Nov. 10, 1942. E. H. GEYER ET AL 2,301,865

JOINT FOR CONCRETE SLABS

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Fig. 1

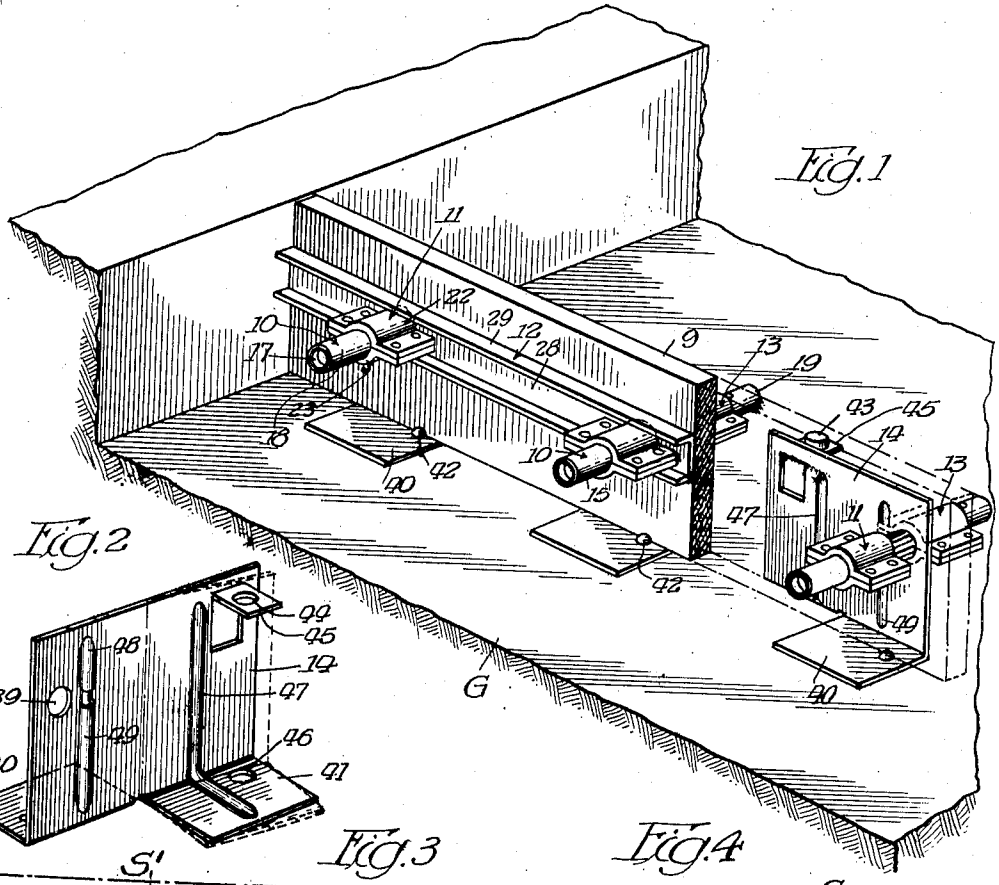


Fig. 2

Fig. 3

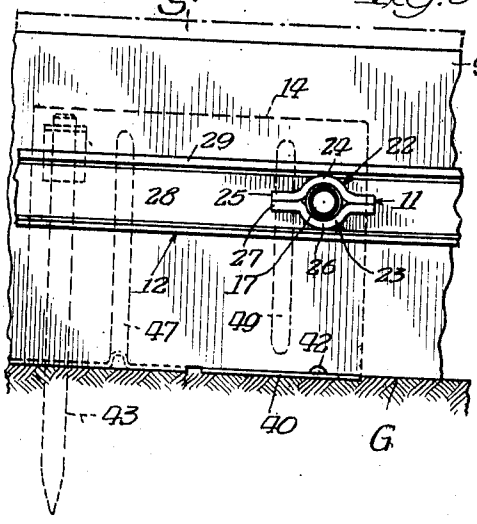
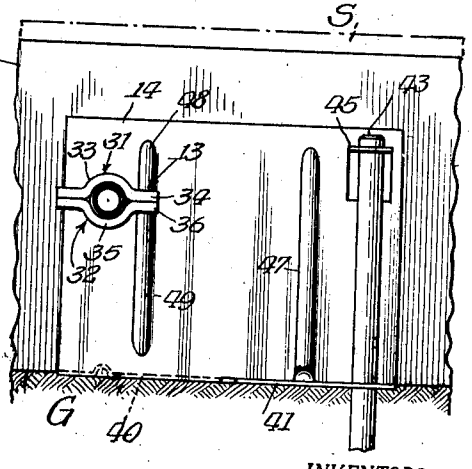


Fig. 4



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Fig. 5

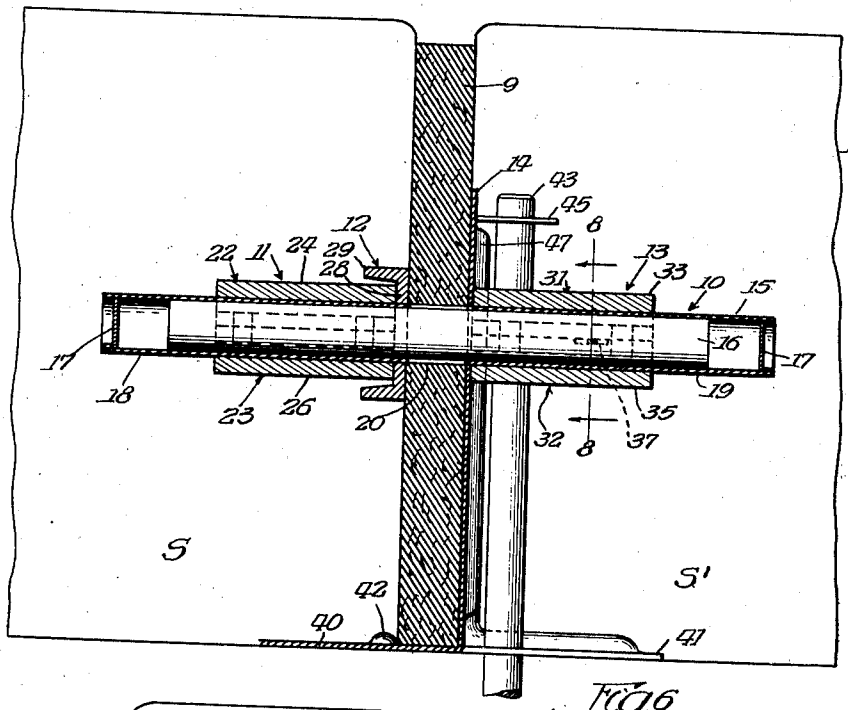
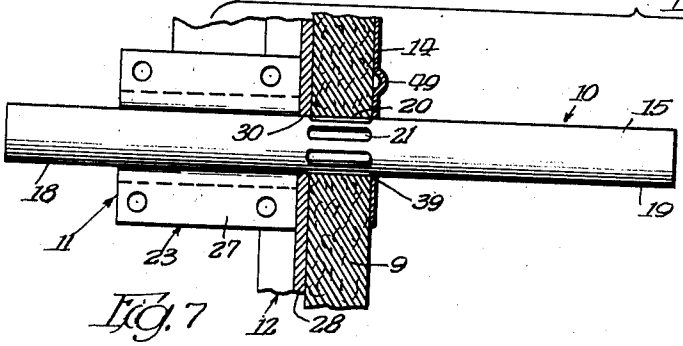


Fig. 6



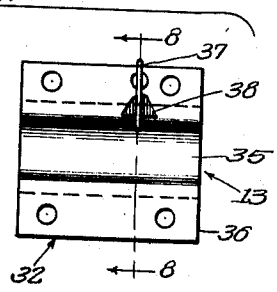


Fig. 7

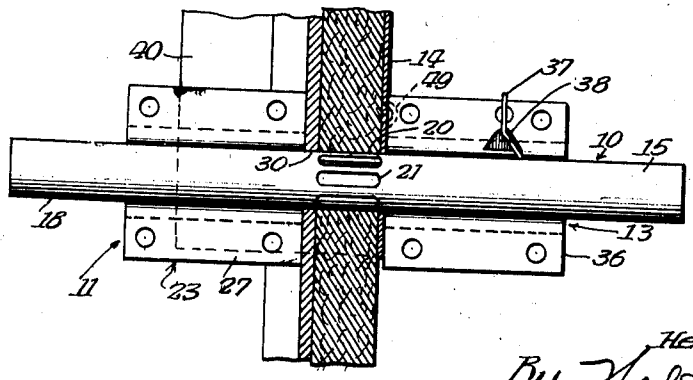
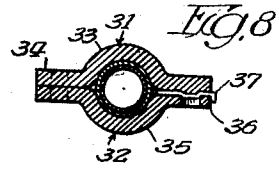


Fig. 8



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UNITED STATES PATENT OFFICE

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JOINT FOR CONCRETE SLABS

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Application April 26, 1940, Serial No. 331,688

9 Claims. (Cl. 94—18)

The present invention relates generally to joints. More particularly the invention relates to that type of joint which is designed primarily for use between a pair of adjoining concrete slabs in a roadway or like concrete structure, operates as a load transfer unit and at the same time permits the slabs to move away from and toward one another in response to contraction and expansion, and comprises: (1) a series of laterally spaced parallel cross members which are adapted to extend across the space between the slabs and have their ends project into the slabs respectively; and (2) tubular metallic wing equipped stress reducers which are mounted on the inner portions of the ends of the cross members and are adapted for embedment in the slabs and to move with the latter in response to contraction and expansion thereof.

One object of the invention is to provide a joint of this type which is an improvement upon, and has certain inherent advantages over, previously designed joints of the same general type, including the various forms of joints which are shown in and form the subject matter of an application for United States Letters Patent filed by us July 3, 1937, and bearing Serial No. 151,818.

Another object of the invention is to provide a joint of the type and character under consideration in which certain of the tubular metallic stress reducers are constructed so that they may be readily slid onto the cross members in connection with assembly of the joint and embody simple and novel locking means for locking them against outward movement during pouring of the concrete for the slabs.

Another object of the invention is to provide a concrete slab joint of the last mentioned character in which the locking means for certain of the tubular stress reducers consists of pieces of wire which project into the interior of such stress reducers and are adapted to lock the stress reducers against outward displacement with respect to the cross members regardless of which end of each stress reducer is first slid into place.

Another object of the invention is to provide a joint of the type and character under consideration in which the cross members are held in proper or predetermined laterally spaced relation by way of a horizontally extending channel bar which has holes therein through which the central portions of the cross members extend, and is adapted for embedment in, and to become bonded to, one of the slabs and in addition to assist the stress reducers for the one slab in transmitting and distributing load and also to coact with the wings of the stress reducers in such manner as to restrict or limit rotation of the stress reducers during pouring of the concrete for the slabs.

A further object of the invention is to provide a concrete slab joint of the type and character here under consideration in which the cross members have on the central portions thereof and in opposed relation with the channel bar, sheet metal plates of novel and improved design for holding the joint against tilting or other displacement during pouring of the concrete in connection with formation of the slabs.

A still further object of the invention is to provide a joint which is generally of new and improved construction, can be manufactured at a low and reasonable cost and not only effectively and efficiently fulfills its intended purpose but also is capable of being quickly and readily assembled at the place of installation or use.

Other objects of the invention and the various advantages and characteristics of the present joint for concrete slabs will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a fragmentary perspective view of a joint embodying the invention, illustrating in detail the manner in which the sheet metal plates on the central portions of the cross members serve to hold the joint against tilting prior to, and during, pouring of the concrete in connection with the formation of the slabs;

Figure 2 is a perspective of one of the plates, showing in detail the construction and design thereof;

Figure 3 is a fragmentary view of the side of the joint with the horizontally extending channel bar;

Figure 4 is a fragmentary view of the other side of the joint;

Figure 5 is a vertical transverse sectional view of the joint;

Figure 6 is a horizontal sectional view showing one of the cross members prior to sliding into place the tubular stress reducer with the locking means;

Figure 7 is a horizontal sectional view like

Figure 6 except that it illustrates the slidable stress reducer after shift thereof into place; and

Figure 8 is a vertical transverse section taken on the line 8—8 of Figure 5 and illustrates in detail the design and construction of the locking means for the slidable stress reducers.

The joint which is shown in the drawings constitutes the preferred embodiment of the invention. It is essentially an expansion type joint and is illustrated in connection with a pair of adjoining roadway forming slabs S and S' on a sub-grade G. The slabs are formed of concrete and are spaced a small distance apart, as shown in Figure 5. The joint operates to transfer load from one of the slabs to the other and permits the slabs to contract and expand in connection with temperature changes. It is adapted to be assembled and placed across the sub-grade G before pouring of the concrete in connection with formation of the two slabs S and S' and as its main or principal parts comprises a compressible filler strip 9, a series of laterally spaced horizontally extending cross members 10, a set of stress reducers 11 on the ends of the cross members at one side of the joint, a channel bar 12, a set of stress reducers 13 on the ends of the cross members at the other side of the joint, and a set of joint supporting and stiffening plates 14.

The compressible filler strip 9 is preferably in the form of molded composition material and is adapted to fill the space between the slabs S and S'. It is designed to assume a vertical position on the sub-grade G, as shown in Figure 1, and after formation of the slabs extends from the sub-grade to a point slightly beneath the top faces of the slabs. When the slabs expand in connection with an increase in temperature the filler strip 9 is compressed between the opposed end faces of the slabs and when the slabs contract due to a decrease in temperature the filler strip expands. As shown in Figure 5 the filler strip fits snugly between the two slabs and serves to prevent dirt, water and other matter from passing between the slabs to the sub-grade G.

The cross members 10 constitute the means for transferring the load from one slab to the other and comprise sheet metal sleeves 15, and solid dowel bars 16 in the sleeves. The sleeves are cylindrical and project through, and are centrally positioned with respect to, the compressible filler strip 9. They are equidistantly spaced, as shown in Figure 1, and have caps 17 driven into the end extremities thereof in order to close them against inflow of concrete. The ends of the sleeves at one side of the filler strip 9 have the reference numeral 18 applied thereto and are adapted for embedment in, and to become bonded to, the slab S. The ends of the sleeves at the other side of the filler strip are designated by the reference numeral 19 and are adapted for embedment in, and to become bonded to, the slab S'. The central portions of the sleeves 15 of the cross members 10 fit snugly within holes 20 in the central portion of the filler strip 9 and are weakened by means of slots 21. The dowel bars 16 are formed of steel and are centrally positioned in the sleeves 15. They extend across the central slotted portions of the sleeves and are of such length that the ends thereof terminate slightly inwardly of the caps 17. When the cross members are assembled the sleeves are filled with graphite or other suitable lubricant in order to permit of relative sliding movement of the sleeves and bars. When the slabs S and S', after setting or hardening thereof, contract the sleeves, due to the slots 21 in the central portions thereof, rupture centrally with the result that the sleeve ends 18 and 19 are free to slide on the dowel bars to and from one another in connection with expansion and contraction of their respective slabs. The slotted central portions of the sleeves, prior to rupture, are confined in the holes 20, as shown in Figure 5, and hence no concrete is permitted to flow into the sleeves in connection with pouring of concrete in formation of the slabs S and S'.

The stress reducers 11 are mounted on the sleeve ends 18 and are adapted for embedment in the slab S and to move with the sleeve ends 18 in connection with expansion and contraction of the slab S. They serve to reinforce the sleeve ends 18 and also to increase the bearing surfaces between the slab S and the joint and consist of upper sheet metal stampings 22 and complemental lower sheet metal stampings 23. The upper stampings embody semi-cylindrical parts 24 and laterally extending side wings 25 and overlie the inner portions of the sleeve ends 18. The lower stampings consist of semi-cylindrical parts 26 and full length laterally extending side wings 27 and underlies the inner portions of the sleeve ends 18. The side wings of the upper and lower stampings of the stress reducers 11 are arranged in lapped relation and are fixedly connected together by way of riveting. Preferably the riveting is done at the place where the joint is manufactured or fabricated. The semi-cylindrical parts of the stampings 22 and 23 are of less internal diameter than the external diameter of the sleeve ends 18 with the result that the riveting together of the side wings serves fixedly or rigidly to connect the stress reducers 11 to the sleeve ends 18.

The channel bar 12 extends horizontally and fits against the side of the compressible filler strip 9 that abuts against the slab S. It extends from one end of the filler strip to the other, as shown in Figure 1, and is positioned substantially midway between the top and bottom of the strip. As shown in Figure 3, the bar 12 consists of a vertically extending web 28 and a pair of vertically spaced laterally extending flanges 29. The web 28 of the channel bar embodies a series of holes 30 through which the sleeves 15 of the cross members 10 extend. These holes register with, and are the same in diameter as, the holes 20 in the central portion of the filler strip 9 and surround the inner portions of the sleeve ends 18. The web 28 of the channel bar is clamped against the adjacent face of the filler strip by means of the inner ends of the stress reducers 11. The flanges 29 of the channel bar are formed integrally with the side margins of the web and project in the direction of the outer extremities of the sleeve ends 18. The channel bar has a four-fold purpose as far as the joint is concerned. In the first place it serves to reinforce the compressible filler strip 9 against bending or sagging. Secondly, it operates to hold the cross members 10 in proper spaced relation. Thirdly, it assists the stress reducers 11 in presenting or affording a comparatively large bearing area between the joint and the slab S. Fourthly, it restricts rotation of the stress reducers 11 and the cross members during pouring of the concrete for the slab S inasmuch as the flanges 29 thereof overhang the inner ends of the side wings of the stampings of the stress reducers 11. The channel bar 12 is embedded in the slab S after setting or hardening of the concrete and moves with

the stress reducers 11 and the sleeve ends 18 in connection with expansion and contraction of the slab S. The inner face of the web 28 of the bar is flat with the result that it fits flatly against the adjoining portion of the filler strip 9.

The stress reducers 13 are mounted on the inner portions of the sleeve ends 19 and are adapted to become embedded in, and bonded to, the slab S'. They are similar in general design and shape to the stress reducers 11 on the sleeve ends 18 and consist of upper sections 31 and complemental lower sections 32. The upper sections are in the form of one-piece stampings and comprise semi-cylindrical parts 33 and full length laterally extending side wings 34. The semi-cylindrical parts 33 are designed and adapted to overlie the inner portions of the sleeve ends 19, as shown in Figure 5, and the side wings are designed and adapted to extend horizontally. The lower sections 32 are also in the form of sheet metal stampings. They underlie the inner portions of the sleeve ends 19 and consist of semi-cylindrical parts 35 and full length side wings 36. Said side wings 36 underlie and are riveted to the side wings 34 of the upper sections 31. The stress reducers 13 in connection with assembly of the joint are adapted, after the sleeve ends 19 of the cross members have been slid through the holes 21 in the central portion of the compressible filler strip 9, to be slid onto said sleeve ends 19 and shifted against the filler strip in order to bring the latter into clamped relation with the channel bar and so clamp the various parts of the joint that they are substantially rigid. In order to permit the stress reducers 13 to be slid readily into place, the semi-cylindrical parts 33 and 35 are so formed that their internal diameters is slightly greater than the external diameter of the sleeve ends 19. For the purpose of preventing outward displacement or movement of the stress reducers 13 relatively to the sleeve ends 19 pieces 37 of comparatively stiff wire are provided. These pieces, as shown in Figures 7 and 8, extend transversely of the stress reducers 13 and are clamped between certain of the side wings 34 and 36 of the upper and lower sections of the stress reducers 13. The inner ends of the wire pieces 37 project into the interiors of the stress reducers 13 and are disposed in V-shaped recesses 38 in the subjacent side wings 36 so that they are free to swing laterally. When the stress reducers 13 are slid onto the sleeve ends 19 in connection with assembly of the joint the inner ends of the wire pieces 37 strike against said sleeve ends 19 and are deflected toward the outer ends of the stress reducers 13, as shown in Figure 7. As the stress reducers 13 are shifted toward the filler strip 9 the inner ends of the wire pieces 37 slide freely on the outer faces of the sleeve ends 19. Because of the angular position of the inner ends of the wire pieces the stress reducers 13, when mounted in place on the sleeve ends 19, are locked against outward movement. From an inspection of Figure 7 it is manifest that the extreme inner extremities of the wire pieces 37 dig into the sleeve ends 19 and because of a so-called toggle action which is set up, preclude any outward movement or displacement of the stress reducers 13 with respect to the sleeve ends 19. Because the recesses 38 are V-shaped the inner ends of the wire pieces are free, prior to application of the stress reducers 13 to the sleeve ends 19, to swing in either direction and hence they are operative to form a positive lock regardless of which ends of the stress reducers 13 are first applied to the sleeve ends 19. In other words, because of the recesses 38 it does not make any difference which end of each stress reducer 13 is first applied to the sleeve end 19 in connection with sliding of the stress reducer into place. The wire pieces 37 constitute simple and novel locking means whereby the stress reducers 13 are permitted to slide readily toward the filler strip 9 but are precluded from reverse or outward displacement. By employing the wire pieces 37 the assembly of the joint is facilitated and there is no likelihood of the stress reducers 13 slipping with respect to the sleeve ends 19 during pouring of the concrete for the slabs S and S'. As shown in Figures 6, 7 and 8 of the drawings, holes are formed in the wings of the lower stress reducer sections 32 that underlie the locking pieces 37. These holes are disposed directly outwards of the apex portions of the recesses 38. The portions of the upper stress reducers that are directly above the aforementioned holes are in the form of protuberances which project into the holes and serve so to distort the outer ends of the wire pieces 37 that such ends are fixedly connected or locked to the stress reducers.

The joint supporting and stiffening plates 14 correspond in number to the cross members 10 and fit against the side of the compressible filler strip 9 that faces the slab S'. They are in the form of sheet metal stampings and serve to stiffen the filler strip 9 and also to hold the joint in place on the sub-grade G during pouring of the concrete for the slabs S and S'. As shown in Figure 2 the plates 14 are horizontally elongated and have end holes 39. The latter register with, and are the same in size as, the holes 20 in the strip 9 and surround the extreme inner portions of the sleeve ends 19. Each of the plates 14 is provided along its bottom margin with a pair of flat horizontally extending feet 40 and 41. The feet 40 are positioned beneath the holes 39 for the sleeve ends 19 and extend under the bottom of the filler strip 9. They are adapted to rest on the sub-grade G, as shown in Figure 1, and have in the central portions thereof upstruck protuberances 42 for preventing movement of the filler strip away from the plates 14. The feet 41 are laterally offset with respect to the feet 40 and project in the opposite direction. They are adapted to underlie the slab S' and together with the feet 40 serve to hold the plates 14 as well as the other parts of the joint against tilting. The plates 14 are anchored or fixed to the sub-grade G by way of a set of stakes 43. The latter extend vertically and are positioned alongside of the ends of the plates that embody the feet 41. The upper ends of the stakes extend through holes 44 in horizontally extending ears 45 on the plates 14, and the lower ends of the stakes project or extend through holes 46 in the feet 41. The holes 44 are vertically aligned with the holes 46, as illustrated in Figure 2. The ears 45 are formed by making U-shaped slits in the plates and then bending upwardly and outwardly the slitted portions of the plates. The ends of the plates provided with the feet 41 have vertically extending out-struck ribs 47 for reinforcing purposes. The other ends of the plates, i. e., the ends with the feet 40 are reinforced against horizontal bending by means of vertically aligned upper out-struck ribs 48 and lower out-struck ribs 49. The inner ends of the wings at one side of the stress reducers 13 fit within the spaces between the upper and lower ribs 48 and 49 and are so interlocked with such ribs that the stress

reducers 13 are held against rotation relatively to the plates. By interlocking the stress reducers 13 against turning relatively to the plates 14 there is little, if any, likelihood of the cross members 10 of the joint being displaced during pouring operation. As indicated in dotted lines in Figure 2, the central portions of the plates 14, i. e., the portions between the inner ends of the feet 40 and 41 are adapted to bend in the event that the stakes 43 when driven into the sub-grade G strike stones or other obstructions which tend to cause them to shift away from the filler strip 9.

It is contemplated that the joint be shipped to the place of installation in knocked-down or dismantled form and then assembled when it is desired to use it. To assemble the joint the slab ends 18 are inserted into properly spaced vertically extending holes in a board or other assembly member (not shown). Thereafter the channel bar 12 is positioned so that the holes 30 register with the outer extremities of the sleeve ends 19 of the cross members and is then lowered in order to bring the flanges 12 into straddled relation with the inner ends of the stress reducers 11. After this operation the compressible filler strip 9 is mounted on the sleeve ends 19 and is shifted into abutment with the inner face of the web 28 of the channel bar. At the conclusion of this step or operation the plates 14 are mounted on the sleeve ends 19 and are slid along such ends until they are in abutment with the adjacent face of the strip 9. In connection with slide of the plates 14 in place such plates are so manipulated that the feet 40 are brought into lapped or hooked relation with the bottom portion of the strip 9. After proper positioning of the plates 14 the tubular stress reducers 13 are mounted on the sleeve ends 19 and are then urged or driven toward the strip 9 until such strip is firmly clamped between the channel bar 12 and the plates 14. At the conclusion of the aforementioned steps the joint is placed across the sub-grade G and tilted or otherwise manipulated so as to bring the strip 9 into a vertical position and the feet 40 and 41 of the joint supporting and stiffening plates 14 into place on the sub-grade. After properly positioning the joint the stakes 43 are inserted through the holes in the ears 45 and the holes in the feet 41 and are then driven downwards into the sub-grade in order to anchor the joint in place. After the latter operation concrete is poured at the sides of the filler strip in order to form the slabs S and S'. When the concrete sets or hardens the channel bar 12, the stress reducers 11 and the sleeve ends 18 are embedded in, and bonded to, the slab S and the plates 14, the stress reducers 13 and the sleeve ends 19 are embedded in, and bonded to the slab S. As soon as the central portions of the sleeves of the cross members rupture in connection with contraction of the two slabs the stress reducers and sleeve ends at one side of the filler strip 9 are free to slide to and from the stress reducers and sleeve ends at the other side of the strip in connection with expansion and contraction of the slab. Before pouring of the concrete for the two slabs grease or any other suitable material is applied to the feet 40 in order to prevent the plates 14 from in any way adhering to the slab S. When the stress reducers 13 are urged or driven into place in connection with assembly of the joint they are so locked in place that they cannot, without extreme force, be shifted outwardly with respect to the sleeve ends 19. Because of the action of the wire pieces 37 it is possible, in connection with assembly of the joint, to slide the stress reducers 13 in such firm clamped relation with the compressible filler strip 9 that the cross members 10 are effectively maintained in a normal or right angle position with respect to the filler strip 9.

The herein described joint effectively and efficiently fulfills its intended purpose and may be manufactured at a comparatively low and reasonable cost. It may be assembled with facility at the place of use or installation and has certain inherent advantages over previously designed joints of like character.

Whereas the joint has been described as an expansion joint it is understood that by eliminating the compressible filler strip 9 it may be used as a contraction or plane of weakness type joint. It is also to be understood that the invention is not to be restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention. For example, in some instances it may be desirable to employ solid one-piece cross members instead of the dowel bar and sleeve type cross members heretofore described. When solid cross members are employed it is contemplated that stress reducers like the stress reducers 13 be used on both ends of the cross members and that such stress reducers will slide on the cross bars after hardening or setting of the slabs since with the first contraction of the slabs the inner ends of the wire pieces 37 will break or rupture and hence lose their automatic locking function.

Having thus described the invention what we claim as new and desire to secure by Letters Patent is:

1. A tubular stress reducer adapted to be slid onto one end portion of a load transfer type cross member and then embedded in a concrete slab and embodying a wire locking piece having one end thereof fixedly connected to the stress reducer and its other end flexible laterally and projecting inwards a sufficient distance to engage said one end portion of the cross member during sliding of the stress reducer into place.

2. A tubular stress reducer adapted to be slid onto one end portion of a load transfer type cross member and then embedded in a concrete slab and embodying an inwardly flared recess adjacent and leading to its interior, and also embodying a transversely extending wire locking piece having the outer end thereof connected fixedly to the stress reducer and its inner end disposed in said recess, flexible laterally and projecting into the interior of the stress reducer a sufficient distance to engage said one end portion of the cross member during sliding of the stress reducer into place.

3. A tubular stress reducer adapted to be slid onto one end portion of a load transfer type cross member and then embedded in a concrete slab by pouring the concrete for the slab therearound, comprising a semi-cylindrical metal stamping with laterally extending flat side wings and a complemental semi-cylindrical metal stamping with laterally extending flat side wings in lapped or abutting relation with, and secured to, the wings of the first mentioned stamping, and having a transversely extending wire clamped between two of its wings and arranged so that the inner end thereof projects into the interior of the stress reducer and serves to lock the stress reducer against outward displacement with respect to said one end portion of the cross member after sliding of the stress reducer into place.

4. A joint for adjoining concrete slabs, comprising a series of laterally spaced parallel cross members adapted to have the central portions thereof extend across the space between the slabs and their end portions project into the slabs respectively, tubular stress reducers with longitudinally extending wings at the sides thereof, mounted on the end portions of the cross members that are at one side of the joint and adapted for embedment in the contiguous slab, and a channel bar extending at right angles to the cross members and mounted on the inner extremities of said last mentioned end portions, said channel bar being adapted for embedment in said contiguous slab and having the flanges thereof arranged in lapped or straddled relation with the inner ends of the wings of the stress reducers and spaced but a small distance apart so that they coact with said wings to limit or restrict turning of the stress reducers during pouring of the concrete for the slabs.

5. A tubular stress reducer adapted to be slid onto one end of a load transfer cross member and then embedded in a concrete slab and having an outwardly extending wing for interlocking with the slab and in addition having as a part thereof automatic one-way clutch type locking means whereby it may be slid inwardly onto said one end of the cross member in connection with assembly while at the same time it is temporarily and effectively held against outward displacement with respect to the cross member.

6. A joint for adjoining concrete slabs, comprising a series of laterally spaced parallel cross members adapted to have the central portions thereof extend across the space between the slabs and their end portions project into the slabs respectively, tubular elements mounted on the end portions of the cross members that are at one side of the joint, and adapted in connection with assembly of the joint and prior to pouring of the concrete for the slab to be slid onto the last mentioned end portions and upon setting of the contiguous slab to become bonded thereto, and separately formed wire locking pieces connected to the tubular elements so that certain of the ends thereof project inwards and grip the cross members frictionally and resiliently and serve to lock the elements in place during pouring of the concrete.

7. A joint for adjoining concrete slabs, comprising a series of laterally spaced parallel cross members adapted to have the central portions thereof extend across the space between the slabs and their end portions project into the slabs respectively, tubular stress reducers on the end portions of the cross members that are at one side of the joint, adapted in connection with assembly of the joint and prior to pouring of the concrete for the slabs, to be slid onto the last mentioned end portions and upon setting of the contiguous slab to move with the latter in response to contraction and expansion thereof and embodying at the sides thereof lapped longitudinally extending side wings for interlocking with said contiguous slab, and wire locking pieces extending transversely of, and clamped between, the wings of the stress reducers and having the inner ends thereof projecting into the stress reducers' interiors so that they engage the cross members frictionally and resiliently and serve to lock the stress reducers in place during pouring of the concrete.

8. A joint for adjoining concrete slabs, comprising a series of laterally spaced parallel cross members adapted to have the central portions thereof extend across the space between the slabs and their end portions extend into the slabs respectively, tubular elements on the end portions of the cross members at one side of the joint, adapted in connection with assembly of the joint and prior to pouring of the concrete for the slabs, to be slid onto the last mentioned end portions and upon setting of the contiguous slab to become bonded thereto, and having in communicating relation with their interiors V-shaped recesses with the apex parts thereof facing outwards, and transversely extending wire locking pieces having the outer ends thereof connected fixedly to the tubular elements and their inner ends extending through and fitting loosely in the recesses and projecting into the interiors of the elements so that they engage frictionally and yieldingly the cross members and serve to lock the elements in place during pouring of the concrete.

9. A joint for adjoining concrete slabs, comprising a series of laterally spaced parallel cross members adapted to have the central portions thereof extend across the space between the slabs and their end portions project into the slabs respectively, tubular stress reducers on the end portions of the cross members that are at one side of the joint, adapted in connection with assembly of the joint and prior to pouring of the concrete for the slabs, to be slid onto the last mentioned end portions, and embodying pairs of lapped longitudinally extending side wings adapted to interlock with the contiguous slab and having between the inner portions thereof inwardly flared recesses, and transversely extending wire locking pieces having the outer ends thereof clamped between the wings outwards of the recesses and their inner ends extending through and fitting loosely in the recesses and projecting into the interiors of the elements so that they engage frictionally and yieldingly the cross members and serve to lock the elements in place during pouring of the concrete.

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