Dec. 16, 1947. R. C. JOHNSTON 2,432,622

STRUCTURAL MEMBER

Filed June 25, 1945 3 Sheets-Sheet 1

Fig. 1.

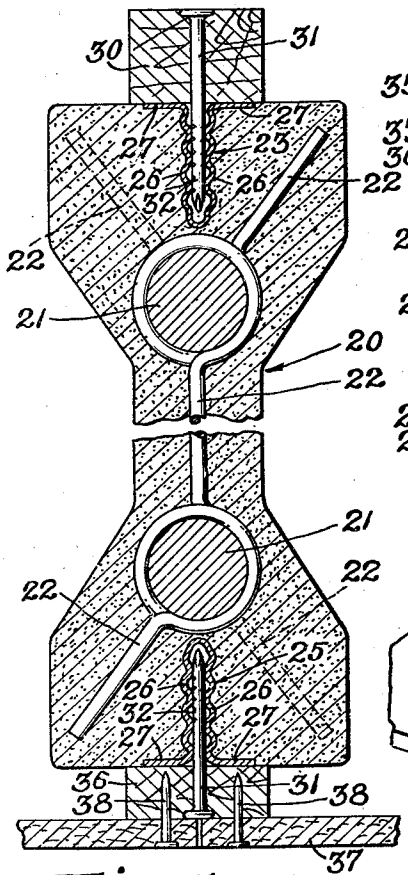


Fig. 2.

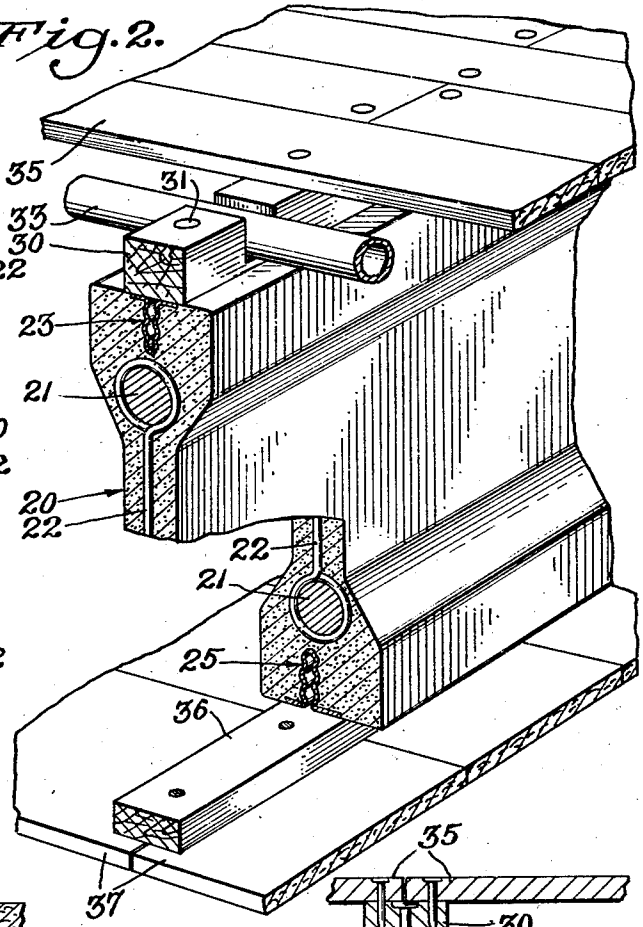


Fig. 3.

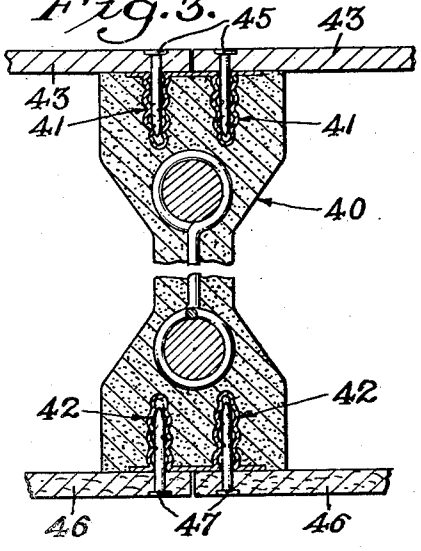
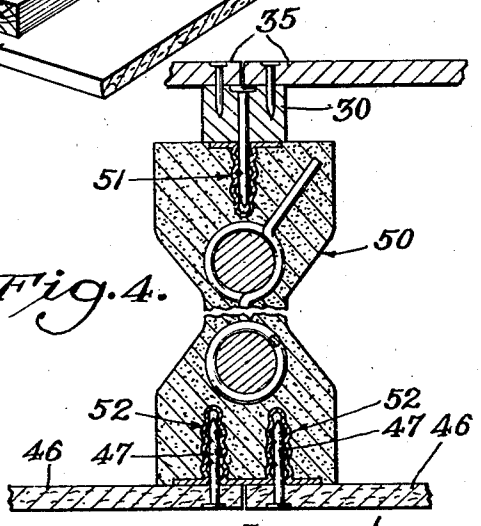


Fig. 4.



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STRUCTURAL MEMBER

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Fig. 5.

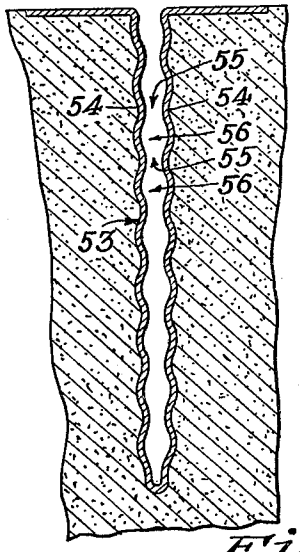


Fig. 6.

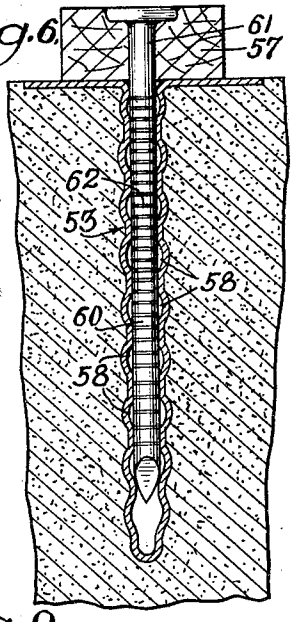


Fig. 7.

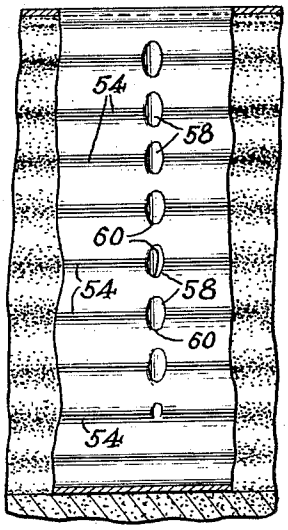


Fig. 9.

Fig. 8.

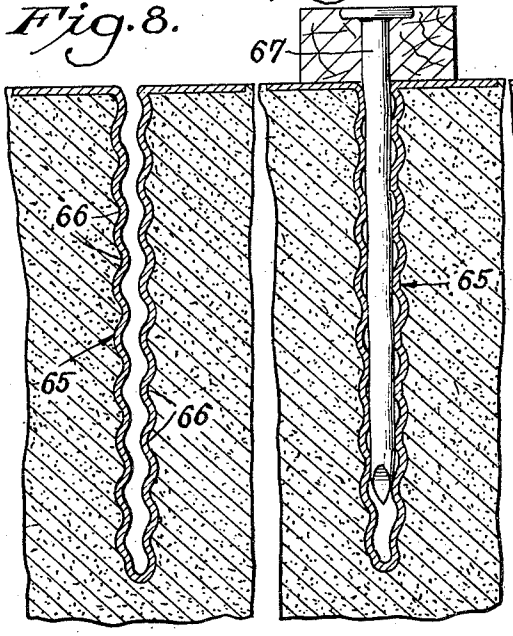
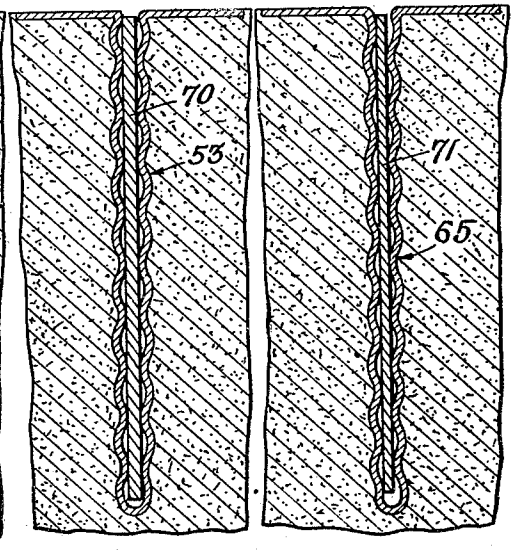


Fig. 10.

Fig. 11.



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STRUCTURAL MEMBER

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Fig. 12.

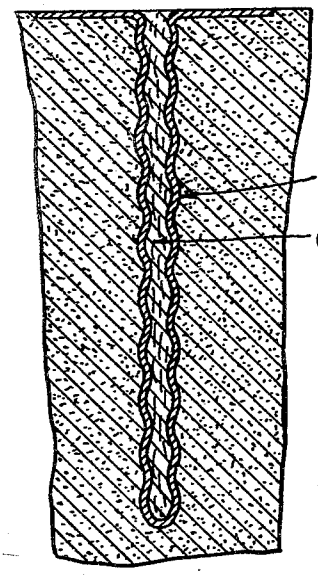


Fig. 13.

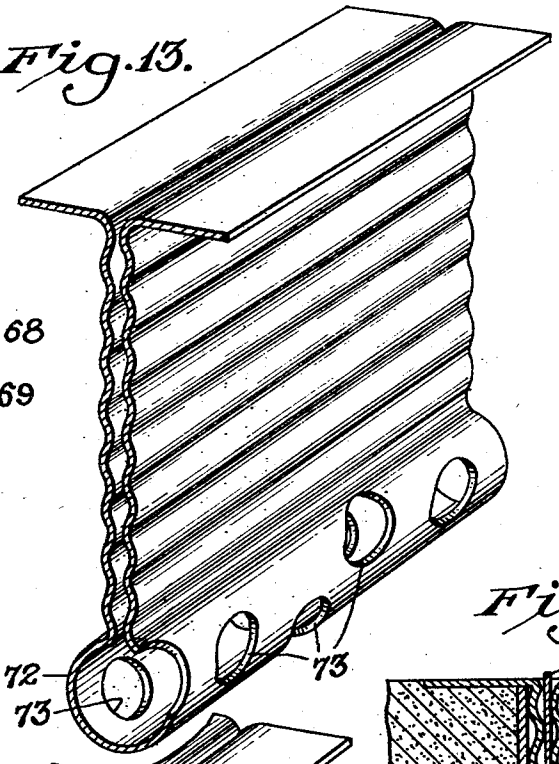


Fig. 14.

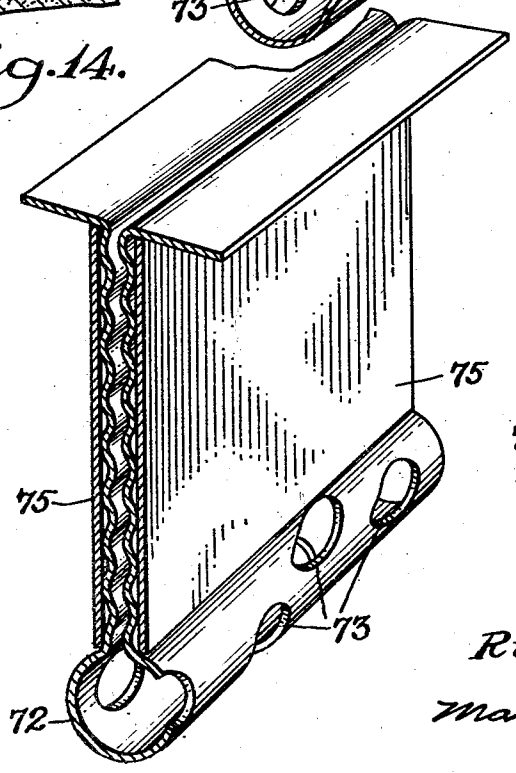
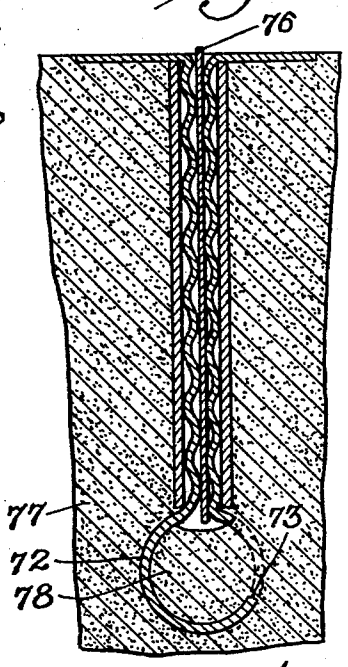


Fig. 15.



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Patented Dec. 16, 1947

2,432,622

UNITED STATES PATENT OFFICE

2,432,622

STRUCTURAL MEMBER

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Application June 25, 1945, Serial No. 601,481

3 Claims. (Cl. 72—61)

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My invention relates to structural members of materials other than wood for use in buildings and the like; for example, such structural members as beams, columns, studs, joists, floor slabs and wall elements made of concrete or other formed, rolled, cast or molded material.

The general object of the invention is to provide such a structural member of substantially non-penetrable material that is adapted for penetration and engagement by attached means, such as nails and screws, whereby structural elements may be directly nailed or screwed to the structural member.

While such structural members may be of various forms and of various materials for various structural purposes, the invention is being initially embodied in a concrete beam to serve as a joist for the flooring and/or ceiling of a building. This embodiment, which will be described herein for the purpose of disclosure, will provide adequate guidance for those skilled in the art who may have occasion to apply the invention to other specific structural purposes.

Where reinforced concrete joists are employed between the floors of a building it has been a common practice heretofore to use twisted wires for tying metal pencil rods to the under sides of the joists, transversely of the joists, and again use wire to attach the ceiling latch to the pencil rod. This wiring procedure is time consuming, costly in labor, and is distasteful to the lathers.

A specific object of my invention is to save time and labor by making it possible to simply nail plaster board and the like directly to the under sides of concrete joists.

A further specific object is to make it possible to mount flooring on the upper sides of the joists by a similar procedure, the flooring being nailed directly to the joists, or, where clearance for pipes and conduits is required, the flooring being nailed to spacer strips that are in turn nailed to the joists.

In general, these objects are attained by embedding in the material of the joist or structural member an engagement means to receive attachment means, such as nails and screws, which engagement means provides a longitudinal recess in the structural member for substantially non-retractable penetration by the attachment means. The engagement means, which may be conveniently termed a nailing strip, comprises, in my preferred practice, two sheet metal walls forming the required longitudinal recess, the two walls being spaced suitably close together and being of suitable broken configuration to provide both outward projections for anchorage in the body of the structural member and inward projections in the path of penetration of the attachment means. The desired broken configuration may be provided in various ways by such operations as bending and die-stamping to produce such effects as corrugations, ribs, bosses, and the like.

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It is contemplated that when a nail is driven into the embedded nailing strip there will be sufficient resilient deformation of material to provide substantially non-releasable engagement of the nail with the nailing strip. The deformation may be substantially wholly in the material of the nailing strip, or may be substantially wholly in the nail itself; or the desired non-releasable engagement of the nail with the nailing strip may involve both deformation of the nailing strip and deformation of the nail. At one extreme the penetrating nail moving against the restrictions or inward projections provided in the nailing strip may cause the material of the nailing strip to be displaced to form grooves or channels tightly embracing the nail from opposite sides, the nail being as straight after driven as before driven. At the other extreme the inward projections in the recess formed by the nailing strip provide a tortuous passage for penetration by the nail and the penetrating nail weaves along the passage, the point of the nail being diverted first in one direction and then another, so that the nail in the end has a tortuous configuration effectively interlocked with the tortuous passage.

Further specific objects of the invention relating to the construction of the nailing strip include the following: To provide a sheet metal nailing strip of simple and inexpensive construction that may be embedded in a concrete joist at no substantial labor cost; to provide means for insuring proper spacing of the recess walls without special care on the part of the fabricator; to provide a sheet metal nailing strip having walls of broken configuration with such clearance between the walls and the surrounding material of the structural member as will readily permit deformation of the walls without excessive interference by the material of the structural member; and to provide a nailing strip that will be automatically positively anchored in place when the concrete for the joist is poured.

Other objects and advantages of my invention will be apparent from the following description, taken with the accompanying drawings.

In the drawings, which are to be regarded as merely illustrative,

Fig. 1 is a sectional view of one form of the new

joist, with certain structural elements attached thereto;

Fig. 2 is a perspective fragmentary view of the same construction;

Fig. 3 is a transverse sectional view of a second form of joist, the flooring and ceiling being attached directly thereto;

Fig. 4 is a similar view of a third form of joist, with associated ceiling and flooring;

Fig. 5 is an enlarged fragmentary section of a concrete joist showing one form of nailing strip embedded therein;

Fig. 6 is a similar view with a nail driven into the embedded nailing strip;

Fig. 7 is a fragmentary face view of one of the inner walls of the nailing strip of Fig. 6, showing how the wall is deformed or grooved by the nail;

Fig. 8 is a view similar to Fig. 5, showing a second form of embedded nailing strip;

Fig. 9 shows the same embedded nailing strip with a nail driven therein;

Fig. 10 is a transverse fragmentary sectional view showing how a penetrable spaced strip may be employed in the nailing strip of Fig. 5;

Fig. 11 is a similar view showing how a penetrable spacer strip may be employed in the nailing strip of Fig. 8;

Fig. 12 is a cross-sectional view of a nailing strip filled with plastic material;

Fig. 13 shows a modified form of spacer strip having a hollow enlarged portion that is open or perforated so that the poured concrete may flow thereinto for highly effective anchorage of the nailing strip;

Fig. 14 shows a further modification in which the nailing strip of Fig. 12 is provided with additional outer walls to insure clearance space for deformation of the inner corrugated walls; and

Fig. 15 is a transverse fragmentary sectional view of the double walled nailing strip of Fig. 13 embedded in a concrete joist.

Fig. 1 shows a poured concrete joist **20** of well known configuration, having embedded therein suitable reinforcement including longitudinal rods **21** and additional reinforcement wires **22**. On the upper and lower sides of the joist are embedded sheet metal nailing strips, generally designated **23** and **25**, respectively, each of which forms a longitudinal recess opening to the exterior of the joist. Each of these nailing strips is shown as comprising a piece of sheet metal that is corrugated, folded on itself and flanged to form two corrugated walls **26** and two exterior flanges **27** substantially flush with the surface of the joist.

Since clearance must be provided in this particular construction for pipes or conduits on the upper side of the joist, a spacer strip **30** is placed on the upper side of the joist longitudinally thereof and is effectively anchored in place by suitable nails **31**. As shown in Fig. 1, each nail **31** extends into the recess provided by the nailing strip **23** into effective engagement with the walls of the recess. Such engagement may be made more efficient by providing the nails **31** with serrations or barbs **32** to interlock with the sheet metal material. The spacer strip **30** is cut away, as shown in Fig. 2, wherever a pipe or conduit **33** crosses the joist, and the flooring **35** is nailed directly to the spacer strip in the usual manner.

On the under side of the joist **20**, in Figs. 1 and 2, a suitable wood strip **36** is anchored by nails **31**, in the manner heretofore described, the nails

31 being driven into the lower sheet metal nailing strip **25**. Plaster board, plywood, or other ceiling panels **37** are then anchored to the wood strip **36** by nails **38**.

Fig. 3 shows a joist **40** of the same general construction that is provided with a pair of sheet metal nailing strips **41** on its upper side, and a pair of sheet metal nailing strips **42** on its lower side, which nailing strips are of substantially the same construction as described in Fig. 1. The two nailing strips of each pair may be separate, or, as indicated in Fig. 3, may be fabricated from a single piece of sheet metal.

In Fig. 3 flooring **43** is directly anchored to the joist **40** by nails **45** driven into the nailing strips **41**, and ceiling panels **46** are attached to the under side of the joists by nails **47** driven into the lower pair of nailing strips **42**.

The joist **50**, shown in Fig. 4, has a single sheet metal nailing strip **51** on its upper side so that a spacer strip **30** may be employed for the laying of flooring **35** in the manner heretofore described with reference to Fig. 2. The lower side of the joist **50** has embedded therein a pair of nailing strips **52**, so that ceiling panels **46** may be directly attached to the joist, in the manner heretofore described with reference to Fig. 3.

In the practice of my invention the sheet metal for forming the described nailing strips may be so folded that the inwardly projecting ribs or corrugations of the two recess walls match or lie at corresponding levels, as shown in Fig. 5, or may be so folded that the inwardly projecting ribs or corrugations of the two recess walls are in staggered arrangement, as shown in Fig. 8. In the simple practice of my invention the corrugating and folding may be done more or less at random, so that both configurations occur in the production of a quantity of the nailing strips.

In the nailing strip generally designated **53** in Fig. 5, the matching of the inward ribs or corrugations **54** produces a cross-sectional configuration in which the nail-receiving recess is characterized by restrictions **55** alternating with enlargements **56**, the two sheet metal walls of the recess being spaced sufficiently close to each other that the inward ribs **54** extend into the path of penetration of a nail.

When a nail **61** is driven into place, as shown in Fig. 6, to anchor a spacer strip **57**, the nail will cause the corrugated sheet metal walls to be deformed, and the nail itself may be substantially unchanged. On breaking the joist open to inspect the interior of the nailing strip to ascertain the effect of the nail penetration, it is common to find that the deformation of the sheet metal consists in displacement of the metal by the nail to form a series of short grooves **58**, as shown in Fig. 7. It is often found, also, that the concrete backing the inward ribs is slightly crumbled. In other words, the grooves **58** may be formed partly by the nail abrading the sheet metal and partly by the nail bending the sheet metal.

One feature to be noted is that the series of grooves **58** in the series of inward ribs **54** produces a series of shoulders at the lower or inner ends of the grooves, as indicated at **60** in Figs. 6 and 7. If the nail **61** in Fig. 6 has a zone of serrations **62**, the serrations will cooperate with the shoulders **60** to prevent retraction of the nail. Since, as shown in Figs. 6 and 7, the shoulders **60** are more or less evenly spaced, it is necessary only that the longitudinally serrated zone

of the nail be slightly longer than such spacing to insure cooperation of the serrations with at least one shoulder 60, regardless of the depth of penetration of the nail.

In the nailing strip 65 shown in Figs. 8 and 9, the inwardly projecting ribs or corrugations 66 of the two recess walls are staggered, and in consequence the recess formed by the nailing strip provides a tortuous passage for the nail 67. In one practice of the invention the nail will resist deformation and remain substantially unchanged when driven into place. In other words, the nail will deform the sheet metal of the nailing strip to produce a series of groves and series of shoulders, as heretofore indicated at 58 and 60, respectively, in Fig. 7.

In other practices of the invention, however, a nailing strip of tortuous configuration, such as the nailing strip 65, causes deformation of the nail 67, in the manner indicated in Fig. 9. In other words, the point of the penetrating nail is diverted alternately in opposite lateral directions, so that the nail, when driven home, has a tortuous configuration, interlocking with the tortuous configuration of the nailing strip. In Fig. 9, while the nail is deformed to the tortuous configuration to a slight but effective extent, the material of the sheet metal may also be deformed to some degree for further anchorage of the nail.

When a nail is slightly deformed to a tortuous or zigzag configuration, the nail is held against retraction not only by the interlocking configuration of the nail but also by the high magnitude of lateral pressure involved. In other words, the nail being somewhat resilient, is under bending stress at numerous points in opposite directions, which stress or tendency of the nail to spring back into straight line configuration results in a highly effective frictional grip.

In some practices of the invention I may employ some type of spacer means or spacer sheet material in the nailing strip to hold the two sheet metal walls of the nailing strip at a predetermined spacing while the concrete is setting. Thus Fig. 10 shows a spacer sheet 70 in the nailing strip 53 of Fig. 5, and Fig. 11 shows a spacer sheet 71 in the nailing strip 65 of Fig. 8. Such spacer sheets must be readily penetrable by nails, and may, for example, be cardboard. One advantage of using such spacer sheets is that they tend to keep the penetrating nails from changing direction in the longitudinal plane of the nailing strip.

Fig. 12 shows how a nailing strip 68 may confine a body of plastic material 69, instead of a spacer of sheet material. With the two corrugated walls of the nailing strip 68 in proper predetermined spacing, a suitable plastic material is poured into the nailing strip and permitted to set. For example, mastic, asphaltum, or the like, may be heated to a liquid state, poured into the nailing strip and permitted to cool to normal hardness.

While the plastic material may be poured after the nailing strip is embedded in a structural member, primarily to form a protective coating and water seal for the nailing strip, I prefer to fill the nailing strip with plastic in advance of installation in concrete so that the mass of hardened plastic may serve the further function of holding the two corrugated walls of the nailing strip at the desired spacing against the pressure of the newly poured concrete. The plastic material must, of course, be readily penetrated by nails and screws.

It will be noted in all of the above described

nailing strips that the corrugations form not only inwardly projecting ribs but also outwardly projecting ribs or enlargements, which outward projections effectively anchor the nailing strips in the concrete body of the structural member. In some practices of my invention it is desirable to employ other expedients to insure such anchorage in the surrounding concrete. Fig. 13, for example, shows a nailing strip that is similar to the nailing strip 53 of Fig. 5, but at the bottom is greatly enlarged to provide a hollow anchoring portion 72. Preferably, but not necessarily, the hollow anchoring portion 72 is open for the admission of newly poured concrete, the hollow portion having numerous openings or perforations 73 for this purpose. The newly poured concrete flows into the hollow portion 72 and sets therein to prevent inward collapse of the hollow portion.

Fig. 14 shows what may be termed a double wall construction for the nailing strip that insures clearance for deformation of the corrugated recess wall without interference by the concrete material of the structural member. The nailing strip in Fig. 14 includes substantially the same construction as shown in Fig. 13, but two outer sheet metal walls 75 are laid loosely against the corrugated walls to keep the concrete from filling the outer grooves formed by the corrugations.

Fig. 15 shows the nailing strip of Fig. 14 provided with a spacer sheet 76 and firmly embedded in a mass of concrete 77, which mass may be a concrete floor or may be the body of a joist such as heretofore described. It will be noted that a mass of concrete 78 is enclosed by the hollow portion 72 of the nailing strip. It may also be noted that the spacer sheet 76 serves as means to prevent any substantial quantity of the concrete from flowing upward from the hollow portion 72 into the nailing recess proper.

The specific forms of my invention described in detail herein for the purpose of illustration will suggest to those skilled in the art various changes and modifications under my basic concept, and I reserve the right to all such departures from such description that properly fall within the scope of my appended claims.

I claim:

1. A structural member adapted for engagement by attachment means such as nails and screws, said member having embedded therein engagement means including two walls forming a relatively deep recess, said engagement means being in part enlarged for anchoring engagement with the surrounding material of the structural member and in part restricted into the path of penetration of the attachment means, said engagement means being deformable by the penetration of the attachment means into secure engagement therewith and where restricted being spaced inwardly from the material of the structural member to provide clearance for such deformation.

2. A structural member adapted for engagement by attachment means such as nails and screws, said member having embedded therein longitudinally thereof sheet metal means having two inner walls and two adjacent outer walls, said inner walls forming a longitudinal recess to receive said attachment means and having inwardly offset portions extending into the path of penetration of the attachment means, said outer walls forming with said inner walls clearance spaces to permit deformation of said inner walls by the penetration of the attachment means.

3. A preformed reinforced concrete joist com-

prising a body poriton of concrete having longitudinally extending reinforcing members running substantially the whole length of the joist, and nail anchoring strips embedded in both top and bottom walls of the joist extending substantially continuously the entire length of the joist, said strips each presenting opposed walls for the reception of a nail or the like, and having deforming means associated therewith for gripping a nail driven therein to resist its retraction.

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