Jan. 12, 1932. S. J. BRANSON 1,840,304

REENFORCED CONCRETE STRUCTURE

Filed May 31, 1928

Fig. 1.

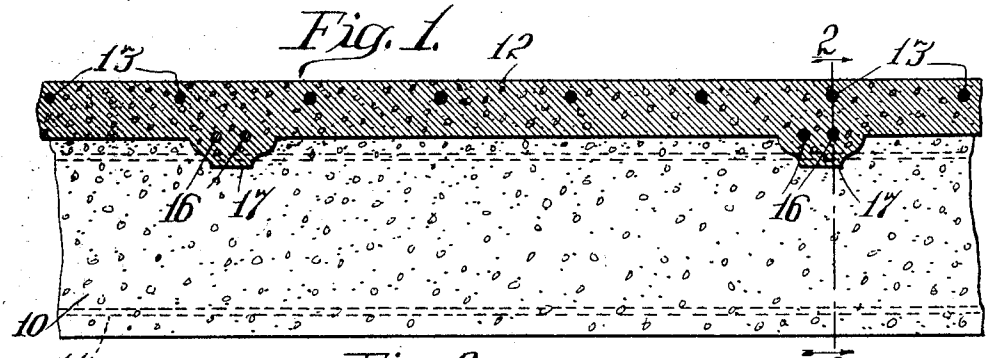


Fig. 2

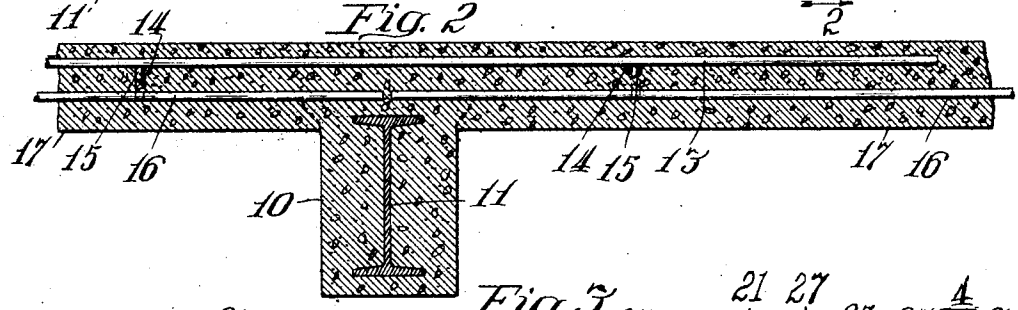


Fig. 3.

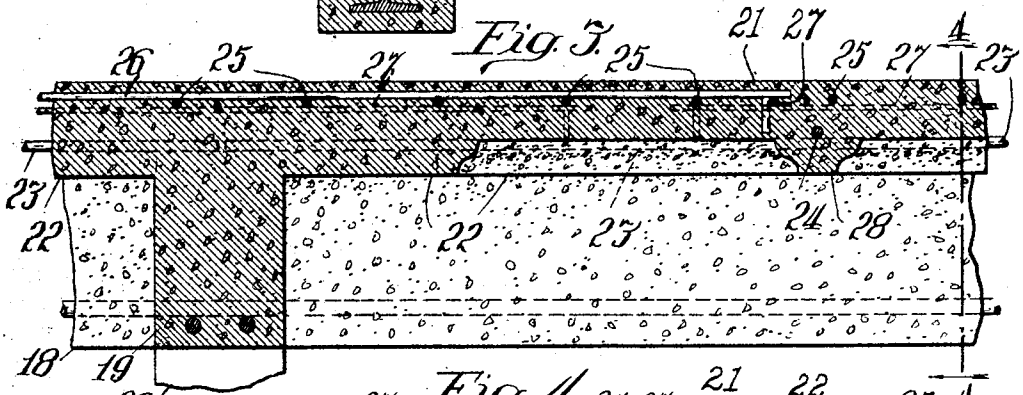
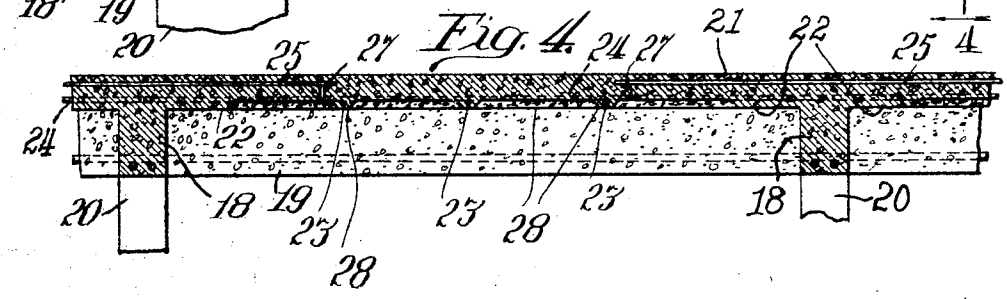


Fig. 4.



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UNITED STATES PATENT OFFICE

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REENFORCED CONCRETE STRUCTURE

Application filed May 31, 1928. Serial No. 281,673.

My invention relates to reenforced concrete structures and it has for its object the provision of a new and improved form and arrangement of concrete and reenforcing steel whereby both the concrete and the reenforcing steel shall have the maximum efficiency in operation for building up tension, compression, and diagonal tension or shear, whereby the thickness of the combination floor and ceiling structure may be kept to a minimum consistent with proper strength, whereby the dead weight of the floor structures throughout the entire building may be greatly reduced so as to correspondingly reduce the load to be supported by the girders, columns and foundations of the building and thus cut down the cost of the entire building structure, whereby the necessity for the use of lath and plaster shall be eliminated, and whereby in other respects the cost of production of the building may be reduced.

It is one of the objects of my invention to provide a slab floor structure, supported by beams or other supports in spaced relation to each other, and formed continuous over such spaced beams, comprising in each slab section between the supports an improved arrangement of concrete and reenforcing steel whereby substantially the full depth of the slab may be effective depth for developing tension and compression, while at the same time each of said sections between the supporting beams is kept in the form of a slab strictly speaking, as distinguished from a beam and slab type of construction, whereby substantially the full depth of the slab may be effective also for developing diagonal tension. It is one of the objects of my invention to provide a construction of this type in which the positive or bottom tension members are located at the best possible position both with respect to positive or top compression and also with respect to diagonal tension, whereby the greatest possible depth of slab is effective depth for both of such stresses. For attaining such novel construction by which substantially the full depth of the slab is effective with respect to both positive compression and diagonal tension, I have arranged bottom tension members substantially at the plane of the bottom face of the slab, bonding the tension members to the slab by means of concrete pads or ribs formed integrally with the slab at its bottom face, such pads being of sufficient size to afford the desired protection against fire and corrosion.

It is another object of my invention to provide an improved construction of this type comprising a continuous slab supported by beams or other supports arranged in spaced relation to each other, with top tension bars in transverse position with respect to the supports and imbedded in the slab sufficiently below its upper face for proper protection against fire and corrosion, in which construction the arrangement may be such as to provide the required compressive strength for effective cooperation with the top tensioning bars for attaining the desired margin of safety. To this end, it is one of the objects of my invention to provide greater compressive strength at the bottom portion of the slab underneath the top tensioning bars adjacent to said supports than is normally provided by the slab itself of even thickness throughout, such increased bottom compressive strength adjacent to the supports being provided by the use of bottom reenforcing bars in transverse position with respect to the supports and located substantially at the plane of the bottom face of the main portion of the slab, such bottom reenforcing rods being bonded to the slab by means of concrete pads or ribs formed integrally with the slab at its bottom face, such pads being of sufficient size to afford the desired protection against fire and corrosion. It is one of the objects of my invention to provide such an arrangement that the same steel bars act as the bottom compression members for the edge portions of the slab adjacent to the supports and as the bottom tension members for the middle portion of the span between the supports, the portion of the bar which is not directly active with respect to any particular force which tends to deform the slab serving as anchoring means for the remaining portions of the bar. In the arrangement as specified, the bottom reenforcing bars develop high

compressive stresses in conjunction with the extreme fiber stresses of the concrete.

It is another object of my invention to increase still further the bottom compressive stresses at the points adjacent to the supports, or the negative compressive stresses as they are called, in cases in which such further strengthening is required, such reenforcement being provided preferably by offsetting the bottom face of the slab downwardly adjacent to the supports to a slight extent with respect to the bottom face of the main portion of the slab, such downward offsetting serving preferably to bring the bottom faces of the edge strips of the slabs into alignment with the bottom faces of the pads or ribs.

It is another object of my invention to provide an improved construction of this type, involving the use of bottom reenforcing steel running both ways through the slab between the oppositely disposed supports, with such bottom tensioning bars located substantially at the plane of the bottom face of the slab and with such reenforcing bars bonded to the slab by pads or ribs of concrete formed integrally with the slab at its bottom face, in which the protecting and bonding ribs or pads are of such size and shape and are spaced at such intervals with respect to each other that an integrally formed mold may readily be used for each of the panels between the ribs so that the slab bottom portion and the adjacent rib side portions may be molded and joined smoothly without any occasion for disfiguring marks in the concrete, thereby giving the bottom face of the slab as a whole an attractive appearance as a paneled molded ceiling, and make unnecessary the use of lath and plaster or other additional moldings in connection with the concrete.

It is another object of my invention to improve structures of this type in sundry details hereinafter pointed out. The preferred means by which I have accomplished my several objects are illustrated in the accompanying drawings and are hereinafter specifically described. That which I believe to be new and desire to cover by this application is set forth in the claims.

In the drawings,—

Fig. 1 is a vertical section through one form of my improved floor structure, being a fragmentary view and showing also a portion of one of the beams by which the floor structure is supported at one side;

Fig. 2 is a vertical section taken substantially at line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 2 but showing a modified form of construction; and

Fig. 4 is a cross section upon a reduced scale showing the construction as shown at line 4—4 of Fig. 3.

Referring now particularly to Figs. 1 and 2, 10 indicates the beams which stand in spaced relation to each other for supporting the combination floor and ceiling structure to be built therebetween. In the drawings as presented, only one of the beams 10 is shown, it being understood that in practice a series of such beams or other suitable longitudinally extending supports is provided in the desired spaced relation for supporting a continuous slab built over and between the supports. In the construction illustrated in Figs. 1 and 2, the beams 10 are shown as being formed integrally with the floor structure and strengthened by I-beams 11.

The floor structure between the oppositely disposed longitudinally extending supports 10 is in the form of a continuous slab 12 of substantially uniform effective thickness throughout the entire span between the supports.

At each edge portion of the slab adjacent to the supporting beam, a series of top tension members 13 are provided, such tension members being in the form of steel rods or bars extending transversely across the beams near the top face of the slab, being positioned as near as possible to the top face of the slab consistently with proper protection of the bars by the concrete against fire and corrosion. As is best indicated in Fig. 2, a plurality of the tension bars 13 are connected together by means of wires 14 into the form of a grill, legs 15 of any suitable type being provided on the grill for supporting the bars 13 in the desired position upon the form upon which the concrete is poured. For the intermediate portion of the slab between the supports 10, bottom tensioning rods 16 are provided, located substantially at the plane of the bottom face of the intermediate portion of the slab 12, such bottom tension rods 16 extending continuously from one support to the other at the level indicated and serving at their end portions as bottom compression members. For bonding the rods 16 to the slab, pads or ribs 17 of concrete are provided on the bottom face of the slab, being formed integrally with the slab, such pads being of sufficient thickness to provide the desired protection of the rods against fire and corrosion and for providing a strong bond between the rods and the slab.

As is well understood in connection with a structure of this type comprising a slab extending over and between a series of spaced supports, there is, under normal conditions involving substantially equal spacing of the supports and uniform loading between supports, in each span a central zone of bottom tension and top compression, with a zone on each side thereof of top tension and bottom compression, the neutral points between zones being called points of inflection. Under conditions of even loading throughout the span and equal spacing of the supports, the points of inflection are located at a distance from the supports corresponding to

approximately one-fifth of the span. The top tension rods 13 are accordingly made of such length as to extend at each side of a support well beyond the normal point of inflection, such rods extending preferably about one-fourth of the distance across the span. The bond between one end portion of a top tension rod 13 and the concrete slab serves as the anchor for the opposite end portion of the rod. The bottom tension members 16 also are sufficiently anchored to the slab by their end portions which extend well beyond the point of inflection at each side of the span.

By reason of the positioning of the bottom tension rods 16 directly at the bottom face of the main portion of the slab, preferably in centered position with respect to the plane of the bottom face, the entire thickness of the slab is effective for developing compressive stresses, rendering the structure of maximum efficiency with respect to both the steel and the concrete in this regard.

As is well understood in the art, the external forces which cause failure of a reenforced concrete floor structure by reason of inadequate diagonal tension in the structure are effective principally at the level of the bottom reenforcement for the structure at the point where the failure occurs. It follows accordingly that when deep reenforced ribs are provided on the bottom face of a slab across the span, such ribs are required by themselves to provide all the diagonal tension necessary for supporting the span, the slab itself assisting very little if any at all in developing effective diagonal tension. By my construction, in which there is no deep reenforced rib or other reenforced or reenforcing structural part between the main supporting members lower than the bottom face of the slab itself, effective diagonal tension stresses are developed directly in the slab itself and the full section of the slab is effective for this purpose.

In a reenforced concrete floor or similar structure, the compressive forces are greatest at the compressive face and decrease to zero at the neutral axis at some point between the compressive face and the plane of the centers of the tensioning bars. By the location of the bottom reenforcing bars 16 substantially at the bottom face of the slab with the depth of concrete in the pads extending below the bars merely sufficient for providing protection against fire and corrosion, the bottom compressive stresses in the slab adjacent to the supporting beams are very materially increased, in view of the much greater compressive strength of the steel as compared with that of the concrete, steel having a compressive strength of from ten to fifteen times that of concrete in a similar position.

By the use of my construction, I have provided the maximum strength in proportion to the amount and weight of concrete required. With an allowable steel stress of eighteen thousand pounds per square inch and an allowable concrete stress of seven hundred pounds per square inch on extreme fiber, my improved slab of a thickness of two and one-half inches will span a distance of ten and one-half feet with a superposed load of forty pounds per square foot in the one-way construction above described. By the development and refinement of the slab structure by which I am able to span a distance of ten and a half feet without the use of strengthening ribs, I have very materially cut down the amount of concrete necessary as compared with those constructions in which such strengthening ribs are used and I have thus greatly reduced the load to be carried by the girders, columns and foundations of the building.

My construction has substantially as great an advantage as compared with an ordinary slab construction, in which the bottom tensioning bars are located above the lower surface for purposes of fire-proofing and bonding. In such construction, it is necessary that the slab be made from an inch to two inches thicker in order to provide the required positive compressive stresses above such tensioning bars, such increase in thickness serving to increase the amount and the weight of the concrete from forty to sixty per cent. or more.

In some ways, the greatest advantage of all in the use of my construction resides in the fact that thereby the over-all thickness of the combination floor and ceiling is very materially cut down, both because of having the slab structure itself of less depth or thickness and also because of the fact that no lath and plaster are necessary. If eight inches be saved at each floor, a builder would be able to provide twenty-one stories by the use of my construction as compared with twenty stories by the former constructions, all without in any way weakening the construction.

Referring now to the construction shown in Figs. 3 and 4, beams 18 are provided in spaced relation to each other, with beams 19 also in spaced relation to each other in crossed position with respect to the beams 18, only one of the beams 19 being shown in the drawings. A column 20 of any approved type is shown as supporting the structure at the juncture of the beams 18 and 19. The form of the beams 18 and 19 differs from that of the beam 10, but at either point any approved form may be used. The construction shown in Figs. 3 and 4 is substantially the same as that above described in connection with Figs. 1 and 2, except that the construction shown in said Figs. 3 and 4 is what is known as the two-way construction, involving the use of reenforcing members

extending both ways through the floor. In this construction as shown, the slab 21 is provided with edge strip portions 22 of increased thickness along each of its four side edges, such edge strip portions being of such increased thickness and of such width as to provide the desired bottom compressive strength for the portions of the slab adjacent to the beams. The bottom tension rods are preferably placed as near as possible to the plane of the bottom face of the main portion of the slab, in the construction shown, the bottom tension members 23 running in one direction being located with their centers slightly below such plane and the bottom tension rods 24 running in the opposite direction being positioned with their centers slightly above such plane, this being necessary in order to allow such bars 23 and 24 to pass each other. In the construction shown, a single bottom tensioning rod is used in lieu of the two bottom tensioning rods 16 as shown in Fig. 1. In the form shown in said Figs. 3 and 4, top tensioning rods are employed in transverse position with respect to each of the beams 18 and 19, the top tensioning bars in one direction being indicated by the numerals 25 and the top tensioning bars in the cross direction being indicated by the numerals 26, a plurality of such tensioning bars being preferably connected by means of bars or wires 27 in grill form as above described in connection with the form shown in Figs. 1 and 2, the desired number of such grills being employed for securing the required reenforcement. Pads or ribs of concrete 28 are employed in both directions across the bottom face of the slab serving to bond the bottom tension bars 23 and 24 to the slab and to protect such tension members against fire and corrosion.

As is well understood in the art, the bottom compressive stresses are greatest at the faces of the supports and decrease gradually toward the points of inflection. By reason of making the edge strips 12 of the slab of increased thickness, with the bottom faces of the edge strips preferably in alignment with the bottom faces of the pads or ribs 17, the effective thickness of the slab underneath the top tension bars 13 is made to correspond substantially to the thickness of the slab above the bottom tension rods 16 at the center of the span where the top compressive stresses are the greatest. The edge strips 12 of increased thickness are made of such width as to extend inwardly toward the points of inflection to such a distance as to provide the desired compressive strength for such edge portions. By reason of the decrease in the compressive stresses toward the point of inflection, it is not necessary that the increased thickness be continued the full distance to the points of inflection, even when such strips of increased thickness are used. In any case it is sufficient that the increased thickness be carried to the point at which the thinner main portion of the slab develops the required compression in cooperation with the bottom compression bars for providing the required support. It will be understood that in many cases it is not necessary to make the edge strips of increased thickness but that in such cases edge strips of a thickness corresponding to the thickness of the main portion of the slab develop the required compressive stresses even at the points adjacent to the faces of the supporting beams.

By the use of the two-way construction involving the pads or ribs 28 extending in crossed relationship to each other, and either with or without the edge strips 22 of increased thickness corresponding to the combined thickness of the pads and the main portion of the slab, a very attractive paneled ceiling is provided. By using care with respect to the contour of the forms against which the edges of the pads and the edges of the strips 22 are molded, a decorative effect is produced without detracting in any way from the effectiveness of the structure mechanically. The arrangement is such that upon the removal of the forms the structure is ready for receiving its final coats of paint or other decorations without the necessity for employing lath or plaster upon the bottom face of the slab, this being made possible by reason of the fact that the individual slab face sections are of such size that they can be cast readily upon integrally formed molds pressed from sheet metal into shape without joints or ribs of any type, the parts of the mold against which the edge portions of the ribs or pads are cast being also formed integrally with the mold for the slab face section.

By the use of my improved construction as described in connection with Figs. 3 and 4, I am able to span a distance of approximately sixteen and a half feet both ways between the supporting beams, with an allowable steel stress of eighteen thousand pounds per square inch and an allowable concrete stress of seven hundred pounds per inch on extreme fiber, without the use of strengthening ribs. I am able thus to make a radical saving in the amount of concrete required, with its corresponding saving throughout the structure.

While I prefer to employ the form of construction as illustrated in the drawings, it is to be understood that I do not limit the invention to the form shown except so far as the claims may be so limited by the prior art.

I claim:—

1. In a reenforced and fire-proof concrete structure, the combination of a plurality of longitudinally extending supports in spaced relation to each other, a slab of concrete extending from one support to the other, reenforcing rods extending in spaced relation

to each other between said supports at substantially the plane of the bottom face of the slab, and pads of concrete formed integrally with said slab on its bottom face and serving to imbed said reenforcing rods between the slab and the pads, said slab of concrete and said imbedded rods serving by themselves by their cooperation to support their own weight from said supports and also to carry a predetermined additional load.

2. In a reenforced and fire-proof concrete structure, the combination of a plurality of longitudinally extending supports in spaced relation to each other, a slab of concrete extending from one support to the other, reenforcing rods extending in spaced relation to each other between each two successive supports at substantially the plane of the bottom face of the slab at the central portion thereof serving as the bottom tension members for the intermediate portion of the slab and extending only slightly either above or below said plane at any point throughout their effective tension portions whereby substantially the full section of the slab above such rods is effective for developing positive compression, and pads of concrete formed integrally with said slab on its bottom face and serving to imbed said reenforcing rods between the slab and the pads, said slab of concrete and said imbedded rods serving by themselves by their cooperation to support their own weight from said supports and also to carry a predetermined additional load.

3. In a reenforced and fire-proofed concrete structure, the combination of a plurality of longitudinally extending supports in spaced relation to each other, a slab of concrete extending from one support to the other, reenforcing rods extending in spaced relation to each other between said supports and each located at substantially the plane of the bottom face of the slab and also at the lowermost point of effective stresses in said structure, and pads of concrete formed integrally with said slab on its bottom face and serving to imbed said reenforcing rods between the slab and the pads.

4. In a reenforced and fire-proof concrete structure, the combination of a plurality of longitudinally extending supports in spaced relation to each other, a slab of concrete extending from one support to the other, reenforcing rods for said slab extending in spaced relation to each other between each two successive supports, with the lowermost reenforcing rods located substantially at the plane of the bottom face of the slab at the edge portions of the slab adjacent to the supports whereby the slab itself is effective for developing diagonal tension, and pads of concrete formed integrally with said slab on its bottom face and serving to imbed said reenforcing rods between the slab and the pads, said slab of concrete and said imbedded rods serving by themselves by their cooperation to support their own weight from said supports and also to carry a predetermined additional load.

5. In a reenforced and fire-proofed concrete structure, the combination of a plurality of longitudinally extending supports in spaced relation to each other, a slab of concrete extending from one support to the other, reenforcing rods extending in spaced relation to each other between each two successive supports at substantially the plane of the bottom face of the slab, and pads of concrete formed integrally with said slab on its bottom face and serving to imbed said reenforcing rods between the slab and the pads throughout the full span from one support to the other, the central portions of the rods serving as the bottom tension members for the intermediate portion of the slab and extending only slightly either above or below the plane of the bottom face of the slab at any point throughout their effective tensioning portions whereby substantially the full section of the slab above said reenforcing rods is effective for developing positive compression, and the end portions of the rods serving as the lowermost reenforcing elements of the structure adjacent to said supports whereby the slab itself is effective for developing diagonal tension at the edge portions adjacent to said supports.

6. In a reenforced and fire-proofed concrete structure, the combination of a plurality of longitudinally extending supports in spaced relation to each other, a slab of concrete extending from one support to the other, and reenforcing rods bonded to said slab and extending in spaced relation to each other between said supports in such position with respect to the slab as to cause substantially the full depth of the concrete of the slab to be effective for building up both positive compression and diagonal tension.

7. In a reenforced and fire-proofed concrete structure, the combination of a plurality of longitudinally extending supports in spaced relation to each other, a slab of concrete extending from one support to the other, reenforcing rods extending in spaced relation to each other between said supports in a single horizontal plane, and pads of concrete formed integrally with said slab on its bottom face and serving to imbed said reenforcing rods between the slab and the pads, the arrangement being such that substantially the full depth of the concrete of the slab is effective for developing top compression at the middle portion of the slab and for developing diagonal tension in the portions of the slab approaching the supports.

8. In a reenforced and fire-proofed concrete structure, the combination of a plurality of longitudinally extending supports in spaced relation to each other, a slab of con-

crete extending from one support to the other, reenforcing rods, and pads of concrete formed integrally with said slab on its bottom face serving to bond said rods directly to said slab in horizontally spaced relation to each other between said supports at substantially the plane of the bottom face of the slab so as to cause substantially the full depth of the concrete of the slab to be effective for building up top compression with respect to the rods at the middle portion of the slab and to cause the same reenforcing rods to be effective for building up bottom compression at the portions of the slab adjacent to said supports.

9. In a reenforced and fire-proofed concrete structure, the combination of a plurality of longitudinally extending supports in spaced relation to each other, a slab of concrete extending between said supports, and reenforcing rods extending in spaced relation to each other transversely from said supports and held against movement longitudinally of themselves with respect to said supports and imbedded in the slab near the top face of the slab serving as the top tension members for said edge portions of the slab, said slab comprising edge strips underneath said reenforcing rods adjacent to said supports of increased thickness as compared with the thickness of the major portion of the span of the slab and of such width transversely from the supports as to provide adequate compressive strength with respect to said imbedded tension rods.

10. In a reenforced concrete structure, the combination of longitudinally extending supports in spaced relation to each other, a slab of concrete extending from one support to the other, reenforcing rods bonded with the slab at substantially the bottom face of the intermediate portion of the slab serving as the bottom tension members between said supports for said intermediate portion of the slab, and other reenforcing rods imbedded in the slab and bonded therewith near the top face of the slab at its edge portions adjacent to said supports serving as the top tension members for said edge portions, said slab comprising edge strips of increased thickness underneath said second named reenforcing rods adjacent to said supports and extending toward the points of inflection for the slab between the supports serving to provide with respect to said second named tension rods substantially as great compressive strength for said edge strips as is provided by the intermediate slab portion with respect to said first named tension rods.

11. In a reenforced concrete structure, the combination of longitudinally extending supports in spaced relation to each other, a slab of concrete extending from one support to the other, reenforcing rods extending across the slab substantially at the bottom face of the main intermediate portion thereof, pads of concrete formed integrally with the slab on the bottom face thereof underneath said reenforcing rods bonding said rods to the slab whereby such rods serve as the bottom tension members between said supports for said intermediate portion of the slab, and other reenforcing rods extending in spaced relation to each other transversely from said supports and held against movement longitudinally of themselves with respect to said supports and imbedded in the slab near the top face of the slab serving as the top tension members for said edge portions, said slab comprising edge strips having downwardly offset bottom faces adjacent to said supports in substantially the same plane as that of the bottom faces of said pads and extending toward the point of inflection for the slab between the supports, said edge strips of increased thickness serving to provide with respect to said second named tension rods substantially the same compressive strength for said edge strips as is provided by the intermediate slab portion with respect to said first named reenforcing rods.

12. In a reenforced and fire-proofed concrete structure, the combination of two longitudinally extending supports in spaced relation to each other, two other longitudinally extending supports in spaced relation to each other and in cross relationship to said first named supports, a slab of concrete extending between said several supports, reenforcing rods extending in spaced relation to each other between two of said supports, other reenforcing rods extending in spaced relation to each other between the other two supports, all of said reenforcing rods being positioned substantially at the plane of the bottom face of the slab, and comparatively shallow and narrow pads of concrete formed integrally with said slab on its bottom face serving to imbed said reenforcing rods between the slab and the pads and serving to provide a two-way paneled bottom face on the slab ready for decoration.

13. In a reenforced and fire-proofed concrete structure, the combination of two longitudinally extending supports in spaced relation to each other, two other longitudinally extending supports in spaced relation to each other and in cross relationship to said first named supports, a slab of concrete extending between said several supports, reenforcing rods extending in spaced relation to each other between two of said supports, other reenforcing rods extending in spaced relation to each other between the other two supports, all of said reenforcing rods being positioned substantially at the plane of the bottom face of the slab, and comparatively shallow and narrow pads of concrete formed integrally with said slab on its bottom face serving to imbed said reenforcing rods between the slab and the pads and serving to provide a two-

way paneled bottom face on the slab ready for decoration, said slab comprising at its edges adjacent to said supports edge strips of substantially as great thickness as the combined thickness of the pads and the intermediate portion of the slab.

14. In a reenforced and fire-proofed concrete structure, the combination of two longitudinally extending supports in spaced relation to each other, two other longitudinally extending supports in spaced relation to each other and in cross relationship to said first named supports, a slab of concrete extending between said several supports, reenforcing rods extending in spaced relation to each other between two of said supports, other reenforcing rods extending in spaced relation to each other between the other two supports, all of said reenforcing rods being positioned substantially at the plane of the bottom face of the slab, comparatively shallow and narrow pads of concrete formed integrally with said slab on its bottom face serving to imbed said reenforcing rods between the slab and the pads and serving to provide a two-way paneled bottom face on the slab ready for decoration, and other reenforcing rods imbedded in the slab and bonded therewith near the top face of the slab at the edge portions adjacent to said supports serving as the top tension members for said edge portions of the slab, said slab comprising edge strips of substantially the same thickness underneath said third named reenforcing rods adjacent to said supports as the combined thickness of the pads and the intermediate portion of the slab, said edge strips being of such width transversely from the supports as to provide adequate compressive strength with respect to said top tension rods.

15. In a reenforced and fireproofed concrete structure, the combination of a longitudinally extending support, a slab of concrete supported at one edge by said support and extending laterally therefrom, a reenforcing rod alongside of said support in spaced relation thereto at substantially the plane of the bottom face of the slab, and a pad of concrete formed integrally with the slab on its bottom face about said rod and serving to bond the rod directly to the slab whereby substantially the full depth of the concrete of the slab is effective for developing top compression with respect to the rod at its middle portion and for developing diagonal tension at the end portions of the rod.

16. In a reenforced and fireproofed concrete structure, the combination of a longitudinally extending support, a slab of concrete extending laterally from the support at both sides thereof and supported thereby at the parts adjacent thereto, reenforcing rods alongside of said support at opposite sides thereof respectively in spaced relation thereto at substantially the plane of the bottom face of the slab, and pads of concrete formed integrally with the slab on its bottom face about said rods serving to bond the rods directly to the slab whereby substantially the full depth of the concrete of the slab is effective for developing top compression with respect to the rods at their middle portions and for developing diagonal tension at the end portions of the rods.

17. In a reenforced and fireproofed concrete structure, the combination of a plurality of longitudinally extending supports in spaced relation to each other, transverse supporting means connecting said first named supports in series, a slab of concrete extending over the intermediate spaced supports and connecting the outermost spaced supports alongside of said transverse supporting means, reenforcing rods extending between adjacent spaced supports in spaced relation to the transverse supporting means at substantially the plane of the bottom face of the slab, and pads of concrete formed integrally with the slab on its bottom face about said rods serving to bond the rods directly to the slab whereby substantially the full depth of the concrete of the slab is effective for developing top compression with respect to the rods at their middle portions and for developing diagonal tension at the end portions of the rods.

18. In a reenforced and fireproofed concrete structure, the combination of two longitudinally extending supports in spaced relation to each other, two other longitudinally extending supports in spaced relation to each other in crossed relationship to said first named supports, a slab of concrete extending between said several supports, reenforcing rods securely connected between each two spaced supports at opposite marginal portions of the slab in spaced relation to the cross-positioned supports, each of said four reenforcing rods being positioned substantially at the plane of the bottom face of the slab, and pads of concrete formed integrally with the slab on its bottom face serving to imbed the several reenforcing rods between the slab and the pads.

19. A reenforced concrete structure comprising in combination a slab of concrete, a second slab of concrete of smaller depth formed integrally therewith, a reenforcing bar extending across said thinner slab portion at substantially the bottom face thereof and extending into said thicker slab portion, and a pad of concrete formed integrally with said thinner slab portion surrounding said reenforcing bar serving to bond said bar directly with said thinner slab portion and merging at its end with said thicker slab portion.

20. A reenforced concrete structure comprising in combination a slab of concrete, a

second slab of concrete of smaller depth formed integrally therewith, a series of reenforcing bars extending across said thinner slab portion at substantially the bottom face thereof and extending into said thicker slab portion at spaced intervals therealong, pads of concrete formed integrally with said thinner slab portion and surrounding said reenforcing bars for bonding them directly to said thinner slab portion, said pads merging at their ends with said thicker slab portion, and a series of negative reenforcing bars extending across said thicker slab portion and into said thinner slab portion adjacent to the upper face of said united slab structure, said second named bars being in substantially parallel position with respect to said first named reenforcing bars.

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