

J. E. CONZELMAN.
 SYSTEM OF REINFORCEMENT FOR CONCRETE SLABS.
 APPLICATION FILED APR. 27, 1911.

1,031,045.

Patented July 2, 1912.

3 SHEETS—SHEET 1.

Fig. 1.

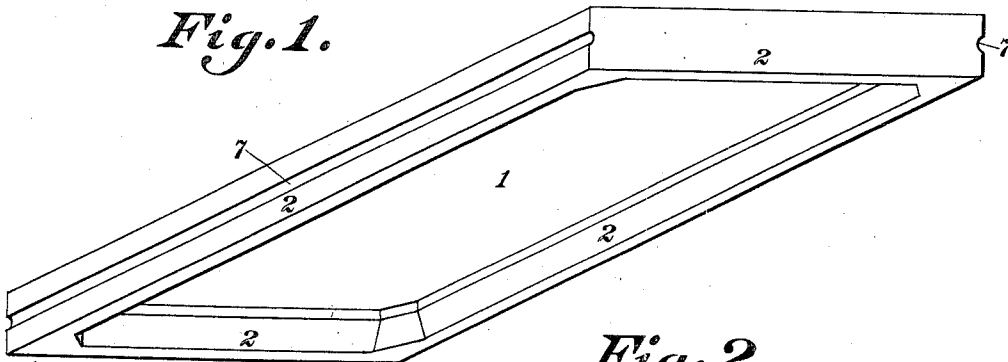


Fig. 2.

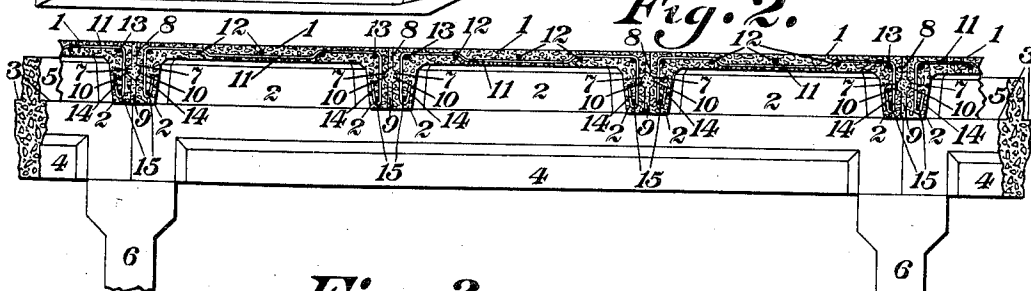


Fig. 3.

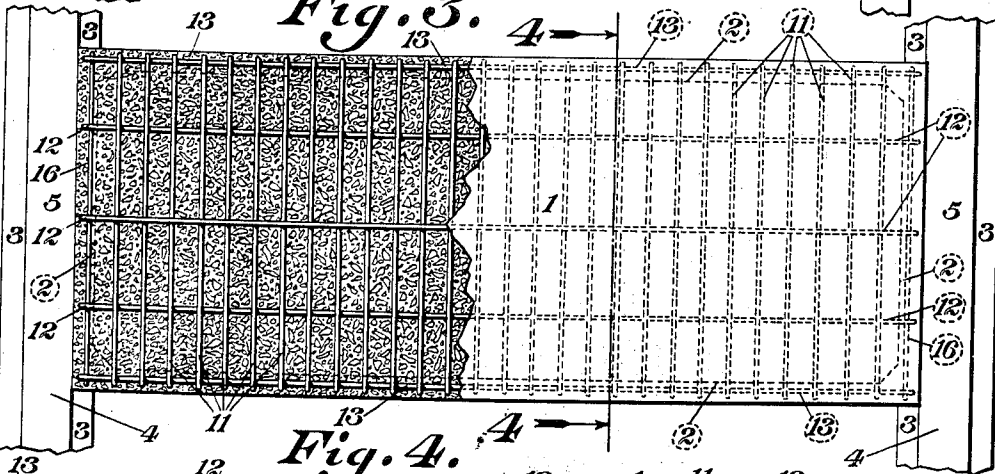
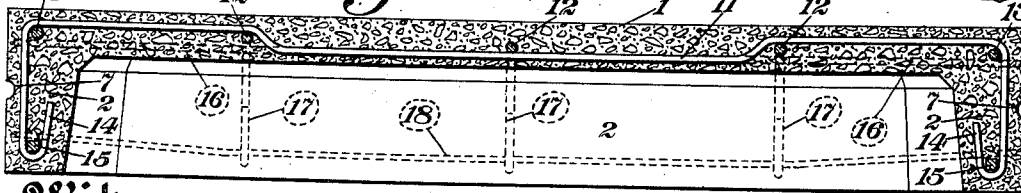


Fig. 4.



Witnesses:

George L. Anderson.
 Harry H. Peiss.

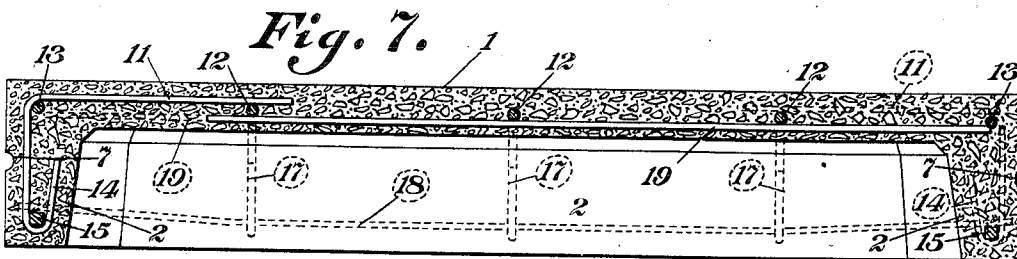
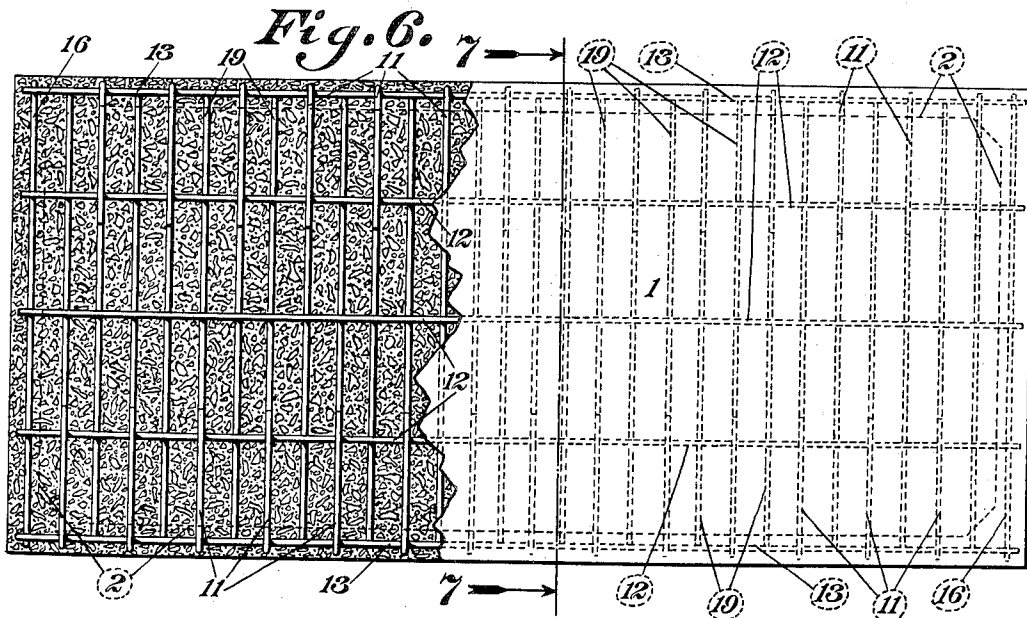
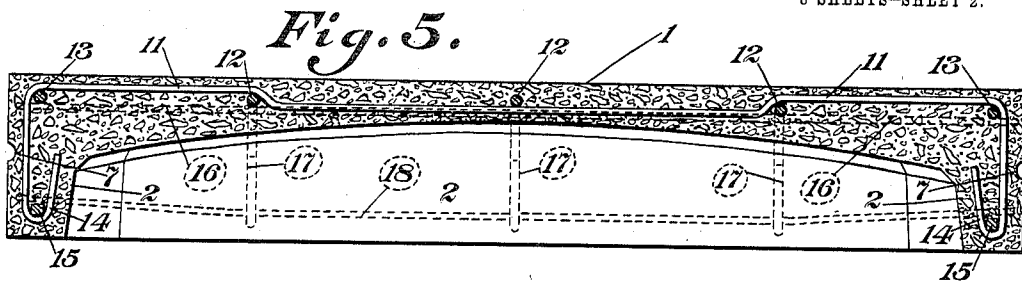
Inventor:
 John E. Conzelman;
 By Hugh N. Wagner,
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3 SHEETS—SHEET 2.



Witnesses:

George L. Anderson.
Harry H. Peiss.

Inventor:

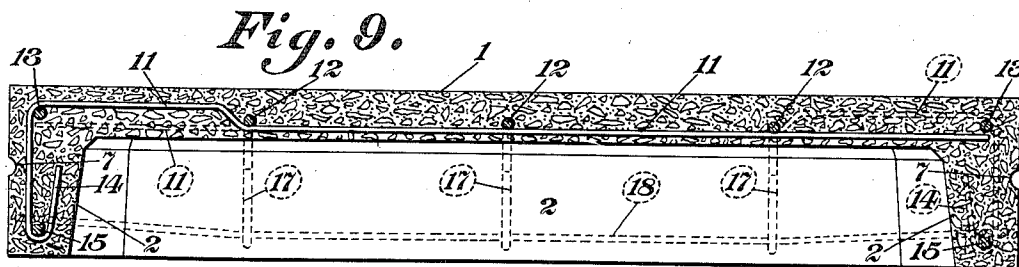
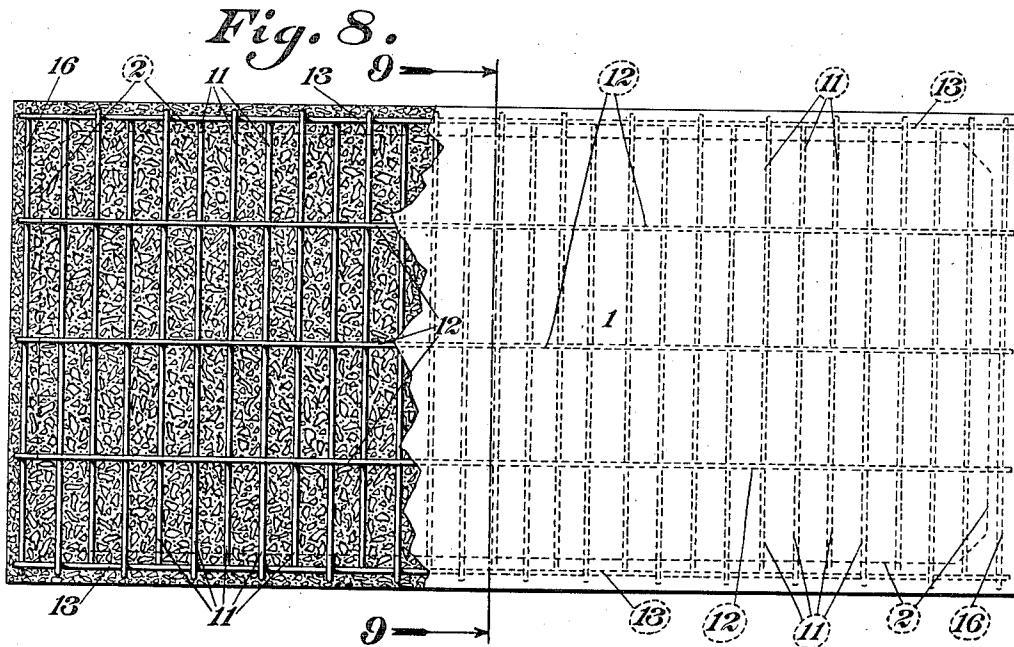
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3 SHEETS—SHEET 3.



Witnesses:

George G. Anderson.
Harry H. Peiss.

Inventor:

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UNITED STATES PATENT OFFICE.

JOHN E. CONZELMAN, OF ST. LOUIS, MISSOURI, ASSIGNOR TO UNIT CONSTRUCTION COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF DELAWARE.

SYSTEM OF REINFORCEMENT FOR CONCRETE SLABS.

1,031,045.

Specification of Letters Patent.

Patented July 2, 1912.

Application filed April 27, 1911. Serial No. 623,751.

To all whom it may concern:

Be it known that I, JOHN E. CONZELMAN, a citizen of the United States, residing at the city of St. Louis, State of Missouri, have invented certain new and useful Improvements in Systems of Reinforcement for Concrete Slabs, of which the following is a specification.

This invention relates to concrete construction in which concrete slabs rest on concrete beams or other supports and are themselves united to form a rigid and unitary structure.

The chief object of the present invention is to provide an improved system of reinforcement for concrete slabs so that, by using less steel and concrete than is customarily used in the formation of reinforced concrete slabs, the slabs can be made as strong and durable as slabs heretofore made. The saving of steel and concrete that results from the use of this system of reinforcement not only reduces the cost of construction to a minimum, but, also, lessens the dead weight of the structure.

Another object of the present invention is to provide a system of reinforcement for concrete slabs, whereby cracks are prevented from forming in the top and bottom surfaces of the slabs.

Further, this invention consists in the provision of a system of reinforcement in which the ends of the reinforcing bars are anchored in such manner so that the chance of sudden failure or breaking of the adhesion between the bars and the concrete is lessened and, also, so that continuous action of the reinforcement in adjoining slabs is obtained.

In the accompanying drawings forming part of this specification, in which like numbers of reference denote like parts wherever they occur, Figure 1 is a perspective view showing the particular type of slab in which this system of reinforcement is used; Fig. 2 is a sectional view of a structure composed of a plurality of such slabs; Fig. 3 is a top plan view of one of the slabs, part of the same being broken away to expose the reinforcement; Fig. 4 is a sectional view, on an enlarged scale, on the line 4—4, Fig. 3; Fig. 5 is a sectional view of an alternate form of slab; Fig. 6 is a top plan view of a slab, part of the same being broken away to expose an alternate form of reinforcement; Fig. 7 is a sectional view,

on an enlarged scale, on the line 7—7, Fig. 6; Fig. 8 is a top plan view of a slab, part of same being broken away to expose an alternate form of reinforcement; and Fig. 9 is a sectional view, on an enlarged scale, on the line 9—9, Fig. 8.

Each slab 1 is molded with any desired configuration and is provided with a flange 2, which projects downwardly from the sides and ends of same. Said slab may be formed with a uniform thickness throughout, as depicted in Figs. 4, 7, and 9, or, if desired, the bottom surface of said slab may be arched as shown in Fig. 5. The flanges 2 at the ends of each slab 1 rest on shoulder 3 of a beam 4 and against tenon 5 on said beam, said beam being supported by columns 6 or other suitable supports and being preferably formed with substantially the same cross-sectional configuration as the beam disclosed in my copending application Serial No. 528,298, filed November 16, 1909.

Each side of slab 1 is preferably provided with a groove 7, which extends longitudinally thereof. When two slabs are placed in position on beams 4, a crack 8 is left between the adjoining sides of said slabs and the grooves 7 in said sides register with each other. Boards or formers (not shown in the drawings) are placed underneath cracks 8 and grout or similar cement mixture or wet concrete is poured into said cracks and, also, upon said boards or formers. When the grout or other mixture is poured into a crack 8, the same is leveled off flush with the surface of slabs 1, and, when it sets, forms a cement or concrete key 9 with tongues projecting into grooves 7 and unites the adjoining sides of slabs 1 that form said crack integrally together, as in the construction constituting the subject-matter of my copending application Serial No. 555,355, filed April 14, 1910.

In Figs. 3 to 9, inclusive, the reinforcement in the slabs 1 is illustrated. In Figs. 3, 4, and 5, the reinforcement consists of a plurality of reinforcing bars 11 and 12, said bars 11 extending transversely of slab 1 and being spaced apart at intervals, and said bars 12 extending longitudinally of said slab and, also, being spaced apart at intervals. Each bar 11 lies near the bottom surface of slab 1 in order to prevent said slab from sagging and, also, to prevent the bottom surface of said slab from cracking. Bar

11 extends underneath a bar 12 or a plurality of such bars in the middle part of slab 1, and, near the flange 2 at the sides of said slab, turns upwardly and extends near the top surface of said slab, in order to prevent same from cracking, because at these points the greatest stress is near the top surface. Each part of bar 11 that lies near the top surface of slab 1 extends over a bar 12 or a plurality of such bars and, adjacent the sides of said slab, said bar turns downwardly and extends into the flange 2 at the sides of said slab. A pair of bars 13 lies near the upper surface of slab 1 and extends approximately from end to end of said slab, said bars 13 being located adjacent the sides of said slab and underlying the points where bar 11 turns downwardly into flange 2. Adjacent the bottom of the flange 2 at the sides of slab 1, the ends of bars 11 preferably turn inwardly and upwardly and form stirrups 14. A bar 15 is embedded in the lower part of flange 2 at one side of slab 1 and another bar 15 is embedded in the lower part of flange 2 at the other side of said slab. Said bars 15 are preferably located directly below bars 13, respectively, and extend through all of the stirrups 14 that are embedded in flange 2, thereby anchoring the ends of each bar 11 securely in said flange. By this arrangement, whenever a slab 1 is loaded, the bars 11 are prevented from being pulled through the concrete and the chance of sudden failure, *i. e.*, the chance of the breaking of the adhesion between the bars 11 and the concrete is lessened.

Adjacent the ends of the slab 1, each bar 12 turns downwardly over bars 16 and extends into flange 2 at the ends of said slab, and, near the bottom of said flange, the ends of said bar 12 preferably turn inwardly and upwardly and form stirrups 17. Bars 18 that are embedded in the lower part of flange 2 at the ends of slab 1 extend through the stirrups 17 and thereby anchor the ends of bars 12 securely in said flange, so as to prevent said bars 12 from being pulled through the concrete when said slab is loaded. Two of the bars 12 that underlie the bars 11 are preferably located at or near the points where each bar 11 turns downwardly into the middle part of said slab, in order to prevent said bars 11 from shearing through the concrete.

When a slab 1 is loaded, the tendency of the load is to cause the middle parts of said slab to sag and thereby produce cracks in the bottom surface of the middle part of said slab and, also, in the top surface near the sides of said slab, but this sagging and cracking is prevented by the bars 11 and 12. The pressure of the load on slab 1 not only tends to cause the middle part of said slab to sag, but, also, tends to tilt the flange 2. As the flange 2 at the ends of said slab abuts

the tenons 5 of beams 4 or other supports, and the flange 2 at the sides of said slab is joined to the flanges 2 of the slabs 1 adjacent thereto, the lower part of same presses against the lower part of said tenons and, also, against the lower parts of the flanges 2 of the slabs adjacent thereto, thereby subjecting the bars 11 and 12 to tensile stress. By reason of the ends of bars 11 being anchored in the flange 2 at the sides of slab 1 and, also, of said flange being joined to the flanges 2 at the sides of the slabs 1 adjacent thereto, as hereinabove described, continuous action of the reinforcement in said slab and the reinforcement in the next slab or slabs is maintained.

In the arrangement of the reinforcement depicted in Figs. 6 and 7, each bar 11 has only one end thereof anchored in flange 2 in the manner hereinabove described. Said bar 11 lies near the top surface of slab 1 and is relatively short, extending from the flange 2 at a side of said slab toward the middle part of said slab and terminating at or near the point where the stress in the top surface changes from tension to compression. Said bar 11 extends over a bar or bars 12, and one of said bars 12 is preferably located at or near the end of said bar 11. A plurality of these short bars 11 is embedded in one side of slab 1 and another plurality of such bars is embedded in the other side of said slab, the former bars being arranged in staggered relation with respect to the latter bars. Reinforcing bars 19 are embedded in the lower part of slab 1 and are preferably located in the same vertical planes with the bars 11, respectively. Each bar 19 extends underneath a bar 12 or a plurality of such bars and, also, underneath a bar 13. Said bar 19 is relatively shorter than the width of slab 1 and extends from one side thereof to a point underneath the end of a bar 11 in the opposite side of said slab and, also, in the same vertical plane with said bar 19. By this arrangement, the bars 11 prevent the top surface of slab 1 from cracking adjacent the sides of the same and the bars 19 prevent the bottom surface of said slab from cracking.

In Figs. 8 and 9 each bar 11 has only one end thereof anchored in the flange 2 in the manner hereinabove described. Said bar 11 is embedded in the lower part of slab 1, in order to prevent said slab from sagging and, also, to prevent the bottom surface of same from cracking. One end of said bar 11 is anchored in the flange 2 at one side of slab 1 and the other end of same terminates underneath a bar 13 adjacent the other side of said slab, the next bar 11 being reversed so that its end is anchored in flange 2 at said other side of slab 1. Said bar 11 extends underneath a bar 12 or a plurality of

such bars and, adjacent the side in which the end of said bar 11 is anchored, said bar 11 turns upwardly and extends near the top surface of said slab, so as to prevent the same from cracking, one of the bars 12 being preferably located above the point where said bar 11 turns upwardly.

One great advantage arising from the manner of arranging the reinforcement, as hereinabove described, is that less steel and concrete is required to form slabs equally as strong as slabs heretofore made, thus lessening the dead weight of the structure and reducing the cost of construction to a minimum.

It should be understood that, while the bars 14 are square and the other bars are round, bars with any desired cross-sectional configuration may be utilized.

I claim:

1. A concrete slab having a flange projecting downwardly from the sides and ends thereof, reinforcing bars embedded in the lower part of said slab and extending transversely thereof, said bars turning upwardly adjacent the sides of said slab and extending near the top surface of same, each of said bars turning downwardly adjacent the sides of said slab and extending into said flange and the ends of said bar turning upwardly in said flange and forming stirrups, bars embedded in said flange and extending through said stirrups, bars extending longitudinally of said slab and underlying the points where said first-mentioned bars turn downwardly into said flange, and reinforcing bars extending longitudinally of said slab and having stirrups at the ends thereof embedded in the flange at the ends of said slab, some of said last-mentioned bars extending underneath the parts of said first-mentioned bars that lie near the top surface of said slab and another of said last-mentioned bars extending above the parts of said first-mentioned bars that lie in the lower part of said slab.

2. A concrete slab having a flange projecting downwardly from the sides and ends thereof, reinforcing bars extending transversely of the length of and embedded in the upper part of said slab and located adjacent the sides of same, the bars adjacent one side of said slab being alternately arranged with respect to the bars adjacent the other side of said slab, reinforcing bars embedded in the lower part of said slab and extending transversely of same, said last-mentioned bars being relatively shorter than the width of said slab and being disposed on opposite sides of the slab so that a bar on one side extends between a pair of bars on the opposite side, and each of said first-mentioned bars having a stirrup anchored in said flange.

3. A concrete slab having a flange project-

ing downwardly from the sides and ends thereof, reinforcing bars extending transversely of the length of and embedded in the upper part of said slab and located adjacent the sides of same, the bars adjacent one side of said slab being alternately arranged with respect to the bars adjacent the other side of said slab, reinforcing bars embedded in the lower part of said slab and extending transversely of same, said last-mentioned bars being relatively shorter than the width of said slab and being disposed on opposite sides of the slab so that a bar on one side extends between a pair of bars on the opposite side, and each of said first-mentioned bars having a stirrup anchored in said flange, said second-mentioned bars being disposed in the same vertical planes with said first-mentioned bars, respectively, and extending partly underneath the ends of same.

4. A concrete slab having a flange projecting downwardly from the sides and ends thereof, reinforcing bars extending transversely of the length of and embedded in the upper part of said slab and located adjacent the sides of same, the bars adjacent one side of said slab being alternately arranged with respect to the bars adjacent the other side of said slab, reinforcing bars embedded in the lower part of said slab and extending transversely of same, said last-mentioned bars being relatively shorter than the width of said slab and being disposed on opposite sides of the slab so that a bar on one side extends between a pair of bars on the opposite side, each of said first-mentioned bars having a stirrup anchored in said flange, said second-mentioned bars being disposed in the same vertical planes with said first-mentioned bars, respectively, and extending partly underneath the ends of same, and bars extending longitudinally of said slab and extending over said second-mentioned bars and under said first-mentioned bars.

5. A concrete slab having a flange projecting downwardly from the sides and ends thereof, reinforcing bars extending transversely of the length of and embedded in the upper part of said slab and located adjacent the sides of same, the bars adjacent one side of said slab being alternately arranged with respect to the bars adjacent the other side of said slab, reinforcing bars embedded in the lower part of said slab and extending transversely of same, said last-mentioned bars being relatively shorter than the width of said slab and being disposed on opposite sides of the slab so that a bar on one side extends between a pair of bars on the opposite side, each of said first-mentioned bars having a stirrup anchored in said flange, said second-mentioned bars being disposed in the same vertical planes with said first-mentioned

bars, respectively, and extending partly underneath the ends of same, bars extending longitudinally of said slab and extending over said second-mentioned bars and under said first-mentioned bars, and stirrups borne by the ends of some of said bars that extend longitudinally of said slab and being anchored in the flange at the ends of said slab.

6. A concrete slab having a flange projecting downwardly from the sides and ends thereof, reinforcing bars extending transversely in the lower part of said slab and turning upwardly adjacent one side of said slab and extending near the top surface of the same, reinforcing bars extending transversely in the lower part of said slab and turning upwardly adjacent the other side of said slab and extending near the top surface of the same, said first-mentioned bars being arranged with respect to said second-mentioned bars, so that a bar of the first-mentioned bars extends between a pair of bars of the second mentioned bars, each of said first-mentioned bars having a stirrup anchored in the flange at one side of said slab, and each of said second-mentioned bars having a stirrup anchored in the flange at the other side of said slab.

7. A concrete slab having a flange projecting downwardly from the sides and ends thereof, reinforcing bars extending transversely in the lower part of said slab and turning upwardly adjacent one side of said slab and extending near the top surface of the same, reinforcing bars extending transversely in the lower part of said slab and turning upwardly adjacent the other side of said slab and extending near the top surface of the same, said first-mentioned bars being arranged with respect to said second-mentioned bars, so that each of the former extends between a pair of the latter, each of said first-mentioned bars having a stirrup anchored in the flange at one side of said slab, each of said second-mentioned bars having a stirrup anchored in the flange at the other side of said slab, and bars extending longitudinally of said slab and extending over the parts of all of said first-mentioned and second-mentioned bars that lie in the lower part of said slab and under the parts of all of said first-mentioned and second-mentioned bars that lie near the upper surface of said slab.

8. A concrete slab having a flange projecting downwardly from the sides and ends thereof, reinforcing bars extending transversely in the lower part of said slab and turning upwardly adjacent one side of said slab and extending near the top surface of

the same, reinforcing bars extending transversely in the lower part of said slab and turning upwardly adjacent the other side of said slab and extending near the top surface of the same, said first-mentioned bars being arranged with respect to said second-mentioned bars so that each of the former extends between a pair of the latter, each of said first-mentioned bars having a stirrup anchored in the flange at one side of said slab, each of said second-mentioned bars having a stirrup anchored in the flange at the other side of said slab, bars extending longitudinally of said slab and extending over the parts of all of said first-mentioned and second-mentioned bars that lie in the lower part of said slab and under the parts of all of said first-mentioned and second-mentioned bars that lie near the upper surface of said slab, and stirrups borne by some of said bars that extend longitudinally of said slab and being anchored in the flange at the ends of said slab.

9. A concrete slab having a downwardly projecting flange, and a bar embedded in the slab and having its end portion turned downwardly and extending along the outer side of the flange and being bent inwardly toward the slab center and extending adjacent the bottom side of the flange, and being finally bent upwardly and extending adjacent the inner side of the flange, whereby the flange is reinforced on all of its said three sides, a longitudinal bar disposed in the space between the portions of said transverse bar which extends along the sides of said slab flange, and a second longitudinal bar which underlies said transverse bar and is disposed adjacent the downturned end thereof.

10. A concrete slab having a flange projecting downwardly from each side thereof, a series of transverse bars having outer horizontal portions disposed adjacent the slab top and at the slab sides and having a depressed central horizontal portion that connects the horizontal outer portions and is located adjacent the slab bottom, a longitudinal bar arranged at each end of said outer portions on the under sides of the latter, and a longitudinal bar arranged at substantially the center of the depressed central horizontal portion, and overlying the latter.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

JOHN E. CONZELMAN.

Witnesses:

GEORGE G. ANDERSON,
GLADYS WALTON.