April 11, 1961 R. TATSCH 2,978,840

BUILDING CONSTRUCTION AND AIR CONDUIT STRUCTURE THEREFOR

Filed July 25, 1955

4 Sheets-Sheet 1

Fig. 1.

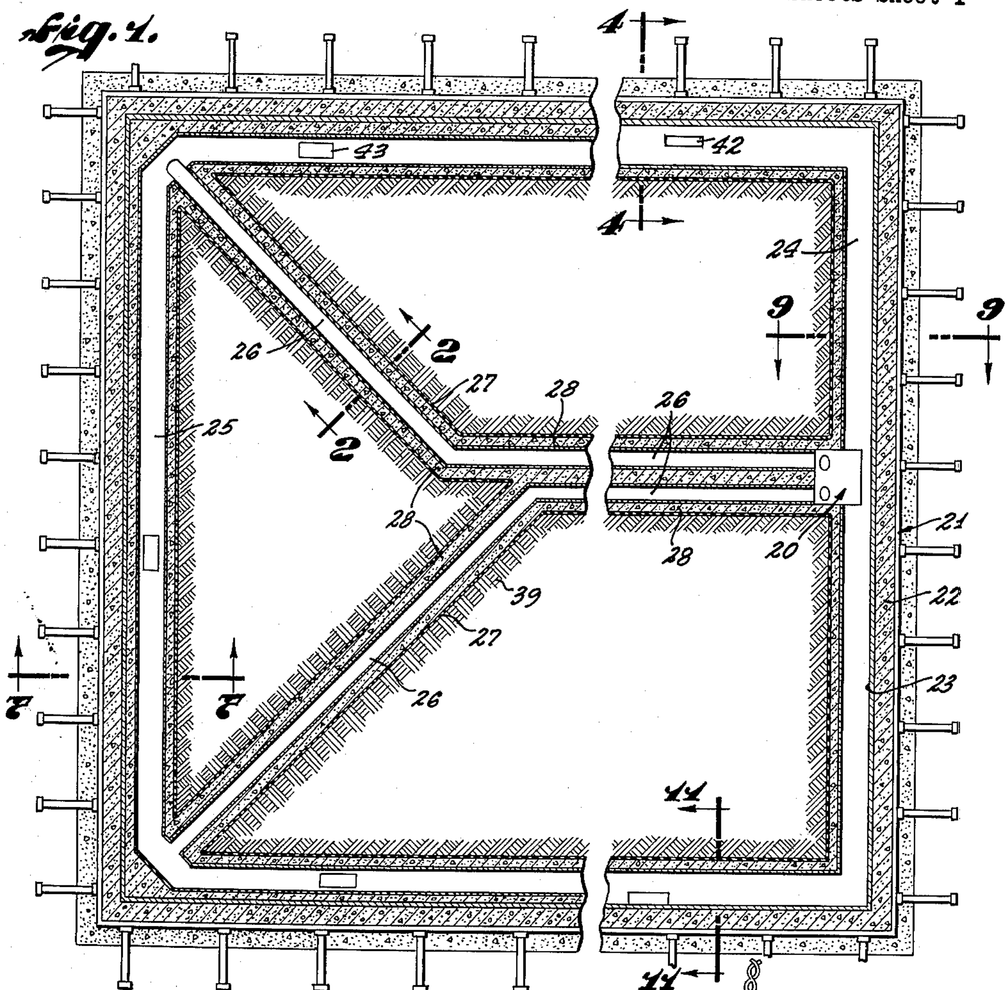
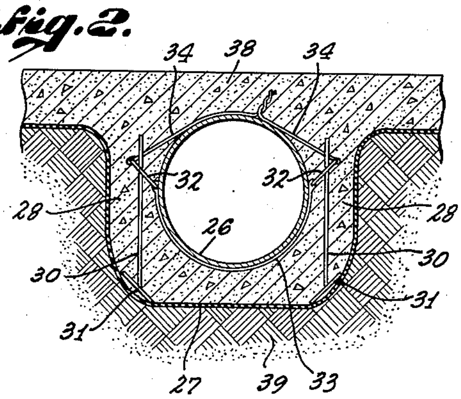


Fig. 2.



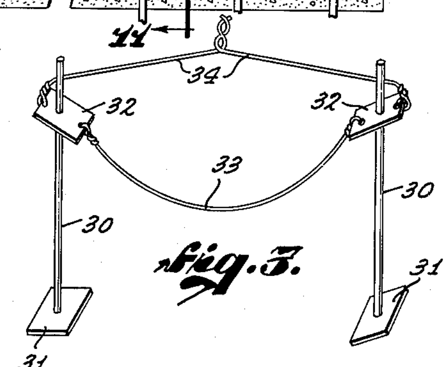


Fig. 3.

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BUILDING CONSTRUCTION AND AIR CONDUIT STRUCTURE THEREFOR

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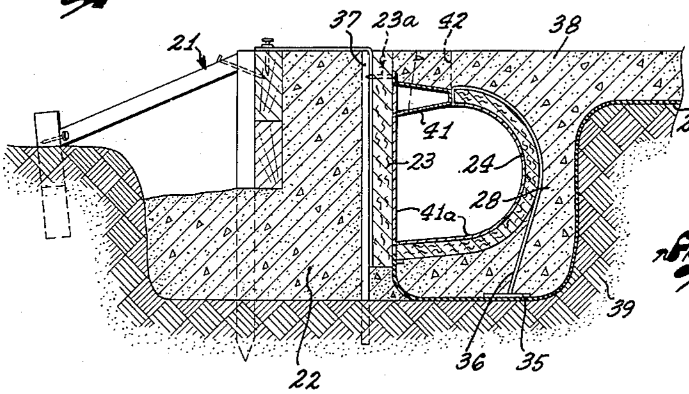
Fig. 4.



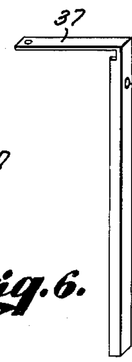


Fig. 6.

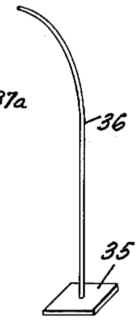


Fig. 5.

Fig. 7.

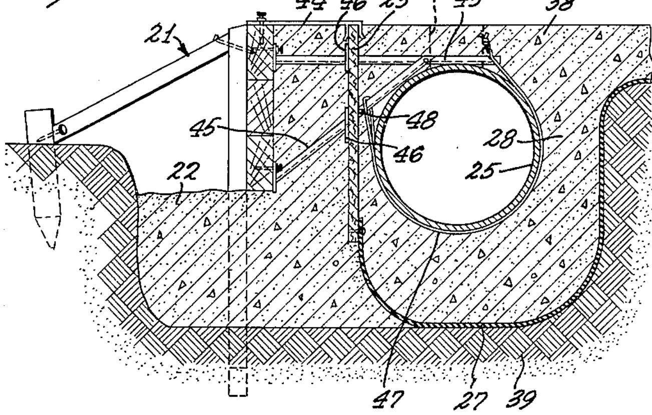


Fig. 8.

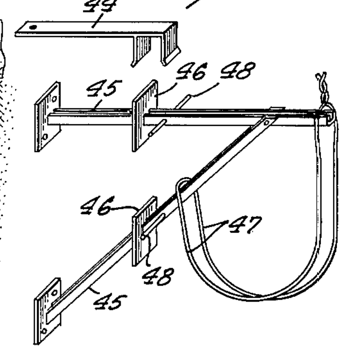
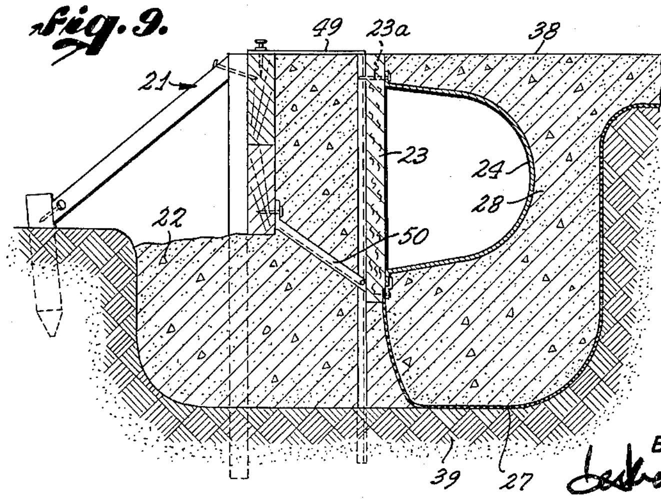


Fig. 9.



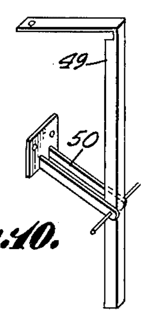


Fig. 10.

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BUILDING CONSTRUCTION AND AIR CONDUIT STRUCTURE THEREFOR

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Fig. 11.

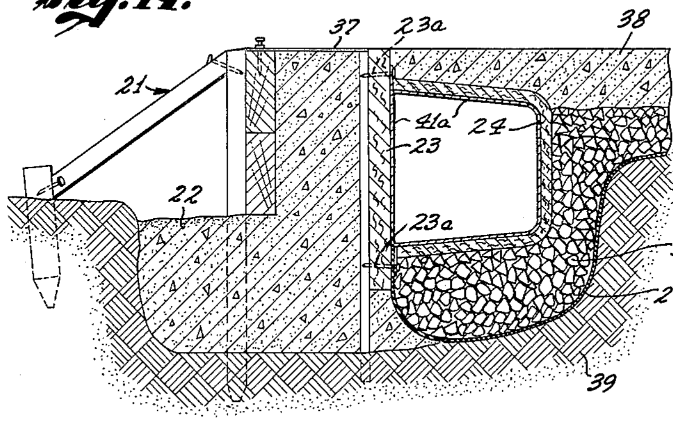


Fig. 12.

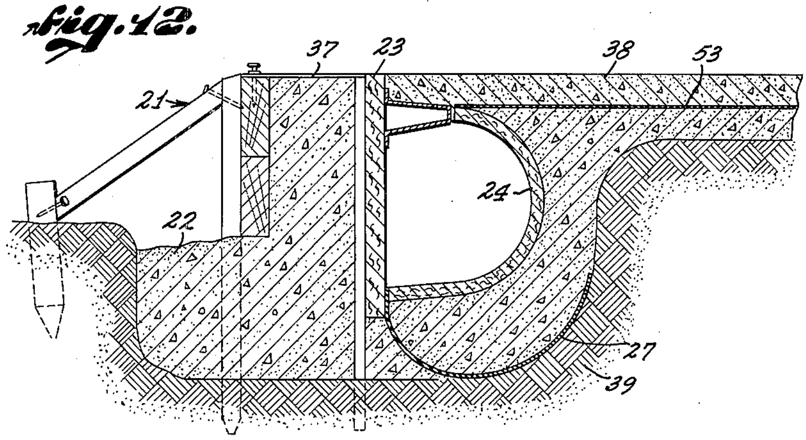
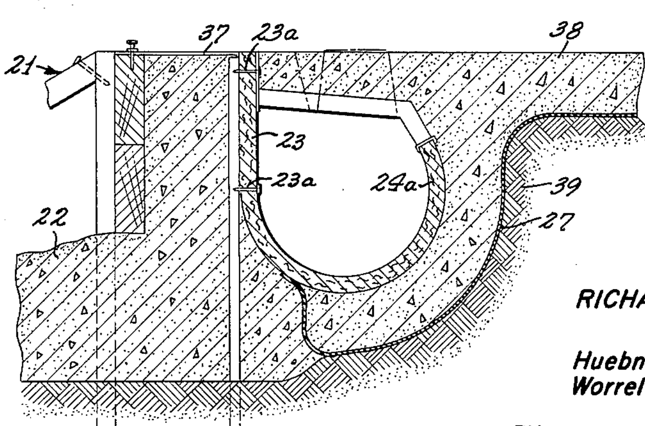


Fig. 13.



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BUILDING CONSTRUCTION AND AIR CONDUIT STRUCTURE THEREFOR

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Fig. 14.

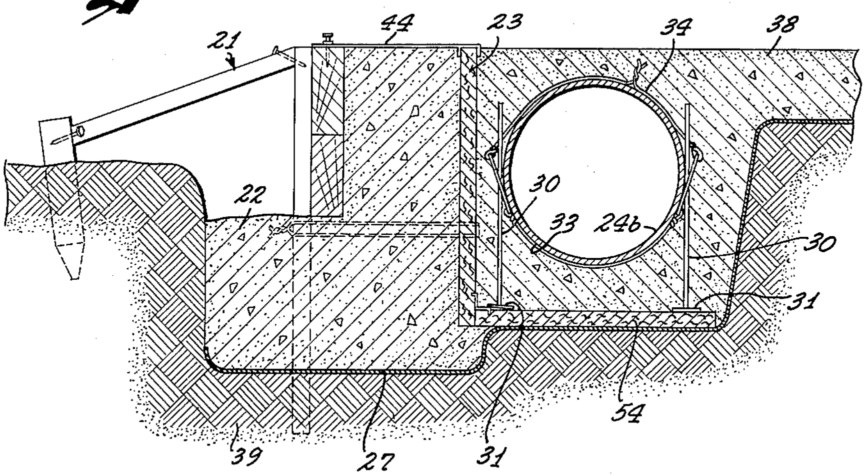
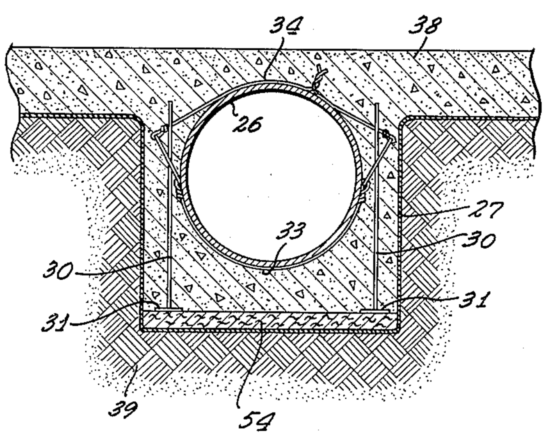


Fig. 15.



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BUILDING CONSTRUCTION AND AIR CONDUIT STRUCTURE THEREFOR

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Filed July 25, 1955, Ser. No. 524,224

11 Claims. (Cl. 50—100)

The present invention relates to conduit installation apparatus and methods, particularly installation of conduits in concrete or masonry structures such as floors, walls or ceilings, and more particularly to installation of radiant heating or cooling conduits which are positioned below concrete floors and are partially or completely encased in concrete.

In certain conduit installations, where the conduit is employed to distribute fluid, such as air, for example, in radiant heating and cooling systems, the conduit system is first positioned and then concrete or other cementitious material is poured partially or completely around the conduit. This is the case in heating and cooling systems known in the industry as "loop systems," "perimeter loop with radial feeder systems," "radial feeder systems," and "extended plenum" with or without "radial feeders systems." In these and other radiant heating and cooling systems, the air carrying conduit is first accurately positioned before concrete or other fluid or plastic material is poured around it.

A very troublesome problem is encountered during the concrete pouring operation. For convenience in description, it will be understood that the term "concrete" as used herein will include other cementitious materials such as cement, mortar, plaster, asphalt, and the like, which harden into a wall or floor from a fluid or plastic state and which may contain particulate or aggregate matter such as sand, gravel, rock, or other filler material. The very heavy fluid concrete exhibits a very strong buoyant force on the relatively light-weight conduit as the concrete is poured around it. These strong buoyant forces tend to displace or float the conduit from its accurately located position. Relocation of such displaced or dislocated conduits and precautions taken against the danger of such dislocation have led to greatly increased conduit installation costs.

Accordingly, it is an important object of my invention to provide an efficient and economical conduit installation means and method for anchoring the conduit against any displacement thereof during pouring of concrete therearound.

A further and more specific object of the invention is the provision of conduit anchoring means comprising a strong imperforate sheet-like barrier structure to overlie the ground beneath the conduit with intervening space between the barrier structure and conduit, means for directly or indirectly supporting the conduit from the ground, and means effectively connecting the conduit to the imperforate barrier structure, whereby the weight of concrete or particulate material placed in the space between the barrier structure and the conduit in the course of encasing the conduit, resists flotation of the conduit.

Another object of the invention is to provide improved means for producing a building structure comprising a concrete foundation wall, a concrete floor slab circumscribed by the wall and a perimeter air conduit encased below the slab, the said means comprising outside formwork for the wall, an air conduit having an outer side wall formed of heat-insulating material and shaped to serve as inside formwork for the wall and rising above the top wall of the conduit a distance equal to the thickness of the floor slab to be poured, and means for supporting the conduit in predetermined space relation to the outside formwork.

Another object of the invention is to provide an improved unitary air conduit structure adapted for perimeter installation and encasement by a concrete foundation wall and floor structure and capable of performing the multiple functions of conduit, perimeter thermal barrier, inside wall formwork and expansion joint filler between wall and slab.

A further object is to provide a means and method for fixing the position of a radiant heating and cooling conduit so that the conduit can be positioned and a continuous concrete placement procedure can be used including pouring concrete for exterior foundation, footing, and wall, for encasing the conduit and for the floor placement of an entire perimeter installation of a building.

Other objects of the invention, more or less incidental or ancillary to those already stated, as well as the manner in which the various objects are attained, will become apparent from the following description of exemplary embodiments of the invention, as shown in the accompanying drawings, in which the same reference numerals are applied to similar parts in the different embodiments.

In the drawings:

Figure 1 is a diagrammatic cross-sectional plan view showing an enclosing exterior foundation wall and air duct conduit layout for a complete floor with the cross-section taken horizontally below the finish floor level and with portions of the structure broken away and different parts of the diagram representing different specific forms of construction respectively shown in other figures;

Figure 2 is a cross-sectional view taken on the line 2—2 of Figure 1 with the finish floor in place and showing a conduit and anchorage attachment means encased in concrete;

Figure 3 is a perspective view showing anchorage attachment means of Figure 2;

Figure 4 is a cross-sectional view taken on the line 4—4 of Figure 1 with the finish floor in place and showing a perimeter conduit and anchorage means therefor;

Figure 5 is a partial perspective view showing a plate and a portion of a rod connecting means employed in the anchoring means shown in Figure 4;

Figure 6 is a similar partial perspective view showing a bracket employed in the structure shown in Figure 4;

Figure 7 is a cross-sectional view taken on the line 7—7 of Figure 1 with the finish floor in place and showing another perimeter conduit and anchorage means;

Figure 8 is a partial perspective view showing anchorage means employed in Figure 7;

Figure 9 is a cross-sectional view taken on the line 9—9 of Figure 1 with the finish floor in place and showing still another perimeter conduit and anchorage means;

Figure 10 is a partial perspective view showing a detail of a portion of the anchorage means employed in the embodiment shown in Figure 9;

Figure 11 is an additional cross-sectional view taken on the line 11—11 of Figure 1 with the finish floor in place and showing an additional perimeter conduit and anchorage means;

Figure 12 is a cross-sectional view similar to that shown in Figure 11 but applied to a floor having two concrete courses;

Figure 13 is a cross-sectional view showing another embodiment of a conduit in the form of a spiral wall of uniform thickness;

Figure 14 is a cross-sectional view showing a perimeter conduit and anchorage means positioned above a thermal barrier; and

Figure 15 is a cross-sectional view showing an interior conduit and anchorage means positioned on a thermal barrier.

In Figure 1, numeral **20** represents a distribution plenum supplying conduits **24** and **26**. In practice, distribution plenum **20** is supplied by air from an air conditioning unit (not shown). The usual single outside foundation formwork is shown at **21** and an exterior foundation wall and footing at **22**. A thermal barrier **23** separates the foundation from the enclosure floor.

The perimeter thermal barrier in prior practice usually separates the outside foundation and floor and normally functions only as a barrier and possibly as an expansion joint. In my invention, as described herein, the thermal barrier functions in additional useful fashion, namely, as air conduit wall and as inside formwork for a concrete foundation wall.

The thermal barrier, in general, should be in board or flat form. Under conditions of extreme temperature differential between indoors and outdoors, thicker barriers, or barriers having a lower coefficient of thermal conductivity, are necessary as compared to the barriers required in milder climates. Inorganic materials, such as fiber glass in board form with moisture-sealed exposed sides and edges, are satisfactory, as are also various cellular materials having good heat-insulating properties. In mild climatic areas, organic fibrous material treated against rot and held together with asphaltic or plastic binders is satisfactory, especially if one side thereof can breathe partially. These latter materials also should be sealed on their most exposed sides and edges where moisture is a severe factor. A barrier formed of such fibrous or cellular materials is more or less compressible, and hence can function as an expansion joint filler between foundation wall and floor slab.

Where the thermal barrier functions as a wall or partial wall of the conduit defining a passage for air, care must be taken that the thermal barrier shall not be eroded by air movement through the conduit or will not otherwise decompose. A metal foil lining or an asbestos-backed foil lining adherent to the barrier will function satisfactorily, as will a proper vinyl plastic coating. Under some conditions, it may prove feasible to sheet metal line the thermal barrier or sandwich it between two layers of sheet metal.

In Figure 1, the conduit **24** utilizes the thermal barrier **23** as a partial wall of the conduit, see Figures 4, 9 and 11. Conduit **25** is complete independently of the barrier, see Figure 7. Conduit feeder line **26** commences at plenum **20** and discharges into conduit **25**. A concrete conduit encasing wall **28** is shown around conduit **26** (see Figure 2), and a concrete floor portion **38**, as it is generally constructed, also is shown.

In Figure 2, a moisture vapor barrier **27** separates concrete conduit encasing wall **28** and concrete floor **38** from the ground **39**. In general, the moisture vapor barrier, or membrane, which usually separates the concrete floor and conduit encasing concrete from the ground consists of smooth roll roofing weighing about 45 to 55 pounds per hundred square feet. The joints are usually well lapped and tarred or cemented together. Double thick craft paper with two directional sisal fibers and a bituminous layer between is often used and this type of membrane is available in widths exceeding 20 feet. Roofing felts are often mopped together with asphalt or tar on the job, but these fracture or tear readily. Various thicknesses of plastic sheets are available and can be used as satisfactory moisture vapor barriers. A polyethylene film 4 millimeters thick has been used.

In general, the moisture vapor barrier, or membrane, should be a strong imperforate membrane of low permeability and not subject to decomposition. All joints should be well lapped and cemented. **Punctures must be** repaired before the concrete slab is poured.

In the embodiment shown in Figure 2, base plates **31** and legs **30**, which are strongly connected to the plates, preferably are made of metal, but other satisfactory materials of adequate strength also can be used. Base plates **31** preferably are attached to moisture vapor barrier **27**, by strong cement or other suitable means. Locking plate **32**, saddle **33**, and ties **34** cooperate to position conduit **26** in a predetermined location prior to the pouring of concrete.

The primary conduit wall, such as **26** in Figure 2, which herein is distinguished from a thermal barrier serving as a portion of a conduit wall, may be constructed of ferrous or non-ferrous metals. These may or may not be insulated or lined. They can be formed with double walls, and with or without an insulation material in the core. They can be constructed of fibrous organic or inorganic materials held together by binders and highly compressed, or be made in a less dense form of fibrous or cellular material suitable for heat insulation. The inner conduit walls may be lined with a metal foil, asbestos-backed foil or vinyl or other coating. The linings used preferably should have properties which offer low resistance to the movement of air and which minimize air erosion. The lining should be heat resistant and also render any combustible material in the conduit wall less combustible. The outer wall surfaces may be waterproofed with suitable coatings or coverings.

When concrete is placed around conduit **26**, shown in Figure 2, it should be more or less evenly distributed under the conduit. This also applies to other embodiments of the invention discussed below. The sheer weight of the poured concrete on membrane **27** will then enable legs **30**, and the cooperating fastening components, to hold conduit **26** securely in place as concrete encasing walls **28** continue to be placed. The usual floating action of the fluid concrete will thereby successfully be countered by the weight of the poured concrete bearing on membrane **27**.

The relationship and cooperation of the various parts of the anchorage means used in the embodiment of Figure 2 is more clearly shown in Figure 3. The holes in plates **32** should be slightly larger than required to fit over legs **30** so as to permit plates **32** to cant on the legs, as shown. After conduit **26** has been positioned over saddle **33**, and adjusted to the desired elevation, it can be secured by tightly drawing bands **34** over conduit **26**, and then securing the bands together. Where desired, the base plates **31** can be constructed with relatively long bodies and can support more than one leg.

In Figure 4, the ordinary single outside foundation form **21** is made of wood, but it may be made of steel or other suitable material. The thermal barrier **23** separates foundation wall **22** from floor **38**, thus serving as an expansion joint filler and thermal insulation between them, and also functions as an inside formwork for the wall. It is supported from the ground directly by attachment to the upright arms of a suitable number of brackets **37** and also indirectly by the horizontal arms of the brackets which are firmly connected to formwork **21** which in turn, is strongly supported from the ground. As shown in the drawings, attachment of barrier **23** to brackets **37** is effected by strong screws **23*a*** engaging apertures **37*a*** (Fig. 6) in the brackets, self-threading screws being suitable for this purpose. The barrier **23**, as already noted, also functions as part of the wall of conduit **24**. The wall of the conduit comprises a metal manifold **41** which is fitted with convection air outlets **42**, and the two other parts of the wall have a metal lining **41*a***. The formwork **21** and the three wall sections constituting conduit **24** mutually brace and stabilize each other. Membrane **27** separates concrete conduit-encasing mass **28** and concrete floor **38** from earth **39** and foundation footing **22**. Membrane **27** is substantially connected to barrier 23 by cementing or stapling it thereto, or by clamping it between conduit 24 and barrier 23 where the bottom wall of the conduit engages with the thermal barrier 23, as shown, or by other suitable means. A plate 35 attached to a link 36 is cemented or otherwise secured to membrane 27 while the link is secured to conduit 24.

In pouring the concrete for the embodiment shown in Figure 4, it is preferable to first pour concrete to form conduit-encasing wall or mass 28. Pouring then is continued to place concrete foundation footing and wall 22 next, and then floor 38. The weight of concrete 28 on membrane 27 stabilizes the membrane and thus assists to laterally hold in position the lower half of thermal barrier 23 and conduit 24 of which the barrier is a part. With the membrane 27 secured to barrier 23, the floating out or lifting action on the conduit, caused by the pouring of concrete mass 28, is countered. Plate 35 secured to membrane 27 aids in resisting this lifting action.

In the embodiment shown in Figure 7, a single outside foundation formwork 21 is used. A foundation wall and footing 22 is used with a thermal barrier 23′ separating foundation concrete mass 22 from floor 38 and mass 28. A moisture vapor barrier 27 separates concrete encasing mass 28 and floor 38 from ground 39, and from foundation wall or footing 22. Membrane 27 is securely fastened to barrier 23′. A bracket 45 is secured to formwork 21. It supports and positions barrier 23′ which, in turn, is secured to bracket 45 through securing means 46, 47 and 48. Bracket 45 in conjunction with bands 47 also supports and positions conduit 25. Fluid convector outlet 43 is shown merely for illustration purposes. Reusable metal spacing brackets 44, spaced at short intervals, laterally position and support barrier 23′ in a spaced relationship with form 21. Brackets 45 may be spaced at greater intervals than the spacing of brackets 44.

In pouring the concrete for the embodiment shown in Figure 7, the concrete pour should first place encasing wall or mass 28. The weight of the concrete poured on membrane 27 will secure the membrane, as described above. Then the secured membrane 27 will help to hold thermal barrier 23′ in lateral alignment. At the same time, the weight of the concrete on membrane 27 will resist the lifting action of the fluid concrete on conduit 25. After pouring wall 28, pouring is continued for foundation footing and wall 22, and then completed by pouring floor 38.

The bracket means 45 used in the embodiment shown in Figure 7, and shown in detail in Figure 8, can be most readily installed by first securing the upper arm to formwork 21. The lower arm should then be raised or lowered to elevate the conduit holding end of the bracket to the proper level. The lower bracket is then fastened to form 21, as shown in Figure 7. Pins 48 are removed and slotted gaps are cut in thermal barrier 23′ sufficient to permit it to be slid against plates 46. At a proper elevation, thermal barrier 23′ is secured to plates 46 and pins 48 are replaced. Conduit 25 is then positioned and secured to bracket arms 45 with bands 47.

In general, when a moisture vapor barrier is used, the concrete covering it and encasing a conduit should preferably have a high slump to enable it to flow easily against the membrane and surround the conduit with a minimum of assistance. This minimizes the danger of injury to the membrane by eliminating the need for further slicing or puddling the concrete. The usual stiffer concrete should be used for the foundation footing, wall, and finish floor.

In Figure 9, an outside foundation formwork 21 and an exterior foundation wall 22 are again shown. Thermal barrier 23 functions in its usual capacities and serves, in addition, as the inside formwork for foundation wall 22. It also functions as a side wall of air conduit 24. The conduit is connected to one leg of angle bracket 49 which is driven into the ground while the horizontal arm of the bracket is secured to formwork 21 by a removable nail, or the like. Diagonal brace 50 (Figure 10) connected

to bracket means 49 also is strongly connected to formwork 21. The moisture barrier sheet 27, as in the case of Figure 4, is strongly connected to the heat-insulating wall 23 of the air conduit. Because of the specially strong bracing of the conduit structure sufficient countering of the flotation action of the concrete on the conduit may be secured without the use of anchoring means such as 35, 36 employed in Figure 4.

As shown in Figure 11, the use of gravel, or other particulate matter, at 51 could apply in numerous installations, wherein the conduit body itself does not require the permanent structural stability given it by the encasing concrete mass previously referred to by numeral 28, and wherein possible disintegration of the conduit body is not a factor. Also to be reckoned with is the capacity of the moisture vapor barrier 27 to function permanently. The gravel or other particulate matter serves to protect the membrane 27 from damage, acting also as a cushion between barrier 27 and floor 38. The gravel or other particulate matter also breaks up the possible capillary action of minor moisture seepage having a tendency to occur.

Floors are sometimes placed in two courses with a moisture vapor membrane separating the two courses. The base course is allowed first to harden, the moisture barrier is installed, and the finish floor is then placed. Figure 12 shows such an arrangement. A piece of roofing paper 53 or other suitable material, described above in connection with the description of the moisture vapor barrier, is attached to the conduit 24 and helps to stabilize it.

In the embodiment shown in Figure 13, the wall of conduit 24*a* is in the form of an integral spiral of heat insulating material. The moisture vapor barrier 27, of the embodiment, is fastened securely to the bottom portion of conduit 24*a* by any suitable means.

In the embodiments shown in Figures 14 and 15, the conduits 24*b* and 26, respectively, are protected by barrier structures comprising both moisture and heat barriers. In Figure 14 the moisture barrier 27 is a sheet of suitable material previously described, and the heat barrier consists of sheets 23 and 54 of insulating material such as has been described herein. In the case of Figure 15 the barrier structure consists of moisture barrier 27 and heat barrier sheet 54. In both of these cases, as well as in the structures shown in Figures 2 and 4–13, the barrier structures form the inner surface of a trench-like space extending continuously lengthwise of the conduit structure and at least partially beneath it. In both Figure 14 and Figure 15 the air conduits are positioned by the means shown in Figure 3 and previously described; and in both cases, as well as in the Figures 2 and 4–13 constructions, the weight of the first concrete (or particulate material) entering the trench-like spaces beneath the conduits effectively resists the flotation forces on the conduits.

The showings of the various embodiments of the invention assume a fairly level building site and the need to provide a trench to receive the foundation wall and the under-floor perimeter air conduit; but it will be understood that a sloping building site might not call for a full perimeter trench with outside as well as inside walls. In practically all cases, however, the bottom of the air conduit will be at a level lower than the bottom of the floor slab, so that there will be a bank of floor-supporting material (earth, gravel or the like) with an outwardly facing side adjacent the air conduit. This is important in connection with the installation of the perimeter conduit since, in the placing of concrete or particulate material around the conduit, the bank of floor-supporting material serves as an outwardly facing fixed abutment and, on the one hand, makes the pressure of the fluid concrete or particulate material initially placed between the abutment and the conduit effective to resist inward movement of the conduit and thus renders the conduit anchoring means more effective and, on the other hand, effectively resists the inward pressure on the conduit of the fluid concrete subsequently poured to form the foundation wall.

It will be observed that in the above embodiments of my invention, an anchorage means is provided which overcomes the necessity of puncturing the moisture vapor barrier supporting the anchorage means. Also, in perimeter installations in general, my invention makes possible a continuous concrete placement procedure, including the exterior foundation footing and wall, and all concrete that encases the conduit, including the floor placement.

Those familiar with the previously known practices in the building industry will appreciate the notable savings in time, labor and material made possible by the use of the unitary, multiple-function perimeter air conduit herein disclosed; and will also understand the economy and convenience made possible by the effective conduit anchoring means disclosed.

The illustrative embodiments of the invention herein shown and described are presented by way of explanation and are not to be taken in a limiting sense since the scope of the invention is indicated by the following claims contrued in accordance with established rules of equivalency.

What I claim is:

1. A heating or cooling forced-air conduit for perimeter installation against the inner surface of the foundation wall and the under surface of the floor of a building, the conduit comprising an upright outer side wall part formed of heat-insulating material, a bottom wall part extending inwardly from the lower portion of the outside wall, an inner side wall part extending upwardly from the bottom wall, and a top wall part extending from the upper portion of the inner side wall to the outer side wall and joining the latter on a line spaced downwardly from the upper edge of the outer side wall, all of the conduit wall parts having interior surfaces formed of metal and that portion of the outer side wall part disposed above the level of the top wall part of the installed conduit serving as thermal insulation and the thermal insulation between the periphery of the floor and the surrounding foundation wall of the building.

2. A conduit structure as claimed in claim 1 in which the bottom and inner side wall parts of the conduit are also formed of heat-insulating material.

3. A heating or cooling forced-air conduit for perimeter installation against the inner surface of the foundation wall and beneath the floor of a building, the conduit comprising an upright outer side wall part, a bottom wall part extending inwardly from the lower portion of the outside wall part, an inner side wall part extending upwardly from the bottom wall part, and a top wall part extending from the upper portion of the inner side wall part to the outer side wall part and joining the latter on a line spaced downwardly from the upper edge of the outer side wall part, all of the conduit wall parts having their interior conduit surfaces formed of a layer of material resistant to air-flow erosion and at least the outer side wall part of the conduit being formed of heat-insulating material, whereby that portion of the outer side wall part disposed above the level of the top wall part of the installed conduit serves as thermal insulation between the periphery of the floor and the surrounding foundation wall of the building.

4. Apparatus for constructing a building foundation wall and floor slab of concrete with a perimeter air conduit at least partially encased by the concrete, the apparatus comprising outside formwork for the wall rigidly supported from the ground; perimeter heat insulation means and associated air conduit means disposed inside the formwork with the insulation means between the associated conduit means and the formwork and with the top of the insulation means extending upward to the floor level of the slab to be formed and higher than the top wall of the associated conduit means; and means connected to the outside formwork and to the insulation and conduit means for holding the insulation means and conduit means in spaced relation to the formwork, whereby the insulation means serves as inside formwork for the concrete wall when the latter is poured.

5. Apparatus as claimed in claim 4 in which the insulation means and associated conduit means are a unitary air conduit structure in which the insulation means constitutes the outer side wall of the conduit.

6. Apparatus as claimed in claim 5 in which the bottom and inside walls, as well as the outside wall, of the unitary air conduit are formed of thermal insulation material.

7. A building structure comprising a ground-supported concrete floor slab, a concrete foundation wall extending at least up to the level of the top surface of the slab, a perimeter air conduit for heating and cooling, the said wall and conduit being disposed in a ground trench having an outwardly-facing side surface and a bottom surface and the conduit comprising an upright insulation board forming the outside wall of the conduit and disposed flush against the inside surface of the foundation wall with its upper part disposed between the foundation wall and edge of the slab and the conduit having a bottom wall disposed above the bottom of the trench, an inside wall spaced outward from the outwardly-facing surface of the trench and a top wall disposed below the floor slab, a moisture barrier sheet lining at least a portion of the outwardly facing surface of the trench and the bottom surface thereof beneath the conduit, said sheet being attached along one edge thereof to the conduit, and a mass comprising aggregate construction material filling the space between the moisture barrier sheet and the bottom and inside walls of the conduit.

8. A building structure as claimed in claim 7 in which the mass of aggregate construction material is bound by cement to form a rigid mass of concrete.

9. The method of constructing a concrete floor slab and circumscribing foundation wall for a building and installing an air conduit for heating or cooling purposes, the method comprising the steps of preparing a trench in the earth to accommodate the wall and conduit, installing in the trench an upright workform to define the outside surface of the wall, fixedly supporting an air conduit in the trench spaced upward from the bottom of the trench, inwardly from the workform and outwardly from the inner side of the trench, lining at least part of the inner side and part of the bottom of the trench with a moisture barrier sheet, attaching the barrier sheet along its outer edge to the conduit, depositing concrete or other heavy material in the trench between the conduit and the barrier sheet, and thereafter placing concrete in the space bounded by the workform to form the foundation wall and floor slab and encase the conduit.

10. Apparatus for installing under-floor, concrete-encassed air conduits of heating and cooling systems, the apparatus comprising means for supporting the conduit to be installed from the ground in a position spaced from the adjacent ground surfaces, an imperforate sheet-like barrier structure disposed between the supported conduit and the ground to form a trench-like space extending continuously lengthwise of the conduit and at least partially beneath the conduit, and means effecting structural connection of the conduit to the barrier sheet and operable to transmit from the barrier sheet to the conduit the weight of concrete or particulate material placed in the trench-like space beneath the conduit when starting encasement thereof to effectively oppose flotation forces on the conduit of later-poured concrete.

11. Apparatus as claimed in claim 10 in which the structural connection between the barrier sheet and the air conduit comprises means effecting direct attachment of one edge of the sheet to the conduit.

(References on following page)

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