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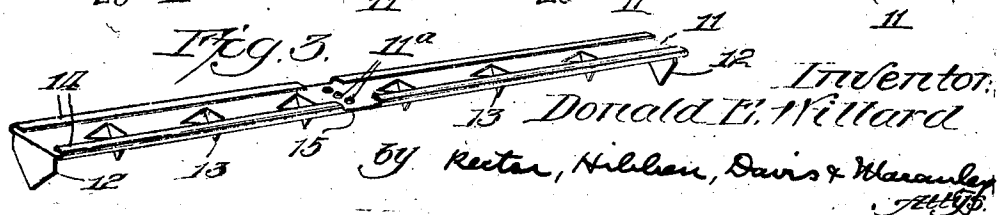
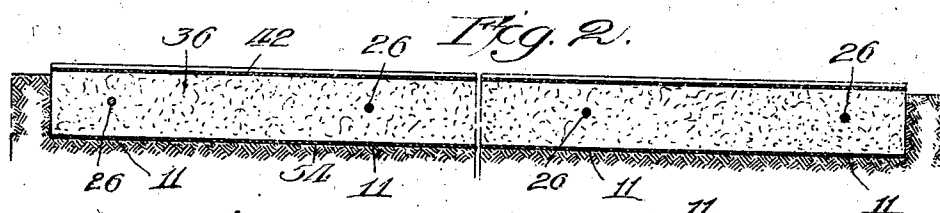
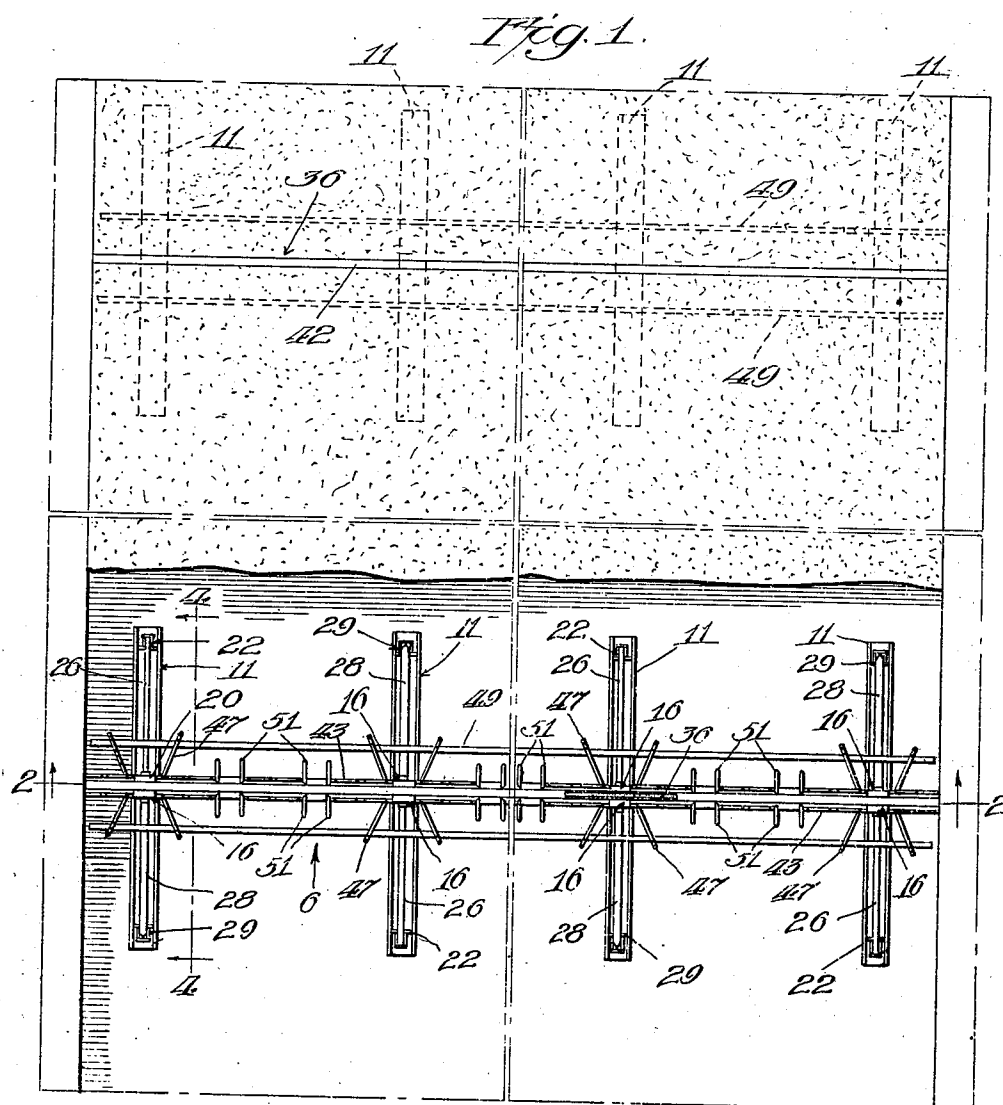
D. E. WILLARD

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Filed March 14, 1934

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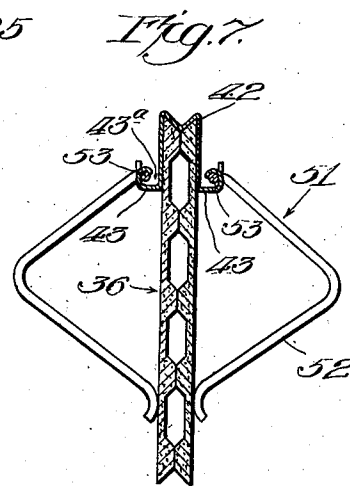
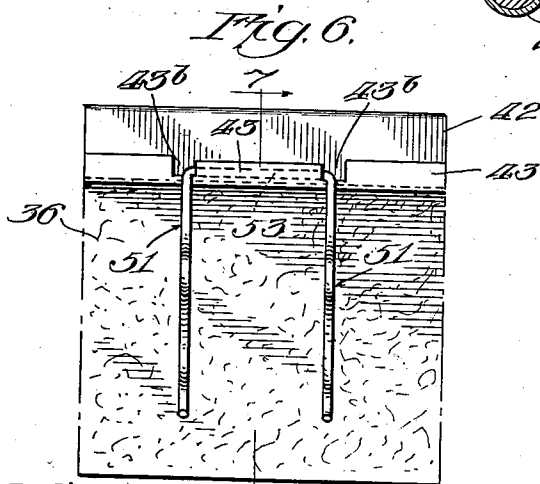
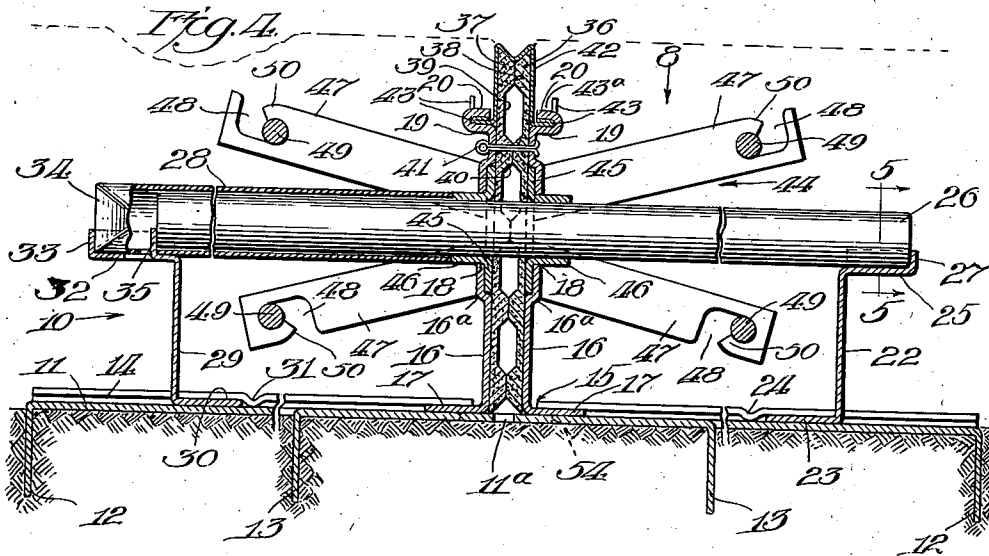
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Fig. 9.

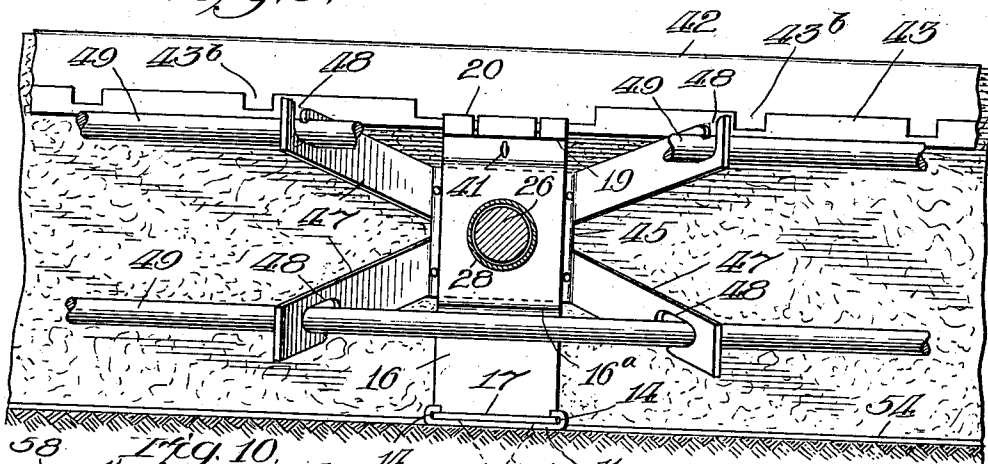


Fig. 10

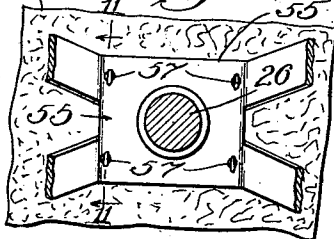


Fig. 11.

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Sept. 23, 1941.

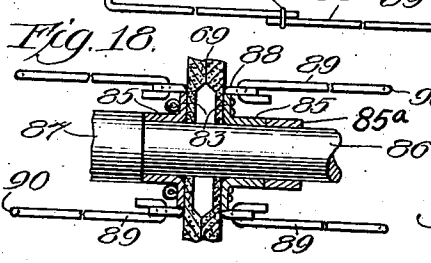
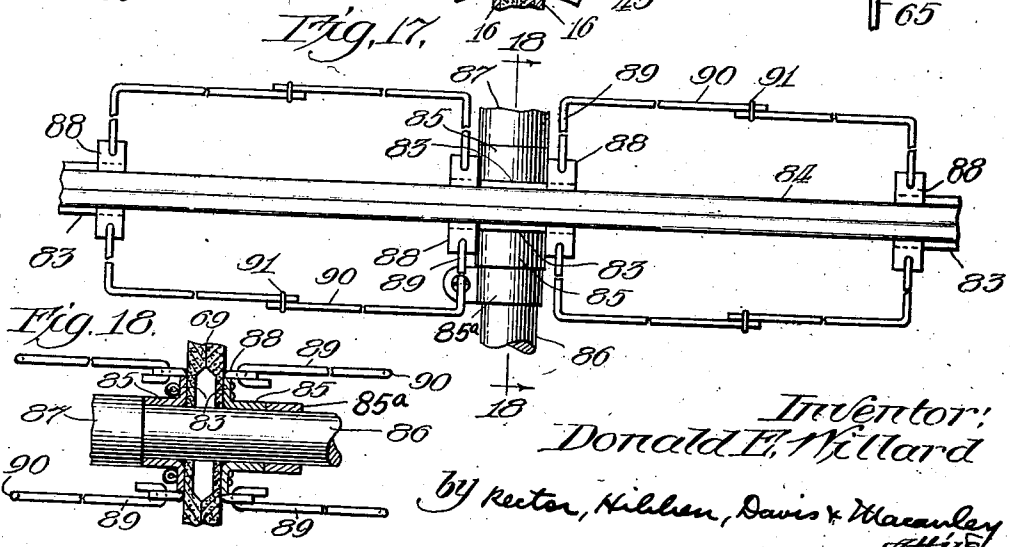
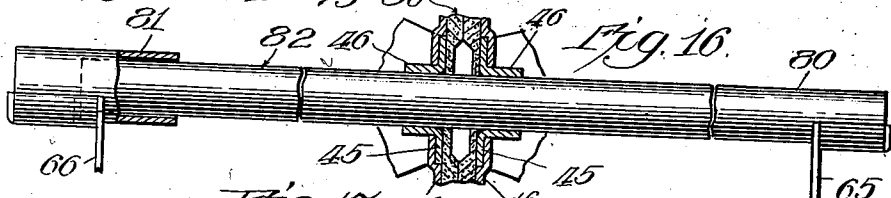
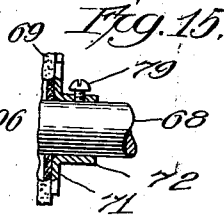
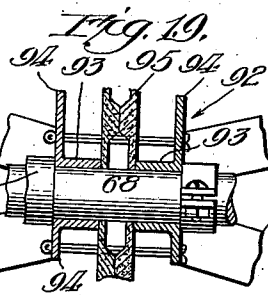
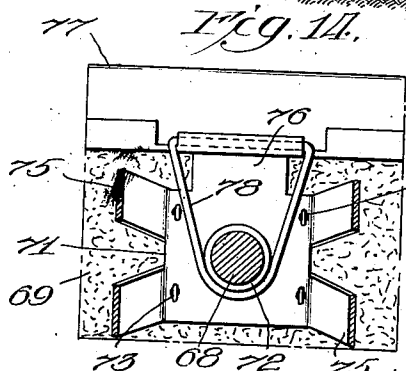
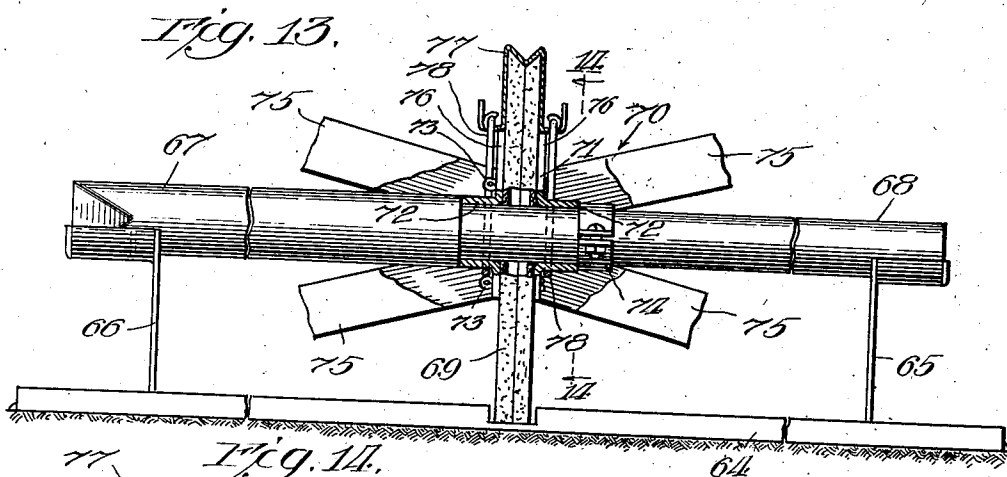
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UNITED STATES PATENT OFFICE

2,256,930

JOINT

Donald E. Willard, Danville, Ill.

Application March 14, 1934, Serial No. 715,384

27 Claims. (Cl. 94—18)

My invention relates to joints, preferably of the expansion type, for roadways, pavements, concrete slabs, wall sections and similar structures, and is concerned more particularly with a structure of this type in which means are provided to effectively protect the concrete around the reinforcing bars between adjoining slabs against the so-called funneling action due to load pressures in the slabs.

In the building of roadways, for example, it is customary to bridge reinforcing or dowel bars between adjoining slabs to prevent their relative vertical movement. The passage of traffic over the roadway and the upward pressure of the sub-soil, however, sets up heavy localized pressures in the concrete around the bars adjacent the opposed faces of the slabs. This action eventually crumbles the concrete and creates a funnel-like cavity around the bar which permits definite relative movements of the slab sections and frequently enlarges the cavity to such an extent that the slabs eventually crack.

It is therefore one object of my invention to associate with such a reinforcing bar a member which reinforces the concrete in the funneling region and carries the stresses normally set up in this locality into the main body of the slab by appropriate arms or prongs and directly into the reinforcing bar and generally to provide an improved structure for transmitting the load across the joints of concrete roadway slabs.

It is a further object of my invention to connect the ends of the prongs with lateral girders or rods which extend the full width of the roadway or the slabs as an additional strengthening agency.

A further object is to provide a joint of the character indicated in which the member which reinforces against the funneling action is suitably maintained in position against the pouring impact of the concrete, thereby insuring that, in the finished slab, this member will be in a position to perform its intended service.

A further object is to devise an expansion joint which can be located with accuracy in advance of pouring the concrete and which forms a permanent part of the roadway or other structural condition, which is additionally adapted to prevent relative vertical shifting of adjoining slab sections, and which is further provided with devices for preventing any funneling action of the concrete around the reinforcing bar which extends between adjoining sections.

A further object is to devise a footing strip which serves as a support for the uprights that

position the expansion strip and carries the reinforcing bar, and which is formed as a simple flat strip having anchorage prongs which are preferably punched and bent out of the plane of the strip and forced into the sub-soil, thereby avoiding the use of ground locating stakes for positioning these parts.

These and further objects of my invention will be set forth in the following specification, reference being had to the accompanying drawings, and the novel means by which said objects are effectuated will be definitely pointed out in the claims.

In the drawings:

Figure 1 is a plan view of a roadway, partly in section, showing my improved expansion joint in position and a suggested arrangement for alternately reversing the positions of the chairs on opposite sides of the expansion strip across the width of the roadway.

Fig. 2 is a section along the line 2—2 in Fig. 1, looking in the direction of the arrows, and showing a suggested arrangement of shielding strips which are located between the footing strips to prevent upward movement of water and soil between the adjoining slab sections.

Fig. 3 is a perspective view of a footing strip which acts as a support for the uprights that position the expansion strip and carry the reinforcing bar.

Fig. 4 is a section along the line 4—4 in Fig. 1, looking in the direction of the arrows, and showing the relation of the reinforcing prongs which carry the stresses from the funneling region around the reinforcing bar into the body of each concrete slab.

Fig. 5 is a section along the line 5—5 in Fig. 4, looking in the direction of the arrows, and showing the manner in which the supporting uprights conform to the peripheral curvature of the reinforcing bar in order to prevent lateral shifting thereof when the concrete is poured.

Fig. 6 is a partial elevation, looking in the direction of the arrow 6 in Fig. 1, showing a bowed reinforcing member that may be carried by the chairs between pairs of reinforcing bars in order to improve the bond of the chair with the concrete.

Fig. 7 is a section along the line 7—7 in Fig. 6, looking in the direction of the arrows.

Fig. 8 is an enlarged plan view of the left end of the expansion strip, as viewed in Fig. 1, or as viewed in the direction of the arrow 8 in Fig. 4.

Fig. 9 is a side elevation of the strip as viewed in the direction of the arrow 9 in Fig. 8.

Fig. 10 is a view corresponding to that shown in Fig. 9, but showing a modified method of mounting the spider member which reinforces the concrete against funneling.

Fig. 11 is a section along the line 11—11 in Fig. 10, looking in the direction of the arrows.

Fig. 12 is a sectional elevation, corresponding to that shown in Fig. 4, showing a modified construction of the spider member.

Fig. 13 is a sectional elevation, corresponding to that shown in Fig. 4, but showing a modified arrangement which eliminates the central pair of spaced uprights and also a different method of holding the cover strip in position.

Fig. 14 is a section along the line 14—14 in Fig. 13, looking in the direction of the arrows.

Fig. 15 is a partial sectional view showing a different arrangement of preventing relative shifting of the reinforcing members and the reinforcing bar.

Fig. 16 is a sectional elevational view showing a modification of the construction illustrated in Fig. 4, the principal difference consisting in a shortening of the sleeve within which the reinforcing bar slips.

Fig. 17 is a plan view showing a modified type of expansion joint and a modified type of reinforcing member.

Fig. 18 is a section along the line 18—18 in Fig. 17, looking in the direction of the arrows.

Fig. 19 is a sectional view in elevation showing a still further arrangement of the reinforcing members with reference to the expansion strip, the flange or plate portion of each reinforcing member being spaced from the expansion strip and therefore from the adjacent face of the associated concrete slab.

Fig. 20 is an elevation showing a stake that may be employed to support the reinforcing rods between the footing strips as viewed in Fig. 1 where the spacing of these strips is such that the rods tend to sag between the reinforcing spiders.

For purpose of illustration and as exemplifying one use of my improved joint and the support therefor, the same will be described in connection with a roadway. It will be understood, however, that the essential conception involved is likewise susceptible of adaptation to structural sections in general, regardless of their composing material, where such sections are subject to expansion and contraction and it is desired to prevent buckling or cracking of adjoining sections by inserting a yielding member therebetween, and where such sections are subject to transverse pressures and it is desired to prevent any funneling action around the reinforcing bars which extend between adjoining sections.

Referring to Fig. 4, the numeral 10 designates a chair which comprises a footing strip 11 whose ends may be bent transversely as at 12 to provide an anchoring device for positioning the strip on the sub-soil for a roadway, for example. The strip is also provided with weakening holes 11^a intermediate its ends which will permit a fracture of the strip in the event that the adjoining slabs contract or expand sufficiently, so that the remaining structure, as hereinafter described, will not be affected. Similar anchorage prongs 13 may be punched and bent out of the body of the strip for a similar purpose, thereby avoiding the use of the usual ground-locating stakes. The longitudinal edges of the strip 11 are also preferably bent to form longitudinal guideways 14 whose inner ends are spaced from each other, as

at 15, (see Fig. 3) in order to permit the association therewith of uprights 16. A pair of these uprights are employed and their lower ends are flanged as at 17 to provide a foot for each upright and which is inserted between a pair of the guideways 14. The intermediate portion of each upright 16 is offset as at 16^a (see Fig. 4) to provide a recess for the reception of a reinforcing spider member hereinafter described, and the upper end of each upright is flanged outwardly as at 19 and then reversely bent as at 20 to grip a flange on a cover strip hereinafter described.

At the right end of the footing strip, as illustrated in Fig. 4, a third upright 22 is supported thereby and includes a flange 23 which serves as a foot therefor and which is slidable between a pair of the guideways 14 or the flange may be fixed in position. The upright 22 is inserted between the guideways 14 from the right end of the footing strip 11 and is moved until it contacts with a stop 24 provided in the footing strip and which may be simply formed by offsetting a portion of the latter strip. The upper end of the upright 22 is provided with a cradle flange 25 which conforms to the peripheral curvature of one end of a reinforcing or dowel bar 26. A flange 27 extends upwardly from the end of the cradle 25 and engages the end of the bar 26.

The bar 26 extends toward the left, as viewed in Fig. 4, through an aperture 18 provided in each offset portion 16^a of the upright 16 and the left end of the bar is received within a sleeve 28 that is supported upon an upright 29 having a footing flange 30 that is carried by the footing strip 11 between the guideways 14 thereof and which is moved along the strip 11 until it contacts with a stop 31, corresponding to the stop 24. The upper end of the upright 29 is also formed with a cradle portion 32 having a stop flange 33 at the left end thereof which engages with the pinched end 34 of the sleeve 28. In order to limit the initial endwise insertion of the reinforcing bar within the sleeve 28, a stop flange 35 is cut out of the cradle flange 32 and bent upwardly through a suitable aperture provided in the bottom of the sleeve 28 for contact with the left end of the bar 26.

The bar 26 is intended to resist any relative vertical movement of the adjoining slab sections, while permitting their lateral expansion and contraction with respect to each other, and the use of the stop flange 35 insures that there will be sufficient space between the left end of the bar and the end of the sleeve 28 to permit a substantial movement of the bar within the sleeve without fracturing the pinched end 34 of the sleeve.

The expansion strip 36 is located between the uprights 16 and is composed of a pair of strips 37 and 38 which are located with their faces in abutting relation. The inner face of each strip is provided with a plurality of longitudinally extending depressions 39 which are separated by ridges 40. When the strips occupy the positions shown in Fig. 4, the presence of the depressions 39 facilitate the yielding of the strip under compression. Preferably, the holes through the strip 36 which are formed by the depressions 39 have a total cross-sectional area equal to approximately one-half of the total cross-sectional area of the strip, although this relation may be varied as desired. With this arrangement, the strip can be compressed without forcing the upper edge thereof above the surface of the roadway. Any number of suitable apertures may be appro-

priately disposed in both of the component strips 37 and 38 to receive the reinforcing bars above described. The expansion strip 36 may be composed of a bituminous composition mixture, such as is now commonly employed in the industry for strips of this nature, or it may be formed of cork or rubber, or the expansion may be accommodated by the so-called metal walled joint in which thin metal walls provide facings for the opposed ends of the slabs, the walls being separated by an air space or other yieldable filling. All of the foregoing expansion members or strips are well known in the art and in and of themselves form no part of the present invention. In any case, it is contemplated that the expansion member will be arranged to yield in response to movements of the concrete, and will be composed of a material that is resistant to water, earth acids, or any other decomposing influences which are commonly met with in the use of structures of this type. The thickness of the strip may be varied as desired and may be as low as one-half inch. Wherever the terms "yieldable spacer" or "yieldable strip" appear in the accompanying claims they are intended to encompass filler members having the foregoing characteristics.

In certain roadway constructions, it is desirable that the upper face of the expansion strip 36 be protected and, for this purpose, a cover strip 42 having an inverted channel section encases that portion of the expansion strip above the flanges 19, the web portion of this strip being deflected transversely toward the expansion strip and longitudinally of the cover strip to thereby provide a web member that will readily yield under the expansive forces of the concrete. The sides of the cover strip extend downwardly along the sides of the expansion strip and are then bent outwardly and upwardly to provide a plurality of flanges 43 (see Fig. 4) which form with the sides of the strip a pair of channels 43^a in which moisture may be collected and conducted to the sides of the road for discharge. The flanges 43 are preferably separated by the slots 43^b for a purpose presently explained, but which do not extend to the bottoms of the channels 43^a and hence do not affect the primary purpose of the latter. The strip 42 is held in position by bending the flanges 20 over the adjacent flanges 43. A key member, such as a cotter pin 41, is bridged between the uprights 16 and extends through the expansion strip 36, thus preventing any lateral spreading of the uprights and inhibiting any tendency of the expansion strip to move upwardly.

One of the most important features of my improved joint resides in the use of a reinforcing spider member 44 which comprises a plate portion 45 that is mounted in the recess formed by the offsets 16^a and which is preferably integrally formed with a shell 46 that encircles the adjacent portion of the reinforcing bar 26. Above and below the bar 26, a pair of arms 47 are bent out of the plane of the plate portion 45, the arms of each pair flaring with respect to each other and each arm being further angularly inclined with respect to the longitudinal axis of the bar. Adjacent each end of each arm 47 is formed an open ended, L-shaped slot 48, the slots of the upper pair of arms facing upwardly and those of the lower pair facing downwardly for a purpose presently explained, and within each slot is received a bar or reinforcing rod 49 that extends across the concrete slab in parallel rela-

tion to the expansion strip 36. In order to retain these rods in position against the pouring impact of the concrete, the tongues 50, formed by cutting the slot 48, are bent around the associated bars 49, as indicated in Fig. 4.

It is considered to be within the scope of my invention to provide the arms 47 with simple holes through which the reinforcing rods 49 may be extended, or to place these rods in contact with the longitudinal edges of the respective arms, or to space these rods at a predetermined distance above and below the arms of the reinforcing members.

In order to provide a further bond of the expansion joint with the adjoining slab sections, it is contemplated that U-shaped, wire reinforcements 51 may be employed, the limbs thereof resting in the slots 43^b and bowed outwardly from the expansion strip as indicated by the numeral 52 in Fig. 7, with the lower ends of the limbs abutting against the expansion strip and the connecting portion 53 thereof disposed in the channel 43^a and held in this position by bending the extremity of the flange 43 over the connection 53.

Figs. 1, 2 and 4 illustrate a characteristic employment of my improved joint and, in this assembly, the footing strips 11 are located across the width of the roadway with appropriate spacing and the uprights 16, 22 and 29 are then positioned as hereinbefore described. The reinforcing spider members 44 are then located, followed by a forcing of the expansion strip 36 downwardly between the uprights 16. The key 41 is then passed through the expansion strip and, if the cover strip 42 is employed, it may be positioned as described above. The reinforcing bar 26 is then passed through the assembly of uprights 16, expansion strip 36 and spider members 44, and into the sleeve 28, the uprights 22 and 29 being appropriately positioned to support the bar and sleeve, respectively. The reinforcing bars 49 are then located in the slots 48 and the reinforcing wires 51 are suitably disposed between the footing strip as set forth above. The assemblage is then conditioned to receive the concrete and it will be particularly noted that each of the parts are appropriately supported and will hold its position against the pouring impact of the concrete, so that when the latter hardens, the several elements will be properly located to perform their intended service.

By examining Fig. 4, it will be apparent that, when the assemblage shown therein is covered by concrete, that which composes the slab section to the right of the expansion strip will directly grip the surface of the reinforcing bar 26, while the concrete to the left of the strip will be completely shielded from the adjacent portion of the bar by reason of the sleeve 28 and the shell 46. Accordingly, as the two slab sections move toward and away from each other due to temperature changes, the reinforcing bar will slip easily between the sleeve 28, so that this construction affords a simple arrangement for preventing any relative vertical shifting of the slab sections, while freely permitting their movement toward and away from each other. In moving toward the left, from the position shown in Fig. 4, the bar 26 will shear off the flange 35 whose only function is to limit the initial insertion of the bar in the sleeve in order to leave space for the subsequent movement of the bar to the left of the flange.

At this point, it should be noted that, in cer-

tain installations, it may be desirable to protect the lower surface of the expansion strip, between the footing strips 11, against the upward movement of moisture and earth. For this purpose, it is contemplated that lengths of an appropriate strip material, either composed of metal or a suitable waterproof fabric, may be laid on the sub-soil between the footing strips and having a greater width than the thickness of the expansion strip 36. Such a shielding strip is denoted by the numeral 54 in Figs. 2 and 4.

By the use of the spider member 44, it is apparent that the plate portion 45 and the shell 46 thereof adequately reinforce and protect that portion of the concrete which encircles the bar adjacent the opposing faces of the adjoining slab sections. The stresses which are set up in this locality are carried into the body of the slab sections by the arms 47, as further reinforced by the rods 49. These latter elements serve to better distribute the imposed stresses and to more adequately utilize the compressive strength of the concrete. Any tendency of one of the slabs to move downwardly is not only resisted by the reinforcing bar 26, but also by the engagement of the reinforcing rods 49 with the bottoms of the slots 48 in the upper arms 47, while an upward movement of the same slab is also resisted by the bar 26 and by the engagement of the lower reinforcing rod 49 with the upper edges of the slots in the lower arms 47. Moreover, because the plate portion 45 is attached to the arms 47 which in turn are anchored in the concrete, the portion provides lateral support for that concrete in the funneling region which transmits vertical force to the bar. The plate portion 45 and the shell 46 also serve to reduce the unit pressure on the adjoining concrete, as compared to that which would otherwise be present in a joint construction employing only simple dowel bars. The dowel bar is positioned at mid-depth or in the neutral plane of the slabs and parallel to the top surface and normal to the joint faces of the slabs. Therefore the arms 47 extend into the compression and tension regions of each slab, respectively.

In Figs. 10 and 11, there is illustrated a modified arrangement for mounting the spider members 44. This modification contemplates that, in certain constructions, it may be desirable to eliminate the use of the uprights 16 and therefore the cover strip 42. Under these conditions, the spider member 55, corresponding to the member 44, would be pinned directly to the expansion strip 58 by cotter pins 57. The strip 58 may be similar to the strip 36, or it may be a simple type of expansion strip, such as an ordinary flat bituminous composition strip, or other types.

In Fig. 12 is illustrated a still further modification of the spider member which contemplates the formation of the latter from two pieces, instead of the integral construction which characterizes the member 44. In the former structure, the numeral 59 designates the plate portion of the spider, corresponding to the portion 45, and this portion is mounted on a shoulder 60 provided on a sleeve 61 whose end 62 may be turned over to embrace the plate portion 59 to retain the two parts together. As before, the reinforcing prongs 63 are bent outwardly from the plane of the plate portion 59. This construction may be desirable under conditions which require a larger journal area in the sleeve portion than could be obtained by a simple punching of the plate portion 45.

In Figs. 1 and 2 is shown a suggested method

of arranging my improved chairs and the accompanying expansion strips in a roadway. These chairs preferably extend lengthwise of the roadway and are disposed in parallel, spaced relation across the width thereof.

These chairs are positioned in the manner hereinbefore described, without any necessity for the use of ground-locating stakes, and they may be located with great accuracy. The expansion strip 36 may be placed in the chairs either before or after the latter have been located on the ground and any one of the before described modifications may be employed in connection therewith, dependent upon the nature of the roadway. Whichever modification is adopted, it will be apparent that the chairs will rigidly hold the expansion strip in position against the pouring impact of the concrete and that, after the concrete has hardened, the roadway is substantially completed, since it is unnecessary to remove any part of the chair thereafter. The latter becomes a permanent part of the roadway and it provides a very effective means for locating the expansion joint from the very commencement of road building operations. The relation of the height of the chairs to the thickness of the roadway bed is preferably such that the web of the covering strip is substantially flush with, or a short distance below, the surface of the roadway, and the same condition obtains with those installations where the covering strip is eliminated. The covering strip protects the expansion strip against wear and is preferably composed of a material that will resist corrosion and is ductile.

As indicated in Fig. 1, the chairs are preferably located transversely of the roadway with the sleeves 28 located in alternating relation on opposite sides of the expansion strip. If the reinforcing wires 51 are employed, they will be located as generally indicated in this figure, that is, between adjacent pairs of chairs.

Referring to the modification illustrated in Figs. 13, 14 and 15, the numeral 64 designates a footing strip, the numerals 65 and 66 the end uprights, and the numerals 67 and 68, respectively, represent a sleeve and reinforcing bar, corresponding to the comparable elements shown in Fig. 4. As in the latter figure, the bar 68 extends through an expansion strip 69 and is slidably received within the sleeve 67, the portion of the bar 68 to the right of the strip 69 being exposed for direct gripping by the concrete.

Instead of employing the central pair of spaced uprights to maintain the vertical position of the expansion strip 69 against the pouring impact of the concrete, it is contemplated that the reinforcing members 70, in conjunction with other parts presently noted, may be utilized for this purpose. Each of the reinforcing members 70 includes a plate portion 71 which abuts directly against and is pinned at 73 or otherwise secured to the expansion strip 69, and also a cylindrical portion 72 which projects outwardly from the expansion strip and covers the adjacent portion of the bar 68. The cylindrical portion 72 to the left of the expansion strip 69 abuts directly against the end of the sleeve 67 and thereby prevents sidewise movement of the expansion strip toward the left, as viewed in Fig. 13. Movement of the strip in the opposite direction is prevented by encircling the bar 68 with a clamp 74 which contacts with the cylindrical portion 72 on the right of the expansion strip.

As in the preceding modification, each reinforcing member is provided with arms 75 which

extend outwardly from the expansion strip and the plate portion 71 thereof may also be provided with a tongue 76, upon which are rested the outwardly extending flanges of a cover strip 77, corresponding to the strip 42. In order to hold this cover strip downwardly in the position indicated against the upward pressure of the concrete when poured, it is contemplated that a simple wire clip 78 may be bent around the reinforcing bar 68 and have its ends engaged with the flanges of the strip 77.

In Fig. 15 is shown an alternative method of securing the expansion strip and associated reinforcing members against a shift toward the right as shown in Fig. 13. This modification eliminates the clamp 74 and substitutes a simple set screw 79 therefor which is mounted in the cylindrical portion 72 of the right hand reinforcing member.

In the modification shown in Fig. 16, the general construction is similar to that illustrated in Fig. 4 as regards the expansion strip and the parts immediately associated therewith and also the particular manner of supporting the reinforcing bar. In this case, however, the reinforcing bar, denoted by the numeral 80, has its left end supported in a sleeve 81 whose open end terminates at some distance from the adjacent side of the expansion strip, leaving a portion 82 of the bar exposed to the concrete. It is contemplated that this exposed portion would be painted and thereafter lubricated or greased in order to facilitate endwise shifting through the concrete, and prevent a direct gripping of the bar by the concrete. Endwise shifting of the bar is permitted as before by the short sleeve 81.

The modification illustrated in Figs. 17 and 18 embodies the functional characteristics of the reinforcing arms 47 and the reinforcing rod 49, shown in Fig. 4. In this case, each reinforcing member 83 is formed as a simple plate which may be directly secured to an expansion strip 84, or it may be associated with a pair of spaced uprights as indicated in Fig. 4. As before, each member 83 also includes a cylindrical portion 85 through which the reinforcing bar 86 extends, the bar on one side of the strip 84 being received within the usual sleeve 87. As in the construction shown in Fig. 13 the portion 85, on opposite sides of the strip, abuts against the sleeve 87 and a clamp 85^a respectively, the latter encircling the bar 86. The plate portion of each reinforcing member is also provided with a plurality of lugs 88 which serve as attaching means for the ends of reinforcing bars 89 that extend outwardly from the strip 84 for a predetermined distance and are then bent substantially parallel to the strip, as indicated by the numeral 90. If desired, the adjacent ends of the portions 90 may be wired together as at 91. The outwardly extending portions of the bars 89 correspond to the arms 47 in Fig. 4, while the portions 90 thereof correspond to the bars 49.

In Fig. 19, which illustrates a still further arrangement of associating the reinforcing members with the expansion strip, the numeral 92 designates one of the members which is provided with the usual cylindrical portion 93 that encircles the reinforcing bar and also with the laterally extending flange or plate portion 94. In this case, however, the plate 94 is spaced at some distance from the expansion strip 95, instead of being substantially flush with the adjacent face of the associated slab. The usual re-

enforcing arms 96 may then extend directly from the plate 94.

In Fig. 20 is illustrated a stake 97 that may have its lower end sharpened as at 98 to facilitate its insertion in the ground and which is utilized to support the reinforcing rods 49 between the spider arms 47 where the footing strips are spaced at such a distance that the spider arms do not prevent sagging of the rods. Each of the rods is received within a slot 99 and the portion 100 of each stake that defines the slot may be bent over in order to retain the rod 49 in position. The correct elevation of the slots 99 above the surface of the sub-soil may be conveniently determined by providing a boss or stop 101 on the stake, it being understood that the stake is driven into the ground until the boss engages the surface thereof.

I claim:

1. A reinforced joint for concrete slab construction comprising a reinforcing bar for extending between adjacent slabs, reinforcing means operatively associated with the bar on each side of the joint, each means having arms adapted to extend into the body of each slab on opposite sides of the bar and each arm having an opening therethrough, and bars located in said openings to provide a reinforcing connection with the associated arms across the slab.

2. A reinforced joint for concrete slab construction comprising a reinforcing bar for extending between adjacent slabs, reinforcing means operatively associated with the bar on each side of the joint, each having arms adapted to extend into the body of the associated slab on opposite sides of the bar and each arm including open ended slots, the slot ends on the uppermost arms facing upwardly and those on the lowermost arms facing downwardly, and bars located in the slots to provide a reinforcing connection across the slab with the associated arms.

3. A reinforced joint for concrete slab construction comprising a reinforcing bar for extending between adjacent slabs, reinforcing means operatively associated with the bar on each side of the joint, each means having arms adapted to extend into the body of the associated slab on opposite sides of the bar and each arm including an L-shaped slot, and bars located in the slots to provide a reinforcing connection across the slab with the associated arms, a portion of each arm which defines the associated slot being bent around the received bar to retain the same in position.

4. An expansion joint for concrete roadway construction adapted for locating in advance of pouring the concrete comprising a yieldable spacer for positioning between adjacent slab sections, footing strip means resting on the supporting surface for the roadway, a pair of spaced uprights carried by the footing strip means and engaging the opposite sides of the spacer to maintain the same against the pouring impact of the concrete when the slab sections are laid, a sleeve extending laterally from one upright, a reinforcing bar slidable in the sleeve and extending through the spacer for inclusion within the adjacent slab section, and uprights adjustable along the footing strip means for supporting the ends of the sleeve and bar, respectively.

5. An expansion joint for concrete roadway construction adapted for locating in advance of pouring the concrete comprising a yieldable spacer for positioning between adjacent slab sections, footing strip means resting on the sup-

porting surface for the roadway, a pair of spaced uprights carried by the footing strip means and engaging opposite sides of the spacer to maintain the same against the pouring impact of the concrete when the slab sections are laid, a sleeve extending laterally from one upright, a reinforcing bar slidable in the sleeve and extending through the spacer for inclusion within the adjacent slab section, and uprights carried by the footing strip means for supporting the ends of the sleeve and bar, respectively, and having parts bent to form cradle portions for supporting, and other parts engaging the end faces of, the sleeve and bar to maintain the same against endwise movement by the concrete.

6. An expansion joint for concrete roadway construction adapted for locating in advance of pouring the concrete comprising a yieldable spacer for positioning between adjacent slab sections, footing strip means resting on the supporting surface for the roadway, a pair of spaced uprights carried by the footing strip means and engaging opposite sides of the spacer to maintain the same against the pouring impact of the concrete when the slab sections are laid, a sleeve extending laterally from one upright, a reinforcing bar slidable in the sleeve and extending through the spacer for inclusion within the adjacent slab section, uprights carried by the footing strip means for supporting the ends of the sleeve and bar, respectively, and having parts bent to form cradle portions for supporting, and other parts engaging the end faces of, the sleeve and bar to maintain the same against endwise movement by the concrete, the sleeve supporting upright having a tongue extending through the sleeve to limit the initial insertion of the bar.

7. An expansion joint for concrete roadway construction adapted for locating in advance of pouring the concrete comprising a yieldable spacer for positioning between adjacent slab sections, footing strip means resting on the supporting surface for the roadway, a pair of spaced uprights carried by the footing strip means and engaging the opposite sides of the spacer to maintain the same against the pouring impact of the concrete when the slab sections are laid, a sleeve extending laterally from one upright, a reinforcing bar slidable in the sleeve and extending through the spacer for inclusion within the adjacent slab section, uprights carried by the footing strip means for supporting the ends of the sleeve and bar, respectively, and a reinforcing member operatively associated with the bar on each side of the spacer and having a flange disposed between the spacer and adjacent spaced upright, and arms extending from the flange for embedding in the concrete.

8. An expansion joint for concrete roadway construction comprising a yieldable spacer for positioning between adjacent slab sections, a reinforcing bar extending through the spacer, and a reinforcing member on each side of the yieldable spacer and having a plate portion secured to the spacer and arms extending into the concrete, the arms having stress carrying connections with the member for transmitting stresses between the bar and slabs.

9. An expansion joint for concrete roadway construction comprising a yieldable strip for positioning between adjacent slab sections, a reinforcing bar extending through the strip, a reinforcing member on each side of the yieldable strip and having a plate portion secured to the strip and arms extending into the concrete, the arms

being adapted to transmit stresses between the bar and slabs, a cover strip in the form of an inverted channel section having outwardly extending flanges and closing the upper edge of the yieldable strip and abutting against the plate portion, and wire clips encircling the reinforcing bar and secured to the cover strip to hold the latter against the upward pressure of the concrete when poured.

10. An expansion joint for concrete roadway construction adapted for locating in advance of pouring the concrete comprising a yieldable strip for positioning between adjacent slab sections, a footing strip resting on the supporting surface for the roadway, a reinforcing bar extending through and on opposite sides of the yieldable strip, a reinforcing member on each side of the yieldable strip and having a flange secured thereto and arms extending into the concrete, the arms being adapted to transmit stresses between the bar and slabs, a sleeve enclosing the bar on one side of the yieldable strip, one end of the sleeve abutting the adjacent reinforcing member, the bar being slidable in the sleeve and extending through the yieldable strip for inclusion within the adjacent slab section, uprights carried by the footing strip for supporting the ends of the sleeve and bar, respectively, and means for preventing movement of the yieldable strip and the associated reinforcing members away from the sleeve under the pouring impact of the concrete.

11. An expansion joint for concrete roadway construction adapted for locating in advance of pouring the concrete comprising a yieldable strip for positioning between adjacent slab sections, a footing strip resting on the supporting surface for the roadway, a reinforcing bar extending through and on opposite sides of the strip, a reinforcing member on each side of the strip and having a flange secured to the strip and arms extending into the concrete, the arms being adapted to transmit stresses between the bar and slabs, a sleeve enclosing the bar on one side of the yieldable strip and having one end thereof abutting the adjacent reinforcing member, the bar being slidable in the sleeve and being exposed on the opposite side of the strip for direct gripping by the concrete, uprights carried by the footing strip for supporting the ends of the sleeve and bar, respectively, and means carried by the exposed portion of the bar for preventing movement of the strip and associated parts away from the sleeve under the pouring impact of the concrete.

12. An expansion joint for concrete roadway construction adapted for locating in advance of pouring the concrete comprising a yieldable strip for positioning between adjacent slab sections, a footing strip resting on the supporting surface for the roadway, a reinforcing bar extending through and on opposite sides of the strip, a reinforcing member on each side of the strip and having a flange secured thereto and arms extending into the concrete, the arms being adapted to transmit stresses between the bar and slabs, a sleeve enclosing the bar on one side of the strip with its end abutting the adjacent reinforcing member, the bar being slidable in the sleeve and being exposed on the opposite side of the strip for direct gripping by the concrete, uprights carried by the footing strip for supporting the ends of the sleeve and bar, respectively, and a clamp secured to the exposed portion of the bar in abutting relation to the adjacent reinforcing member for preventing movement of the strip and as-

sociated parts away from the sleeve under the pouring impact of the concrete.

13. An expansion joint for concrete roadway construction adapted for locating in advance of pouring the concrete comprising a yieldable strip for positioning between adjacent slab sections, a footing strip resting on the supporting surface for the roadway, a reinforcing bar extending through and on opposite sides of the yieldable strip, a reinforcing member on each side of the yieldable strip and having a flange secured to the yieldable strip and arms extending into the concrete, the arms being adapted to transmit stresses between the bar and slabs, a sleeve enclosing the bar on one side of the yieldable strip and having its end abutting the adjacent reinforcing member, the bar being slidable in the sleeve and being exposed on the opposite side of the yieldable strip for direct gripping by the concrete, uprights carried by the footing strip for supporting the ends of the sleeve and bar, respectively, and a set screw mounted in the member adjacent the exposed portion of the bar for engaging the latter to prevent movement of the yieldable strip and associated parts away from the sleeve under the pouring impact of the concrete.

14. An expansion joint for concrete roadway construction adapted for locating in advance of pouring the concrete comprising a yieldable strip for positioning between adjacent slab sections, a footing strip resting on the supporting surface for the roadway, a pair of spaced uprights carried by the footing strip and engaging the opposite sides of the yieldable strip to maintain the same against the pouring impact of the concrete when the slab sections are laid, a reinforcing bar extending through and on opposite sides of the yieldable strip, a reinforcing member on each side of the yieldable strip and having a flange held by the spaced uprights and arms extending into the concrete, the arms being adapted to transmit stresses between the bar and slabs, a sleeve enclosing one end of the bar leaving an exposed portion of the bar between the sleeve and the yieldable strip, the exposed portion being lubricated to facilitate slippage thereof through the concrete and the portion of the bar on the opposite side of the yieldable strip being included within the adjacent slab section, and uprights carried by the footing strip for supporting the ends of the sleeve and bar, respectively.

15. An expansion joint for concrete roadway construction comprising a yieldable strip for positioning between adjacent slab sections, a reinforcing bar extending through the strip, a reinforcing member operatively associated with the bar on each side of the yieldable strip and having a flange secured to the strip and attaching means mounted on the flange, and strengthening bars connected to the attaching means and extending outwardly from the strip for a predetermined distance and then parallel to the strip.

16. An expansion joint for concrete roadway construction comprising a yieldable strip for positioning between adjacent slab sections, reinforcing bars extending through the strip at intervals across the slab, a reinforcing member operatively associated with each bar on each side of the yieldable strip and having a flange secured to the strip and arms extending from the flange for embedding in the concrete and attaching means on the flange, and strengthening bars connected to each of the attaching means and extending outwardly from the strip for a prede-

termined distance and then parallel to the strip, the ends of the parallel portions across the slab being secured together.

17. A joint for concrete slab construction comprising a reinforcing member for extending between adjacent slabs, reinforcing means for embedding in the slabs on each side of the joint and having a pair of stress carrying arms for extending into the body of the associated slab on opposite sides of the bar, each arm having an opening therethrough and being adapted to transmit stresses between the member and slabs, and bar means located in the openings to provide a reinforcing connection with the associated arms across the slab.

18. A joint for concrete slab construction comprising a reinforcing member for extending between adjacent slabs, reinforcing means for embedding in the slabs on each side of the joint and having a pair of stress carrying arms for extending into the body of the associated slab on opposite sides of the member, each arm including open ended slots, the slot ends on the uppermost arms facing upwardly and those on the lowermost arms facing downwardly and the arms being adapted to transmit stresses between the member and slabs, and bar means located in the slots to provide a reinforcing connection across the slab with the associated arms.

19. A joint for concrete slab construction comprising a reinforcing member for extending between adjacent slabs, reinforcing means for embedding in the slabs on each side of the joint and having a pair of stress carrying arms for extending into the body of the associated slab on opposite sides of the bar, each arm including an L-shaped slot and being adapted to transmit stresses between the member and slabs, and bar means located in the slots to provide a reinforcing connection across the slab with the associated arms, a portion of each arm which defines the associated slot being bent around the bar means to retain the same in position.

20. A joint for concrete slab construction comprising a reinforcing bar for extending between adjacent slabs for transmitting the load therebetween, a sleeve encircling the bar on each side of the joint and contacting the bar and having a flange portion encircling the sleeve for embedding in a face of the slab, and devices adapted to be anchored in the slabs on each side of the joint, the devices having load transmitting connection with the sleeves and adapted to transmit the load between the bar and slabs and also being connected to the flanges whereby the flanges provide lateral support for the concrete in the funneling regions around the bar.

21. A joint for concrete slab construction comprising a reinforcing member for extending between adjacent slabs for transmitting the load therebetween, a sleeve encircling the member on each side of the joint and contacting the member and having a flange portion encircling the sleeve on each side of the joint for embedding in a face of the slab, and arms formed integrally with the sleeve and flange portion and extending therefrom for embedding in the concrete, the sleeves and arms being adapted to transmit the load between the member and slabs and the flange portions being adapted to provide lateral support for the concrete in the funneling regions around the member.

22. A reinforced joint for concrete slab construction comprising a joint member for positioning between adjacent slabs, a load transfer

member bridging the space between the slabs, means for reenforcing the load transfer member operatively associated therewith on each side of the joint member, the reenforcing means entering and reenforcing their respective slabs, and means for reenforcing the joint member, said last-mentioned means assisting in retaining the load transfer member in a predetermined position during the pouring of the concrete.

23. A reinforced joint for concrete slab construction comprising a joint member for positioning between adjacent slabs, a load transfer member bridging the space between the slabs, means for reenforcing the load transfer member operatively associated therewith on each side of the joint member, the reenforcing means entering and reenforcing their respective slabs, and means for reenforcing the joint member, said last-mentioned means maintaining the reenforcing means for the load transfer member against rotation and assisting in retaining the load transfer member in a predetermined position during the pouring of the concrete.

24. A reinforced joint for concrete slab construction comprising a joint member for positioning between adjacent slabs, a load transfer member bridging the space between the slabs, means for reenforcing the load transfer member operatively associated therewith on each side of the joint member, the reenforcing means entering and reenforcing their respective slabs, means for reenforcing the joint member, said last-mentioned means assisting in retaining the load transfer member in a predetermined position during the pouring of the concrete, and means for anchoring said last-mentioned means in a predetermined position during the pouring of the concrete.

25. A bracket for supporting a dowel bar which bar and which bracket are adapted to extend

across a pavement joint and into adjacent slabs of a pavement, said bracket having a central portion for positioning it with respect to the pavement joint, said central portion terminating in oppositely-extending portions, said latter portions being adapted to extend into the adjacent slabs of the pavement and support the dowel bar during pouring and setting of the pavement material, said central portion being structurally weakened so that said bracket may shear at said central portion after the pavement material has set and when relative movement between the pavement slabs occurs.

26. Connecting means for a pair of slabs comprising a dowel bar connecting the slabs, and means engaging a medial portion of the dowel bar for distributing stresses to which the dowel pin is subjected when either slab is loaded through the material of the loaded slab laterally to either side of the dowel pin, said means including arms in firm supporting cooperation with the dowel pin directly adjacent to the adjacent faces of the slabs and extending upwardly and outwardly and downwardly and outwardly, respectively, from the medial portion of said dowel pin into the material of the slabs.

27. Connecting means for a pair of slabs comprising a dowel pin extending between and into the slabs, a tubular structure embedded in one of the slabs and slidably accommodating the related end portion of the dowel pin, and means for distributing stresses to which the tubular structure is subjected when either slab is loaded, said means comprising arms rigid with said tubular structure directly adjacent to the end face of the related slab and extending upwardly and outwardly and downwardly and outwardly, respectively, from said tubular structure into the material of the slab.

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