Nov. 24, 1942. J. H. JACOBSON 2,302,773

LOAD TRANSFERENCE UNIT

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Fig. 1

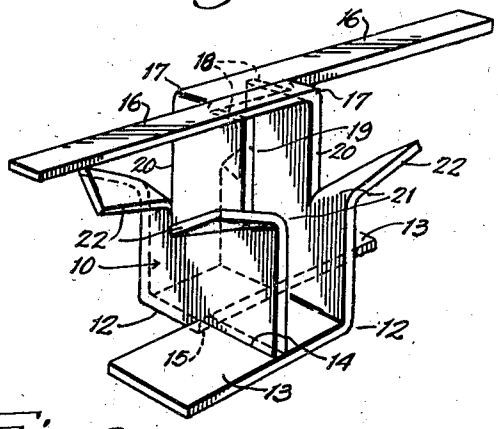


Fig. 2

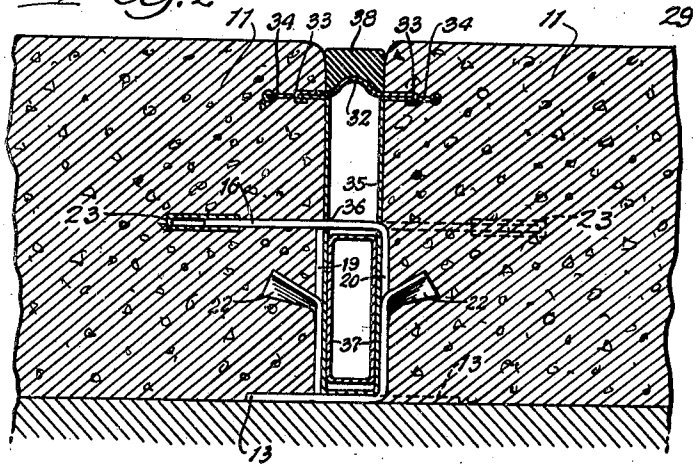


Fig. 3

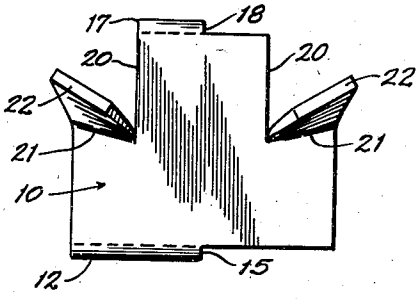
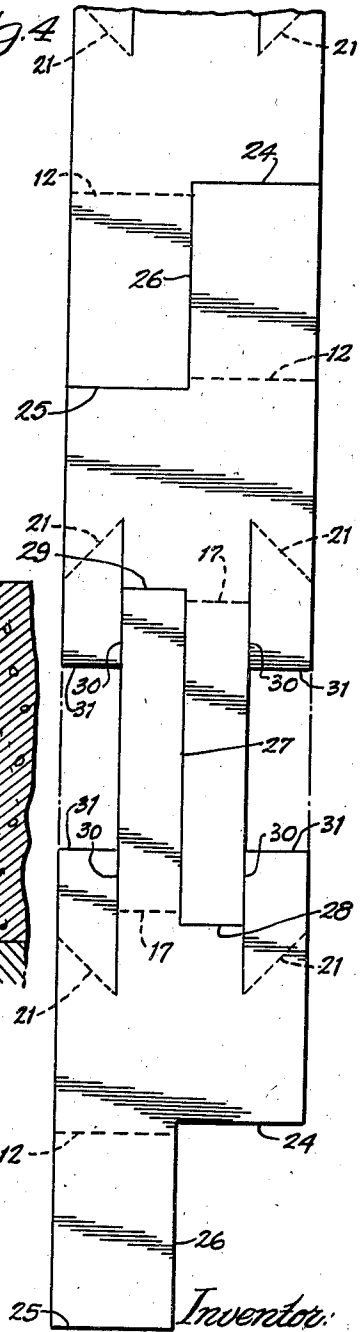


Fig. 4



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Fig. 5

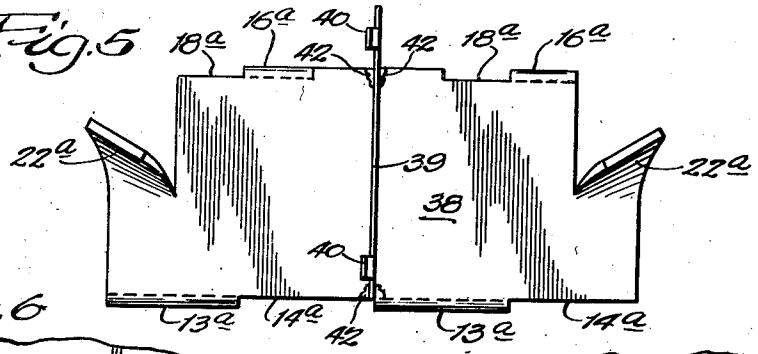
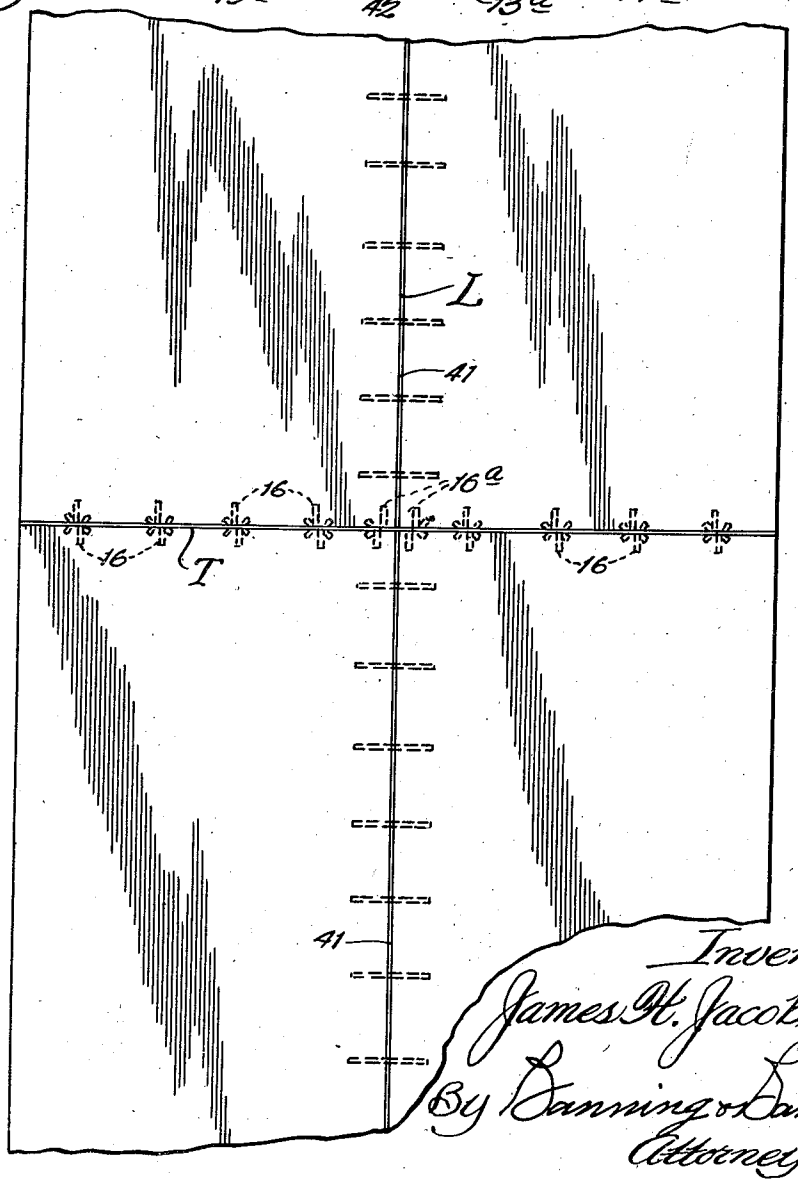


Fig. 6



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Patented Nov. 24, 1942 2,302,773

UNITED STATES PATENT OFFICE

2,302,773

LOAD TRANSFERENCE UNIT

James H. Jacobson, Chicago, Ill.

Application June 5, 1941, Serial No. 396,742

10 Claims. (Cl. 94—18)

The load transference unit of the present invention is designed primarily for use in the construction of concrete highways, for the purpose of connecting the ends of adjoining road slabs, and transmitting load stresses across the gaps between the adjacent faces of the slabs in such a manner as to prevent vertical displacement under the pressure of a rolling load.

Before discussing the mechanical details of the present invention it is proper to point out that the term "load transference unit" refers to the means employed for interconnecting the adjacent ends of concrete road slabs across the gap provided for expansion and contraction and which unit includes members which are movable horizontally to accommodate the advance and recession of the slabs, and which serve in conjunction to bridge the gap and resist vertical displacement of either of the slabs with respect to the other. In such an arrangement it is of primary importance to distribute the stresses imposed by an approaching load, so that a considerable portion of such stress will be resisted by the more distant slab, which thus serves to reinforce the near slab which receives the initial impact of the advancing load, and it is also important to provide against vibration or similar movements which, unless counteracted, have a cumulative tendency to wear away the concrete adjacent the unit members, and thus in time permit displacement of the unit with a resultant failure to perform the service intended.

On the present invention, provision is made for the rigid and immovable union of each unit section at the face of the slab to which it is connected, and the union thus afforded is rendered more effective by the reinforcement provided by slidable connection with the opposed slab section and by the bearing surfaces presented by the body of the companion unit members, all with a view of providing interfitting members which bridge the gap at two separated levels and are designed to maintain the utmost rigidity against vertical displacement, while at the same time allowing freedom for the required longitudinal movement. Every portion of the composite unit member is designed to cooperate in the transmission and distribution of load stresses under the conditions mentioned.

The companion members, constituting in conjunction a load transference unit, are so disposed and interfitted as to provide complete reinforcement of the unit without the employment of dowel bars of the conventional type, and with the added advantage of providing parts or elements for bridging the gap which are formed rigidly and integrally with the bodies of the respective unit members, and are mutually interfitted and reinforced in a highly effective manner.

The load transference unit members have also been designed with a view to extreme economy in production, being in the preferred form of identical stampings, which may be cut from a bar of metal with almost no waste of material and bent to finished form, ready for use, by a stamping operation, and which need not be cut or formed with extreme precision in order to be interfitted in the intended manner for use in a road joint. It will be understood, however, that the present unit need not be formed as a stamping, but may be produced as a malleable unit or otherwise.

Further objects and details will appear from the description of the invention in conjunction with the accompanying drawings, wherein,

Figure 1 is a perspective view of identical companion unit members in their assembled relation;

Fig. 2 is an end elevation of the unit showing its relation to the opposed faces of contiguous road slab sections;

Fig. 3 is a rear face elevation of one of the two unit members;

Fig. 4 is a plan view of the unit blanks illustrating the manner of cutting the same from a continuous section of metal plate without material waste;

Fig. 5 is a rear face elevation of one of the two unit members of a modified form of construction, designed for use in bridging the intersection between the longitudinal and transverse road joint gaps; and

Fig. 6 is a plan view of a portion of a roadway showing four road slabs contiguous to an intersection between the longitudinal and transverse road joints.

The companion load transference members composing a complete unit are of identical formation, each comprising a flat generally rectangular vertical body **10** which is adapted to present its rear face in flatwise relation to the joint face of the concrete slab **11** with which it is associated. The length of the body may be varied, depending upon the thickness or gauge of the metal employed in relation to the pressures to be resisted, and the height of the body may also be varied within limits, but ordinarily the height will be sufficient to afford contact with the face of the slab to a level at or near its center, as shown in Fig. 2.

The lower edge of the body, on one side of the vertical center line, is bent along the angle 12 and is extended at a 90° angle to provide a flat rectangular foot 13, which, as shown in Fig. 2, when the unit is assembled, will rest upon the sub-grade and underlie the base of the opposed concrete slab, and the dimensions of the foot should be adequate to afford a substantial area of contact with the under side of the slab for a considerable distance behind the joint face.

The opposite end of the body terminates in an edge 14 which is upwardly offset at the point of juncture 15 with the bend 12, to provide for the reception of the foot of the companion unit section, so that when the two sections are interfitted, the under faces of the oppositely projecting offset feet will lie in a uniform horizontal plane or flush with one another.

The body of each unit member is provided with a forwardly projecting horizontal dowel arm 16, which partially overlies the foot of the same unit section and is united with the body along a bend line 17, and beyond the bend line the edge 18 of the body is exposed to afford contact for the dowel arm 16 of the companion unit member, the edge being slightly offset to bring the upper surfaces of both of the dowel arms into a uniform horizontal plane.

The body of each unit member is cut vertically along the edges 19 and 20 to free the material at the upper corners of the body, which material is bent backwardly along inwardly and downwardly directed bend lines 21 to provide anchoring lugs 22, which converge inwardly toward one another with their inner edges at a lower level than the arms 16, so that in the shoveling of the concrete around the unit, the concrete will readily flow under the overlying dowel arm, thus preventing the formation of voids or pockets beneath the dowel arms.

By bending the anchoring lugs along the obliquely disposed bend lines 21, the lugs will diverge laterally beyond the body, as shown in Fig. 3, thus increasing the overall spread of the unit and providing inwardly convergent oblique surface planes of anchorage which conjointly serve to resist both lateral and vertical displacement of the unit members and to afford a throat for directing the flow of concrete inwardly and downwardly.

With the unit members formed and configured in the manner above described, when they are brought into interfitted cooperative relation as in Fig. 1, each of the dowel arms will rest upon and find intermediate support upon the edge 18 of the companion body, and at the same time the foot 13, which likewise bridges the gap from below, will afford support for the lower edge of the companion body, and these contacts will be maintained at all variations in the width of the gap occasioned by the expansion and contraction of the road slabs, due to variations in temperature or other causes.

In use, the ends of the respective dowel arms will be slidably housed within expansion tubes 23 embedded within the concrete, and provided to afford the voids required for the longitudinal movements of the dowel arms occasioned by expansion and contraction.

The manner in which identical unit blanks may be cut from a continuous bar of plate metal is illustrated in Fig. 4, from which it will be noted that the amount of waste is negligible and is occasioned only by reason of the fact that the length of the anchoring lugs is less than the length of the dowel arms. It will be noted from Fig. 4 that the blanks may be cut from a continuous bar of metal of a width equal to the width of each section body, and that, in cutting, the blanks will lie in opposed relation to one another; that is to say, the material forming the feet of contiguous blanks will be cut along offset transverse cut lines 24 and 25 and a connecting longitudinal medial cut line 26. The contiguous dowel arms will be cut free from one another along a longitudinal center cut line 27, and cut free at their respective ends along offset transverse cut lines 28 and 29. The anchoring lugs will be freed from the adjacent arms along longitudinal cut lines 30, which project inwardly in each case beyond the adjacent arm to expose the vertical edges 19 and 20 of the body. The cut lines 30 run continuously to expose the outer edges of the dowel arms, and the anchoring lugs are terminated by cross cut lines 31, leaving a small rectangular waste section occasioned by the fact that ordinarily the dowel arms will have a greater length than the anchoring lugs.

It will be seen from the foregoing description that the unit blanks have been so configured that identical blanks, rather than blanks of a right and left formation, can be severed from a continuous bar with a negligible amount of waste, and transformed into completed unit members by merely bending the arms and feet and lugs along the bends whose position is indicated by dotted lines in Fig. 4.

In the transmission of loads across a road gap, the two interfitted unit members cooperate throughout in the identical manner and irrespective of the direction of approach of a rolling load toward the joint. Each unit member stands with its body suspended in a vertical plane through the use of the anchoring lugs, which are preferably struck at approximately a 45° angle from the horizontal, and on a 60° angle from the vertical. The camber of these lugs, being directly opposed, present a greater spread at their most extended points than that afforded by the original face width of the metal.

Each unit member affords an intermediate bearing surface at its top for the dowel arm of the companion member, which bearing is equal to the width of the dowel arm supported thereon. Each dowel arm thus supported at the gap projects forwardly into the concrete at a relatively high level and overlies the associated foot of the same unit member which projects beneath the same concrete slab into which the associated arm is slidably entered. In order to prevent bonding of the concrete upon the embedded dowel arm, the bottom and two edges of the dowel arm, along that portion of the arm which is exposed to the concrete and outside of the expansion tube, will be greased. Each unit member, therefore, is held in rigid suspension against the joint face of the slab to which it is attached by the embedment of the lugs, and is reinforced against any bending or canting by the unit contact of the integrally formed foot and dowel arm, which engage the body of the oppositely facing slab at two widely separated levels, and these factors, in conjunction with the inherent rigidity of the unit member, insure rigid and immovable connection with the near slab, and two-level sliding engagement with the opposite slab.

With the two halves of the unit member thus placed in opposition, the vertical plate body of each member rests upon the foot of the opposing member, while each rigidly connected dowel

arm rests upon the top surface of the vertical plate body of the opposing member. This provides for a free longitudinal movement of the unit members, so that the early shrinking or setting of the mortar, which becomes the concrete stone, has sufficient strength, even in its semi-fluid condition, to draw back the connected unit with its own motion and therefore prevent a loss of strength resulting from a moving or shrinking away from the unit so included.

In the transference of load across a gap, three factors are considered in general practice, namely, suspension, shear, and bearing.

In the present invention, suspension is afforded by the inclusion in bond of the two anchoring lugs rearwardly extending from each vertical body plate. These lugs are placed at an angle, so as to offer a greater bond and a greater resistance to shear at their bends. The dowel arms also afford a method of suspension.

In the matter of shear, the two dowel arms bridge across the gap and each is intermediately supported by contact with the body of the opposed unit member. The shear strains occur, therefore, at the line of bend at the junction point of each dowel arm with the body, and also at the lines of bend of the lugs and the line of bend of the horizontal foot of each opposing member.

Bearing is afforded by the flat faces of the dowel arms, by the obliquely disposed surfaces of the lugs, and by the resistance to bending afforded by the horizontal surface of the foot of each of the unit members.

It is proper to note the results of applied stress occasioned by the approach of a rolling load upon a gap thus reinforced. As the load approaches the gap, the extended dowel arm of the further unit member, projecting into the concrete beyond the body of the nearer unit member, comes into action, and its pressure downward is met by the resistance of the anchoring lugs of the nearer unit member, with the result that the down pressure of the dowel arm directly upon the edge of the nearer body plate distributes a portion of the stress into the underlying horizontal foot of the companion or more distant member, so that the pressure thus applied to the foot is transmitted and resisted by the embedded anchoring lugs of the more distant member. As the pressure is taken up by the lugs of the distant member, a lifting pressure is exerted upon the dowel arm which projects toward the approaching load.

The resultant action is the coordination of all planes of resistance to an equalization or distribution of the created stresses throughout the various functional portions of each half of the unit, so that all portions of each of the members are effectively cooperating at all times in the attainment of the result sought.

It will, of course, be understood that the unit of the present invention is designed and intended for use in conjunction with a suitable expansive metallic joint which serves as a pouring form and for closing the gap to prevent the ingress of foreign material, but the use of such devices is well known in the art and forms no essential portion of the invention, so that it is not deemed necessary to illustrate the same in full detail.

However, for purposes of illustration only, I have shown the present unit used in association with a joint provided with an expansible and contractible arch shaped seal **32** having hooked flanges **33** which engage the flanges **34** extending outwardly from the spaced side walls **35** of a collapsible stool which serves as a form during the pouring of the concrete to define the initial width of the gap between the slabs.

The walls of the stool abut against the bodies of the unit members, and the dowel arms are entered through slots **36** in the walls **35**, and in order to maintain the walls of the stool in properly spaced relation to resist the pressure of the concrete while being poured, the inner spacer **37** is provided, which as shown is of flat sided tubular formation, but which may be of any other formation adequate to prevent collapse. The arch shaped seal is straddled by a filler strip **38** of suitable composition such as latex rubber, which projects the seal and fills the space, and is adapted to expand and contract in conformity with variations in the width of the gap.

The load transference unit of the present invention, being interfitted with the stool of the joint, will afford full support therefor, and hold the same in proper position during the pouring of the concrete.

In addition to the functional advantages heretofore described and referred to, it is proper to point out that the individual unit members, being identical in form, can be closely nested together in packing, and in view of the fact that the assembled unit is self-sustaining when placed in position, it will not require any involved means of securement to the sub-grade.

It will also be noted that the interfitting of the arms and feet of the respective unit members is one which permits of slight lateral adjustment of the arms necessary to allow the same to slide past one another and compensate against slight inaccuracies in cutting or bending, so that close adjustment is not essential in order to permit the parts to move freely in response to the expansion and contraction of the road slabs.

The principles of construction and operation heretofore described are equally applicable to the modified form of construction shown in Fig. 5, which illustrates an enlarged type of low transverse unit which is designed particularly for use at points of intersection between the transverse joint gaps in a roadway and the continuously extending longitudinal joint.

Fig. 6 illustrates a section of roadway in which the longitudinal joint gap is indicated by the reference letter L, and the transverse joint gap by the reference letter T. The enlarged unit of Fig. 5 is designed to reinforce and fortify the road at this intersection point, and is so constructed as to bridge the intersection in both directions.

The intersection unit is formed of oppositely facing companion members each comprising a body **38** of substantially double the length of the unit member first described, which is provided at each end with an anchoring lug **22a** similar in all respects to the lugs previously described, and is also provided with a pair of forwardly extending dowel arms **16a** identical in structure with those previously described, and with a pair of forwardly extending feet **13a**, also of the character previously described.

The upper edge of the body, adjacent each dowel arm, is recessed to afford contact edges **18a** for the support of the dowel arms of the companion unit member, and likewise the lower edge is provided with recesses **14a** affording contact edges for the feet of the companion member of the unit. The construction thus involves merely a duplication of the feet and dowel arms, without, however, duplicating the anchoring lugs,

which occupy positions corresponding to the anchoring lugs first described.

Each unit member has secured to the rear face of the body, in the center thereof, a vertical tie plate **39** which extends upwardly from a point adjacent the foot to a point above the upper edge of the body, and the plate is provided with upper and lower punched out tongues **40** which afford sockets which firmly grip the end of the longitudinally extending joint member **41** which divides the road sections.

The vertical tie plate is preferably secured by welding **42** to the body and stands normally to the plane of the body. The body of the intersection unit thus affords a bridge across the longitudinal joint gap at the intersection, while the dowel arms bridge the transverse joint gap, so that the road as a whole will be rigidly supported and reinforced at this point, which is of special importance in preventing the breaking down or wearing away of the concrete at the intersection point where the inner corners of four contiguous concrete slabs adjoin one another. It will of course be understood that the intersection unit consists of two companion members which interfit and cooperate in the manner first described, with the added function of affording a bridge across the longitudinal joint.

Although the invention has been described with particularity in its present form, it will be understood that modifications in the shape and arrangement of the respective parts may be made without departing from the spirit of the invention.

I claim:

1. In a load transference intersection unit adapted to bridge the transverse gap and also bridge the longitudinal gap between road slab sections adjacent an intersection point, the combination of companion oppositely facing members each consisting of a vertically disposed body section of a length to bridge the longitudinal road joint gap, a pair of horizontal forwardly extending dowel arms projecting beyond the body of the companion member and spaced to engage concrete slabs on opposite sides of the longitudinal road joint gap and having intermediate support on the body of the companion member and serving to bridge the transverse road joint gap, and a pair of horizontal forwardly extending feet underlying and projecting beyond the base of the body of the companion member and affording support therefor and spaced to contact with road slabs on opposite sides of the longitudinal road joint gap and serving to bridge the transverse road joint gap.

2. In a load transference intersection unit adapted to bridge the transverse gap and also bridge the longitudinal gap between road slab sections adjacent an intersection point, the combination of companion oppositely facing members each consisting of a vertically disposed body section of a length to bridge the longitudinal road joint gap, a pair of horizontal forwardly extending dowel arms projecting beyond the body of the companion member and spaced to engage concrete slabs on opposite sides of the longitudinal road joint gap and having intermediate support on the body of the companion member and serving to bridge the transverse road joint gap, and a pair of horizontal forwardly extending feet underlying and projecting beyond the base of the body of the companion member and affording support therefor and spaced to contact with road slabs on opposite sides of the longitudinal road joint gap and serving to bridge the transverse road joint gap, and anchoring means on each member extending rearwardly therefrom and adapted to be embedded within the contiguous road slabs on opposite sides of the longitudinal road joint gap.

3. In a load transference unit adapted to bridge the gap between adjacent road slab sections, the combination of companion oppositely facing members each consisting of a vertically disposed body section provided with a rigidly connected horizontal dowel arm of less width than the connected body section to expose a laterally adjacent upper portion of said body section and forwardly projecting beyond the body section of the companion member and having intermediate support upon the exposed upper portion thereof and each body section having a rigidly connected horizontal forwardly extending foot of less width than the body section to expose an adjacent lower portion of the body section and projecting beyond the base of the body section of the companion member and contacting the exposed lower portion thereof, the oppositely projecting dowel arms lying in staggered laterally offset relation to one another and the oppositely projecting feet lying in staggered laterally offset relation to one another.

4. In a load transference unit adapted to bridge the gap between adjacent road slab sections, the combination of companion oppositely facing members each consisting of rigid plate material bent to afford a vertically disposed body section provided with a horizontal dowel arm of less width than the connected body section to expose a laterally adjacent upper portion of said body section and terminating at its inner end in said body section and forwardly projecting beyond the body section of the companion member and having intermediate support upon the exposed upper portion thereof and each body section having a horizontal forwardly extending foot of less width than the body section to expose an adjacent lower portion of the body section and projecting beyond the base of the body section of the companion member and contacting the exposed lower portion thereof, the oppositely projecting dowel arms lying in staggered laterally offset relation to one another and the oppositely projecting feet lying in staggered laterally offset relation to one another.

5. In a load transference unit adapted to bridge the gap between adjacent road slab sections, the combination of companion oppositely facing members each consisting of a vertically disposed body section provided with a horizontal dowel arm of less width than the connected body section to expose a laterally adjacent upper portion of said body section and rigidly connected at its inner end to said body section and forwardly projecting beyond the body section of the companion member and having intermediate support upon the exposed upper portion thereof and each body section having a rigidly connected horizontal forwardly extending foot of less width than the body section to expose an adjacent lower portion of the body section and projecting beyond the base of the body section of the companion member and contacting the exposed lower portion thereof, the oppositely projecting dowel arms laying in staggered laterally offset relation to one another and the oppositely projecting feet lying in staggered laterally offset relation to one another, and anchoring means on each member extending rear-

wardly therefrom and adapted to be embedded within the contiguous road slab.

6. In a load transference unit adapted to bridge the gap between adjacent road slab sections, the combination of companion oppositely facing members each consisting of rigid plate material bent to afford a vertically disposed body section provided with a horizontal dowel arm of less width than the connected body section to expose a laterally adjacent upper portion of said body section and terminating at its inner end in said body section and forwardly projecting beyond the body section of the companion member and having intermediate support upon the exposed upper portion thereof and each body section having a horizontal forwardly extending foot of less width than the body section to expose an adjacent lower portion of the body section and projecting beyond the base of the body section of the companion member and contacting the exposed lower portion thereof, the oppositely projecting dowel arms lying in taggered laterally offset relation to one another and the oppositely projecting feet lying in taggered laterally offset relation to one another, and anchoring means on each member extending rearwardly therefrom and adapted to be embedded within the contiguous road slab.

7. In a load transference unit adapted to bridge the gap between adjacent road slab sections, the combination of companion oppositely facing members each consisting of a vertically disposed body section having a forwardly extending horizontal dowel arm terminating at its rear end in said body section at a high level and each body section having a forwardly extending horizontal foot terminating at its rear end in said body section at a low level, each of said body sections, adjacent the arm carried by said body section, being provided with an exposed contact surface affording contact and intermediate support for the dowel arm of the companion body section, and each body section adjacent the foot thereof having an exposed contact surface contacting and receiving support upon the foot of the companion body section.

8. In a load transference unit adapted to bridge the gap between adjacent road slab sections, the combination of companion oppositely facing members each consisting of a vertically disposed body section having a forwardly extending horizontal dowel arm terminating at its rear end in said body section at a high level and each body section having a forwardly extending horizontal foot terminating at its rear end in said body section at a low level, each of said body sections, adjacent the arm carried by said body section, being provided with an exposed contact surface affording contact and intermediate support for the dowel arm of the companion body section, and each body section adjacent the foot thereof having an exposed contact surface contacting and receiving support upon the foot of the companion body section, and anchoring means on each body section extending rearwardly therefrom and adapted to be embedded within the contiguous road slab.

9. In a load transference unit adapted to bridge the gap between adjacent road slab sections, the combination of companion oppositely facing members each consisting of rigid plate material bent to afford a vertically disposed body section having a forwardly extending horizontal dowel arm terminating at its rear end in said body section at a high level and each body section having a forwardly extending horizontal foot terminating at its rear end in said body section at a low level, each of said body sections, adjacent the arm carried by said body section, being provided with an exposed contact surface affording contact and intermediate support for the dowel arm of the companion body section, and each body section adjacent the foot thereof having an exposed contact surface contacting and receiving support upon the foot of the companion body section, and each body section having a pair of spaced anchoring lugs bent backwardly from the plane of the body section along downwardly converging bending lines and presenting their upper and lower faces at convergently oblique angles to one another.

10. In a load transferring unit adapted to bridge the gap between adjacent road slab sections, the combination of companion oppositely facing members each consisting of a vertically disposed body section having a forwardly extending horizontal dowel arm rigidly connected to said body section at a high level and each body section having a forwardly extending horizontal foot rigidly connected to said body section at a low level, said companion members being interengaged in such manner that each dowel arm extends beyond the body section of the companion member and finds intermediate support upon a portion thereof at a relatively high level, and each foot support extends beyond the body section of the companion member and affords support therefor at a relatively low level, and means for anchoring each member to its contiguous road slab section.

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