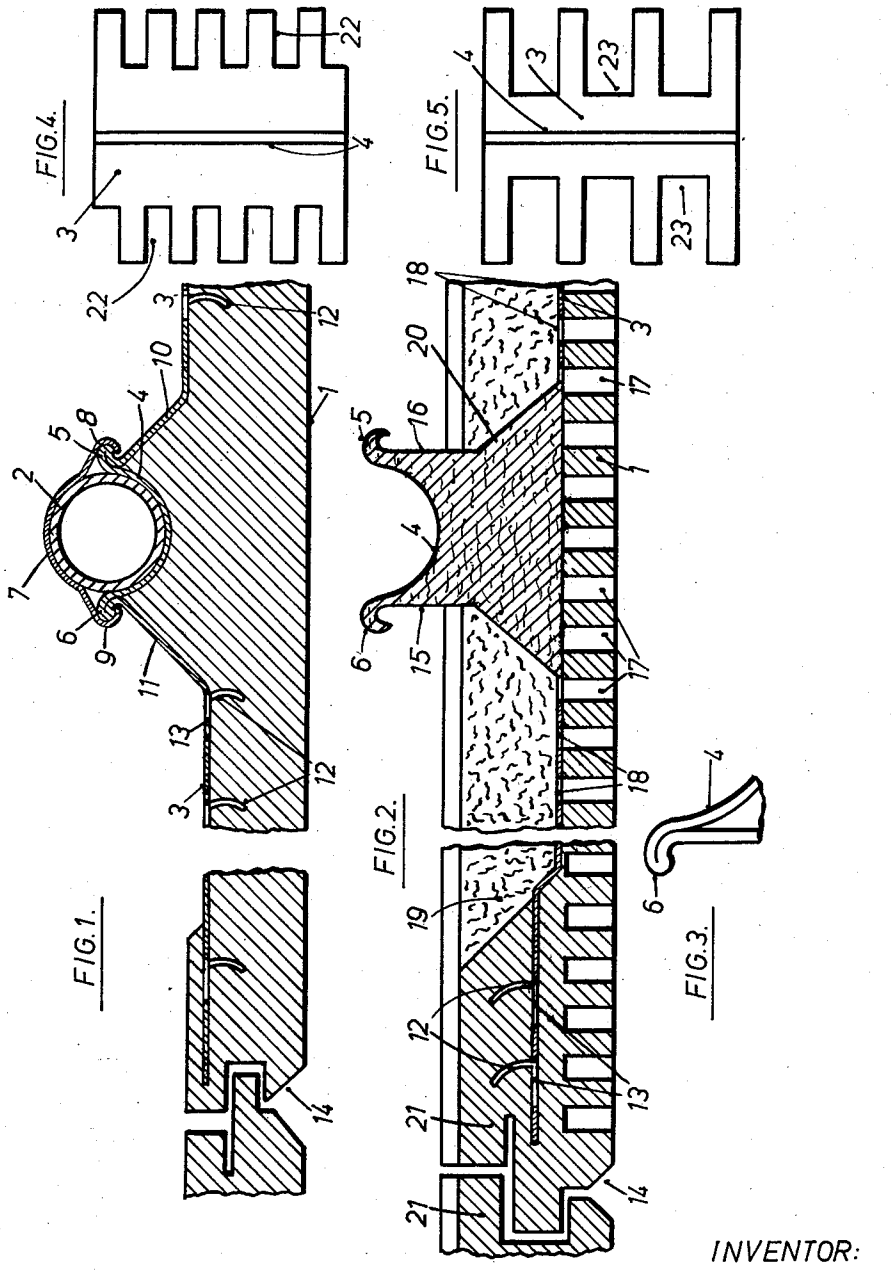
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STRUCTURAL ELEMENT FOR HEATING OR COOLING ARRANGEMENTS IN BUILDINGS

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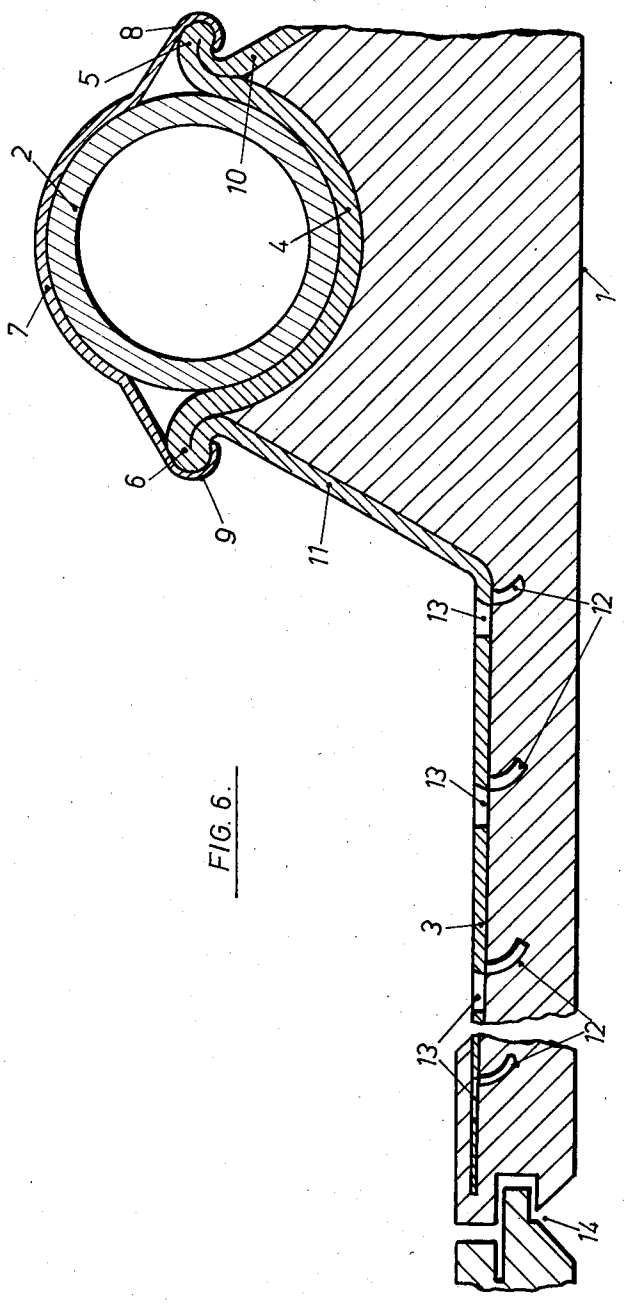


FIG. 6.



FIG. 7.

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STRUCTURAL ELEMENT FOR HEATING OR COOLING ARRANGEMENTS IN BUILDINGS

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This invention relates to heating or cooling arrangements in buildings.

According to the present invention there is provided a structural element for heating or cooling arrangements in buildings with heating or cooling tubes which are laid under a surface layer, for example, under plaster and which are connected in a heat-conducting manner with heat-conducting elements, for example, sheet metal plates, disposed between the tubes and the surface layer and distributing the heat, characterised by the combination of a flat heat-conducting element and a surface layer, for example, of plaster, synthetic material or other building material, designed to form a surface of the structure in order to provide a structural plate forming a finished building part to be laid as a unit and adjoining at least one heat-conducting tube.

The flat heat-conducting element preferably consists of sheet metal and is expediently so fashioned that at the place facing the tube, it forms a channel surrounding the tube over a part of its periphery and adapted to the external diameter of the said tube, the side edges of said channel each comprising an outwardly projecting fold, and that the said channel has associated with it a holder which engages around the remainder of the periphery of the tube and which is provided on both sides with edges engaging under the channel folds and is thereby adapted to hold the channels bearing closely on the tube.

By this means, it is readily possible to obviate the difficulties existing with the former heating or cooling arrangements of connecting the heat-conducting plates with the tubes to the extent sufficient for the predetermined heat flow, since the channels are in one piece with the other parts of the heat-conducting plates and consequently the heat flow at the transfer points of these channels into the other parts of the heat-conducting plates is not prevented by any kind of resistance, such as can occur at the point of connection with plates consisting of different parts, according to the manner in which this point of connection is obtained.

A further development of the invention has for its object to provide a better utilisation of the heat conductivity of the heat-conducting surface of such heating or cooling arrangements, and achieves this object by the fact that the heat-conducting plates have a thickness decreasing towards both sides from the central portion bearing on a tube. In the ideal case, the decrease in thickness of the heat-conducting plates can be such that the heat flow density is at least substantially constant at all parts of the heat-conducting plates. By this dimensioning of the heat-conducting plates, the material at all parts of the plates is utilised to the optimum degree for conducting heat, taking into account the predetermined successive heat delivery from the conducting plates from the middle towards the side edges. Consequently, it is possible to effect a saving in sheet material and, accordingly, also in weight as compared with heat-conducting plates having the same overall thickness. The saving in sheet material is of considerable importance when a comparatively expensive material is employed, such as is the case, for example, when copper is used. However, as is known, copper has a very high coefficient of thermal conductivity and consequently is particularly suitable for heat-conducting plates which are laid under plaster, having regard to the fact that in such cases, for preventing the formation of water of condensation, the temperature difference between the tubes and the temperature of the room to be conditioned is to be as small as possible. The higher the coefficient of thermal conductivity of the material employed for the heat-conducting plates, the better this effect can be attained. Consequently, owing to the saving in material capable of being attained by the dimensioning of the heat-conducting plates as set forth, it is possible to make a heat-conducting plate of comparatively expensive material without having to allow for a correspondingly large increase in costs. The saving in weight produced at the same time with the dimensioning of the sheet is also very desirable in practice, so that in both respects, a very desirable improvement as compared with the former position can be achieved by the dimensioning of the heat-conducting plates as set forth.

An additional saving in material for the heat-conducting plates can also be attained in certain circumstances by the fact that only one part of a unitary plastered surface is provided with heat-conducting plates and the other part is constructed without heat-conducting plates. It has been shown that, in practice, the prescribed supply and dissipation of heat can usually be achieved without the total available surface, for example, the ceiling of a room, being fitted with heat-conducting plates. In order to take this circumstance into account, the individual heat-conducting plates can be provided with cut-outs or recesses for the prescribed dimensioning of the total heat-conducting surface. In such cases, however, the consumption of material for the heat-conducting plates is by no means reduced to such an extent as that which can be achieved if only a part of the plastered surface is provided with heat-conducting plates, which altogether are able to supply or dissipate the same heat quantity and therefore altogether produce the same total heat-conducting surface as in the first case.

If the plaster is arranged on slabs which adjoin one another, each with a cemented joint on the plaster side, it is expedient to provide only some of these slabs with one heat-conducting plate each, and to construct the other slabs without heat-conducting plates, the slabs in other respects being of the same dimensions so that one type of slab or the other can be placed side by side according to requirements.

Several embodiments of the invention are shown in the accompanying drawings in which:

Figures 1, 2 and 6 each show a ceiling construction in vertical section,

Figure 3 is an end view to a larger scale of a channel fold in connection therewith,

Figures 4 and 5 each show, in plan view and to a smaller scale, a different form of heat-conducting plate.

Figure 7 is a cross-sectional view to a smaller scale of a rolled plate from which the heat-conducting plates of Figure 6 are produced.

The embodiment illustrated in Figure 1 presupposes a ceiling construction in which a series of spaced parallel tubes or pipes are arranged in the usual manner under the plaster, only one tube or pipe 2 being shown in the drawing. These tubes can be directly incorporated in a piping system through which a liquid or gaseous medium flows in a closed cycle, the said medium serving as heat carrier, such as for example hot water or cool water, according to whether it is desired to effect a heating during the cold season of the year or a cooling action during the hot season of the year.

For the uniform transfer of heat over the entire ceiling surface, the tubes and the plaster 1 have arranged between them heat-conducting plates 3 which are connected in heat-conducting fashion with the tubes 2 by the fact that, as will be seen from Figure 1 in relation to the tube 2, the heat-conducting plates at the places facing the tubes each form a channel 4 embracing the tube over a part of its periphery, the said channel being conformed to the external radius of the tube 2 and the side edges thereof each comprising an outwardly projecting fold 5 or 6. As indicated in Figure 3 in connection with the fold 6, the folds are fashioned by firmly pressing together the sheet metal parts forming the fold in such manner that these sheet metal parts contact one another over a comparatively large area and the folds project outwardly in a substantially horizontal direction.

As shown in Figure 1, each channel 4 has associated with it a holder or clip 7 which is also made channel-shaped with a curvature conformed to the external radius of the tube and which engages around the remaining periphery of the tube. The said clip is also provided at both sides with inwardly bent edges 8 and 9 which are hook-shaped in cross-section and which engage under the channel folds 5 and 6, respectively. The clip 7 is of resilient sheet metal and is of such dimensions that, when it is resting on the upper side of the tube, it exerts by means of the edges 8 and 9 a sufficient pressure on the folds 5 and 6 in order to maintain the channel 4 in a position bearing fully on the tube 2. By this means, there is assured a reliable heat transfer from the wall of the tube 2 to the heat-conducting plate 3.

As will be seen from Figure 1, the heat-conducting plate 3 is so bent upwardly in the region of the tube 2 that it forms a hollow support with sloping lateral flanks 10 and 11 and a ridge formed by the channel 4. The heat-conducting plate 3 is further provided with securing tongues 12 which are stamped or struck, except for a base, out of the plate 3 and are bent downwardly to serve as a key or anchoring for the plaster layer 1. The slot 13 formed in the heat-conducting plate by the bending down of the tongues 12 also contribute to the better adhesion of the plaster to the plate.

As will be seen from the left-hand side of Figure 1, the ceiling plasterwork is subdivided into separate slabs which adjoin one another with formation of a joint and are fixed separately in known manner (not shown) to a part of the ceiling construction by suspension. The joints 14 are subsequently closed on the plaster side by means of an elastically yieldable cement. Such a plaster slab has embedded therein respective extremities of one heat-conducting plate 3, so that the plaster slab and the heat-conducting plate form a unit (Fig. 1).

The assembly is as follows: with the clip 7 removed and the tubes or pipes firmly laid, the slabs are brought separately and in succession from below into the prescribed position, adjacent slabs being pushed into the respective groves and the channel 4 of the heat-conducting plate of each slab being firmly pressed on to the underside of the corresponding tube 2. The clip 7 is then pushed from the end over the tube 2, bearing axially of the tube against the associated channel 4, the edges 8 and 9 being pressed down slightly so that they engage under the corresponding folds 5 and 6 of the channel 4. It is then sufficient to push the clip 7 forward with a suitable axial pressure over the full length of the folds 5 and 6 of the respective heat-conducting plate in order to assure that the channel 4 bears completely on the tube 2 over its entire length.

For the sake of simplicity, the tube and the clip are omitted in the embodiment according to Figure 2. These parts may be provided in the same form as that shown in Figure 1. Once again, there is shown the conducting plate 3 which, at the place facing the tube (not shown), forms a channel 4 adapted to the external diameter of the tube and surrounding the latter over a part of its

periphery, the side edges of said channel each comprising an outwardly projecting fold 5 or 6. Moreover, the heat-conducting plate 3 again forms a hollow support in the region of the tube (not shown), the ridge of said support being formed by the channel 4. In contrast to the embodiment according to Figure 1, the flanks 15 and 16 of the hollow support only slope at their lower portions, whereas the upper portions thereof are arranged vertically, this being mainly due to the fact that the hollow support is of a comparatively large height. This larger structural height is provided in order to adapt it to known plaster slabs having a sound-damping material arranged above the plaster. As will be seen in Figure 2, the ceiling plaster 1, which is again seated on the heat-conducting plate 3, is formed with perforations 17, for example, in the form of bores with an internal diameter of about 5 mm. In addition, outside the hollow support, the heat-conducting plate 3 comprises apertures 18 which coincide with the perforations 17 and is covered with sound-damping filling material 19 on the side remote from the plaster 1. The filling material 19 expediently consists of material which is at the same time heat-insulating, for example, of glass wool, in order as far as possible to prevent the heat-conducting plate 3 from giving off heat in an upward direction. Moreover, the cavity 20 between the wall of the hollow support and the plaster 1 is filled with a filling material which is sound-absorbing but which does not have to be at the same time heat-insulating, since the plaster 1 at this place is associated with the channel 4 which participates in the conduction of heat.

The heat-conducting plate 3 is seated in a slab comprising the plaster 1 and a continuous marginal ledge 21. The entire ceiling is again split up into a number of such slabs which abut one another with joints 14 which are cemented on the plaster side. The fixing of the slabs and the assembly thereof takes place in a manner similar to that described in connection with Figure 1. The marginal ledges 21 of adjacent slabs are again shaped to interengage one another. Furthermore, the heat-conducting plate 3 is again provided inside the marginal ledges 21 with securing tongues 12 which are stamped out on three sides and bent out of the sheet surface, said tongues assisting the anchoring of the material forming the marginal ledges, to which also contribute the cut-outs 13 formed by bending out the tongues 12.

In order to be able to keep the mean plaster temperature at a predetermined value, it is necessary under certain circumstances to keep the total heat-conduction surface smaller than the total ceiling surface. For this purpose, as shown in Figures 4 and 5, each heat-conducting plate 3 may be formed externally of the channel 4 with cut-outs 22 or 23, which are chosen to be of such a size that altogether the desired reduction of the heat-conducting surface is produced. The cut-outs or recesses 23 according to Figure 5 are considerably larger than those (22) of Figure 4. The result is a correspondingly greater reduction of the total heat-conduction surface in the case of Figure 5 as compared with that of Figure 4.

The embodiment according to Figure 6 differs from that according to Figure 1 only by the fact that the heat-conducting plate 3 is of different thicknesses at places at different distances from the tube 2, the central portion forming the channel 4 being of the greatest thickness. This thickness is constant longitudinally of the tube, but decreases steadily towards both lateral extremities in the direction transversely of said tube, this decrease in thickness being linear at least over the lateral flanks 10 and 11 and also thereafter as far as the free side edges or extremities of the plate, so that each heat-conducting plate is fashioned to taper outwards at those ends or extremities remote from the associated tube 2. In the choice of the decrease in thickness, attention is to be paid to the best possible utilisation of the material for the conduction of heat, on the basis of the best possible uni-

formity of the heat dissipation or supply in relation to the plaster 1, so that a plaster temperature as constant as possible can be produced over the entire conducting plates. The plate thickness at a place located at a predetermined spacing from the associated tube of the heat-conducting plate is therefore dependent upon the delivery or supply of heat to the plaster which has already been effected from the centre of the plate as far as the said place and is consequently proportional to the heat which still remains and has to be conducted.

As will be seen from Figure 7, the heat-conducting plates can be made from a rolled plate which is made to taper transversely from the middle towards the two lateral edges. The underside of the rolled plate is left plane as with ordinary plates and the decrease in thickness is effected merely by the shaping of the top side of the plate. Such a constructional form has the advantage that with the sets of rollers which are employed, only one roller of a pair of rollers, that is, for example, the top roller, has to be made in the form of a double truncated cone, whereas the counter-roller, that is, for example, the bottom roller, can be cylindrical in a manner which is usual for normal sheet rollers.

Contrary to what is shown in the drawing, it is not absolutely necessary to split up the plaster layer into juxtaposed slabs, but the heat-conducting plates can also be fixed to constructional parts of the building independently of the plaster and the plaster can be subsequently applied as a continuous layer to a number of successive heat-conducting plates.

Various changes and modifications may be made without departing from the spirit and scope of the present invention and it is intended that such obvious changes and modifications be embraced by the annexed claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent, is:

1. A structural element for the transfer of heat from a tube containing a heating medium, comprising a sheet of copper including a pair of elongated, substantially planar, outer portions and an integral elongated, intermediate portion connected to and coextensive with said outer portions, said sheet at said intermediate portion being deformed and doubled upon itself to form a first pair of oppositely directed ears projecting laterally toward said outer portions and spaced from the plane of the latter, said sheet intermediate said ears defining a channel-shaped seat conforming substantially to a part of the periphery of said tube, said sheet decreasing continuously in thickness from said intermediate portion to the ends of said outer portions, said outer portions of said sheet being provided with tongues stamped therefrom and bent in a direction substantially transverse to said plane of said outer portions of said sheet, a layer of plaster on said copper sheet and secured thereto by said tongues, said plaster layer being provided on its marginal portion with a profiled ledge for joinder to a corresponding profiled ledge of a similar further element, and an elongated clip conforming substantially to the contour of said tube and provided with a second pair of ears, said second pair of ears cooperating with said first pair of ears of said sheet, respectively, to hold said element to said tube.

2. A structural element for cooperation with tubular heat control means, comprising a front layer of relatively poor heat-conducting material, a sheet of heat-conducting material disposed on and for contact with said front layer, said sheet including a pair of outer substantially planar end portions and an integral, elongated channel portion intermediate said planar portions and deformed to extend rearwardly of said planar portions, said channel portion defining an elongated seat conforming partially to the periphery of said tubular heat control means, and elongated clip means conforming to said tubular means and provided with a pair of laterally extending ears, said channel portion of said sheet being doubled upon itself to form an integral pair of laterally extending ears, said pairs of ears cooperating with each other, respectively, to hold said element to said tubular means, whereby when said element is operatively connected with said tubular heat control means, there is a transfer of heat between said tubular means and said seat defined by said channel portion and between the latter and said substantially planar portions.

3. A structural element according to claim 2, said front layer being provided with a marginal portion terminating in a profiled ledge, whereby said element may be interengaged with a further similar element through a corresponding profiled ledge thereof, respective extremities of said outer planar portions being embedded in said marginal portions.

4. A structural element according to claim 2, said sheet decreasing continuously in thickness from a maximum value at said channel portion to a minimum value at the outermost edges of said outer portions, so that a triangular cross-section of said sheet is obtained.

5. A structural element according to claim 2, said sheet being provided with cut-outs distributed relative to said channel portion and spaced from the latter to thereby reduce the heat conduction surface of said sheet.

6. A structural element according to claim 2, said front layer being provided with external perforations, said sheet being provided with apertures overlying said perforations of said layer to thereby increase sound absorption and to substantially cancel sound waves entering said perforations and said apertures.

7. A surface for conduction of heat between tubular heating means and a zone to be heated, said surface being composed of a plurality of interengaged elements, each of said elements including a layer of relatively poor heat-conducting material having a front surface and a rear surface for facing said zone and said heating means, respectively, each of said elements being further provided along its marginal portion with a profiled ledge for interengagement with a corresponding profiled ledge of an adjacent element, at least some of said elements further including a sheet of heat-conducting material on said rear surface and having a pair of substantially planar portions and an integral elongated channel portion intermediate said planar portions and deformed to extend rearwardly of said planar portions, said channel portion defining an elongated seat conforming partially to the periphery of said tubular heating means, and a plurality of elongated clip means each conforming to the contour of a corresponding part of said tubular heating means and cooperating with said channel portion of a respective sheet to secure the latter to said tubular heating means, whereby when said elements having said sheets of heat conducting material are secured to said tubular heating means, there is a transfer of heat from the latter to said seats defined by said channel portions and from said channel portions to said substantially planar portions, the deformations of said sheets serving to equalize the heat distribution to said layers of relatively poor heat-conducting material.

8. A heat transfer element for use in connection with a pipe containing a heating medium; comprising a sheet of metal of high thermal conductivity, said sheet having an intermediate portion and a pair of substantially coplanar lateral portions integral and coextensive with said intermediate portion, said sheet decreasing gradually and continuously in thickness from said intermediate portion to the edges of said lateral portions, said intermediate portion of said sheet comprising a channel-shaped trough spaced from the plane of said lateral portions and conforming substantially to a part of the periphery of said pipe, a pair of slanted flank portions extending from said lateral portions to opposite sides of said trough, a first pair of oppositely directed ears disposed, respectively, at the junctions of said flank portions with said trough and extending therefrom in the directions of said edges of said lateral portions, a plurality of tongues stamped from said lateral portions and bent therefrom in a direction

substantially transverse to said plane of said lateral portions, a layer of plaster arranged adjacent one surface of said sheet and secured thereto by said tongues, said plaster layer being provided on its marginal portion with a profiled edge designed for joinder to a corresponding profiled edge of a similar further heat transfer element, and an elongated clip conforming substantially to another part of the periphery of said pipe and provided with a second pair of ears engageable with said first pair of ears of said sheet, respectively, said clip thereby being adapted for positioning diametrically opposite said trough, with said second pair of ears engaged, respectively, with said first pair of ears, whereby said sheet and clip when interengaged are adapted for heat-conductive contact with said pipe, said pipe being disposed during such contact in said trough.

9. A structural element for use in conjunction with a pipe for conducting a heating and like medium; comprising a sheet of material of high heat conductivity, said sheet including an intermediate portion and two substantially coplanar lateral portions longitudinally coextensive with said intermediate portion, said sheet gradually and continuously decreasing in thickness from said intermediate portion toward the extremities of said lateral portions, said intermediate portion being provided with a channel-shaped trough spaced from the plane of said lateral portions and conforming substantially to one part

of the periphery of said pipe, two flank portions extending respectively from said lateral portions to opposite sides of said trough, a first pair of oppositely directed ears disposed, respectively, at the junctions of said flank portions with said trough and projecting laterally therefrom, and an elongated clip conforming substantially to another part of the periphery of said pipe located opposite said one part of the latter, said clip being provided with a second pair of ears engageable, respectively, with said first pair of ears, whereby said sheet and clip when in operative position and connected to each other are adapted for heat-conductive contact with said pipe, said pipe being substantially encompassed by said clip and said trough in said operative position.

10. A structural element according to claim 9 and forming a unitary slab structure with a layer of plaster, said layer of plaster terminating in respective marginal portions each having a profiled end edge, said extremities of said lateral portions of said sheet being embedded in said marginal portions of said layer of plaster and terminating short of said profiled edges thereof.

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