



# UNITED STATES PATENT OFFICE

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## DOWEL BAR STRUCTURE

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20 Claims. (Cl. 94-18)

My present invention relates to highway construction and particularly to the building of concrete pavements, and more particularly to a device for transferring road loads from one concrete slab to the next adjoining slab, and is an improvement over what is known as the common dowel bar.

This is a division of my prior and co-pending application, filed May 20, 1935, Serial No. 22,308.

It is well recognized in this art that concrete pavements are continually undergoing a change in volume due in a large sense to moisture content or temperature change, and that as these volume changes take place the concrete slabs, under restraint, will rupture and establish natural joints or, preferably, mechanical joints are interposed at predetermined intervals which permit of the unrestrained and unrestricted movement of the slabs.

When mechanical joints are employed, thus dividing the pavement into a plurality of relatively short slabs, and in order that the surface of the adjoining slabs may be maintained uniform and in substantially the same plane so as to obtain a comparatively smooth and uninterrupted surface for the motoring public, it has been customary for many years to dowel across from one slab to the next adjoining. The common dowel has been universally accepted as the most practical means for this purpose, but the common dowel has many deficiencies. The common dowel, economical due to its inherent shape, is lacking in bearing, and many methods have been employed in an attempt to extend the bearing of the dowel, for the purpose of distributing the applied load both to the face of the slab and to points back within the slab. Most of these devices are prohibitively expensive to manufacture and install. They are very cumbersome and create field difficulties and raise considerable uncertainty in engineers' minds as to their final positioning within the slabs after the concrete has set.

It is the province of the common dowel to first acquire a portion of the superimposed load, and to carry it across the gap or space between the adjoining slabs, and then to distribute the load within the slab. It is, therefore, a paramount object of this invention to:

First, reduce the high bearing stresses existing at the edge of the slab by providing a greater bearing area in contact with the concrete at the edge of the slab; and

Second, to further reduce the high edge stresses by virtue of radiating anchors which

either absorb load or transmit and distribute the dowel loads to and within the slab and thereby eliminate high stress areas in the slab that would otherwise exist.

A further object is to decrease the deflection of the short dowel during periods of load transmission by furnishing a definite structural support for the body of the dowel, which not only eliminates channeling within the slab, but by so doing, also decreases deflection under periods of load transmission.

My object is to provide a shorter effective length of structural dowel member whereby the deflection of the dowel is materially reduced.

It is a further object to increase the load transmission capacity of the common dowel, as a dowel used for the purpose of load transmission is required to withstand bending and shearing stresses, and I materially reduce these bending stresses in a dowel by effectively reducing the length of the dowel. I further increase the load transmission capacity of the dowel by virtue of its reduction in length with its consequent increased capacity in bending. Due to this shorter length and consequent smaller deflection, the load transfer capacity of the dowel is considerably increased. Naturally, the amount of this increase also depends upon the thickness of the slab and the modulus of the subgrade reaction.

It is a still further object of my invention to provide an air space at the end of the short dowel so that the dowel may move freely within the slabs to accommodate the lateral movement of the adjoining slabs during periods of volume change.

My present invention has these and other objects, all of which are explained in detail and may be more readily understood when read in conjunction with the accompanying drawing (one sheet) which illustrates the preferred embodiment of my invention, it being manifest that changes and modifications may be resorted to without departure from the spirit of the claims forming a part hereof.

In the drawing:

Fig. 1 is a perspective view of a commercial type of expansion joint showing my invention in its relative association therewith; the joint is shown in broken lines as forming no part of my invention;

Fig. 2 is a vertical section through the same type of expansion joint shown cast between the end faces of adjoining concrete slab sections, one half of the unit is in section, the dowel and the opposite unit being shown in elevation;

Fig. 3 is a transverse section through the dowel and bearing taken on line 3—3 of Fig. 2;

Figs. 4, 5, 6 and 7 are illustrative of various cross-sections of conventional forms of dowel bars, which are considered applicable in carrying out my invention;

Fig. 8 is a sectional view, similar to Fig. 2, wherein I have shown a plurality of concentric fins cast integral with the dowel bearing; and

Fig. 9 is a section through Fig. 8 taken on line 9—9.

The structures illustrated involve the application of my invention to a roadway slab, and for purposes of description only, I choose to define my invention as applied to this particular construction; however, I wish it understood that its adoption and use are equally applicable to any poured or pre-cast structure, whether it be a roadway slab or a retaining wall, dam or building structure, for, as a matter of fact, my invention is applicable to an almost unlimited number of structures.

For purposes of illustration, I have shown a conventional type of expansion joint comprising a stool 20 with spaced side walls 21—21, closed at the bottom and supporting a metallic seal 22 with a mastic cap 23, the seal is provided with lateral anchors 24—24 adapted to be cast into adjoining slab sections A and B; and whereas I have shown and described such a joint, I wish it understood that any type of joint may be employed in connection with my invention, whether it be an expansion joint, contraction joint, or only a construction joint or space.

My invention consists in spanning the space or gap provided by the joint between slabs A and B with a relatively short dowel bar 25, positioned at substantially mid-depth of the slabs, parallel with the top surface thereof, and normal to the plane of the joint; and whereas I have shown the dowel 25 as the common rolled bar of circular cross-section, it will be apparent to those skilled in the art, that dowels of various cross-sections may be employed without departing from the spirit of my invention. Figs. 4, 5, 6, and 7 are illustrations (as before described) of the most commonly used steel sections which I employ for this purpose.

The ends of the dowel 25 are telescoped into a pair of counterpart and relatively reversed rigid bearings or sleeves 26, each of which consists of a single unitary casting adapted to be imbedded in its respective slab, and each such sleeve or bearing comprises a cup-like portion which is reamed to provide a snug and tight sliding fit for the dowel and of a length sufficient to provide an air chamber 27 of a depth substantially equivalent to one-half of the gap or space between the adjoining slabs. The outer ends of the sleeves are sealed with a well 28, whereas the inner faces 29 are placed approximately flush with the face of their respective slab sections, so that the axis of the bore is substantially horizontal and at right angles to the slab end.

As shown at Figs. 1 and 2, a pair of radial arms or anchors 30—30 are cast integral with the wall 28 of the sleeve 26, the anchors 30 diverge therefrom and approach (but do not penetrate) the surface, top and bottom, of their respective slabs. The outer ends of the anchors 30 are enlarged in cross-section to establish bulb-like portions or knobs 31.

Lateral bearings or anchors such as fins 32 may also be provided to increase the bearing in the concrete; such fins, one on each side of each unit

radiate from the sleeve 26 from a point flush with the inner face 29 and taper back to a point approaching the wall 28, thereby providing an extended bearing surface at the face of the slab where it is most needed.

As shown at Figs. 8 and 9, I further contemplate employing a plurality of concentric rings or anchors 42 and 43 which are cast as an integral part of and encircle the bearing sleeve. The rings or anchors 43 are preferably positioned directly adjacent the open end of the sleeve and immediately adjacent the slab face, whereas the anchors 42 are spaced therefrom, and as shown, may be located directly adjacent the closed end of the sleeve. And laterally disposed anchors 44, similar in purpose and function to the anchors 32, may also be employed, preferably positioned intermediate and connecting the encircling rings or anchors 42 and 43 as shown, whereby the unit pressure on the concrete surrounding the anchors, when the dowel is under load, will be less than that in the concrete which directly contacts the sleeve.

In the assembly of this dowel structure, the dowel 25 is first passed through the joint with equal lengths protruding on each side thereof, a pair of sleeves 26 are next placed over the protruding ends of the dowel as shown, and then temporarily keyed in place with soft metal pins 35 driven through aligning holes in the sleeve and dowel. The dowel structure just defined is assembled at spaced intervals throughout the length of the mechanical joint, and at the desired spacing to accommodate the estimated loads the pavement is to carry. The entire structure, including the dowel assembly and the joint, is then placed upon the sub-grade, and due to the particular assembly, the dowels are immediately in proper alignment, the slabs are then poured, cured, and the highway opened to traffic and the resultant application of moving wheel loads applied in turn.

In operation and as the moving wheel load approaches the joint traveling from the initially loaded slab A towards the next adjacent slab B, the load is absorbed by the dowel structure and particularly the radial anchors 30, 32, 42 and 43, concentrated, and then transmitted to the sleeve and dowel and thence across the joint to a like unit on the opposite side or next adjacent slab, where the concentrated load is dissipated through the sleeve and the radial anchors and distributed into the slab structure. As the load crosses the joint and onto the next adjacent slab, the reverse of the above action starts at a maximum and diminishes as the load passes on. The short dowel remains at all times at or near the neutral axis of the slabs, whereas the radial anchors remain within the tension and compression areas intersecting the shear planes and reinforcing the edge of the slab. This action of the dowel structure absorbs and so distributes the load, that if failure does occur, it will take place outside of the field embraced by the dowel bar structure, as the dowel in its bearing effectively transmits the full strength of one slab to the other without interruption; in fact, the employment of this structure insures the highway against joint failures, as the slab, here, is stronger at the joint than at any other point, as the anchors 30, 32, 42 and 43 all increase the bearing value of the sleeve 26 in the concrete and assist in the distribution of load to such an extent as to prevent channeling of the concrete structure.

Having thus described my invention, what I

claim as new and desire to secure by United States Letters Patent is:

1. A load transfer device for bridging a gap between the adjacent end faces of two substantially horizontally aligned concrete slabs, comprising two counterpart and relatively reversed rigid major members each consisting of a single unitary casting having its integrated parts adapted to be imbedded in its respective slab, each major member comprising a cup-like sleeve portion opening at the end face of the slab in which that member is imbedded and adapted to have the axis of its bore horizontal and at right angles to said slab end and substantially within the neutral plane of the slab, integral anchors extending outwardly from the outer wall of the cup-like sleeve portion of each major member and into the body of the slab within which it is adapted to be imbedded, and a dowel-like bridging member adapted to seat and have bearing in the bore of the cup-like sleeve portion of one major member and adapted to project beyond the end face of its respective slab and to bridge the gap intervening between the adjacent end faces of the adjoining slabs and to extend into and slidably engage the bore of the cup-like sleeve portion of the other associated major member.
2. A load transfer device as per claim 1 in which the anchors, which are in integral part of each major member, diverge away from the open end of the sleeve portion of each major member and are symmetrical with respect to a horizontal plane at right angles to the slab end for transmitting the imposed loads between the dowel-like member and the slab.
3. A load transfer device as per claim 1 in which the anchors, which are an integral part of each major member, diverge away from the open end of the sleeve portion of each major member and have their axes in a common vertical plane with the axis of the dowel-like member, and further have their free end portions formed for interlocking with the material of the slab in which that member is adapted to be imbedded to prevent a movement of that member toward the adjacent end face of the slab.
4. A load transfer device as per claim 1 wherein the anchors which are integral with the cup-like sleeve portion of each major member diverge away from the open end of the sleeve portion both upwardly and outwardly and downwardly and outwardly therefrom and into the body of the slab to transmit the imposed loads away from the slab face.
5. A load transfer device as per claim 1 which includes laterally disposed anchors extending outwardly from the sleeve portions in a substantially horizontal plane for transmitting pressure directly to the material of the slab, whereby the unit pressure on the concrete around the sleeve and the anchors is less than that on the concrete which would directly contact the sleeve of the major member if the anchors were omitted.
6. A load transfer device as per claim 1 including an enlarged ring portion integral with and encircling the sleeve at a point adjacent the open end thereof and immediately adjacent the slab face for transmitting pressure directly to the material of the slab.
7. A load transfer device as per claim 1 which includes a plurality of concentric fins integral with and encircling the sleeve at spaced intervals for transmitting pressure directly to the material of the slab in which they are imbedded.
8. A load transfer device as per claim 1 wherein the integral sleeve portion of each major member is adapted to slidably house an end portion of the dowel member, and wherein each sleeve portion has its bore of sufficient length to afford an air space at each end of the assembled dowel to permit relative movement between the dowel and its enclosing sleeves.
9. A load transfer device as per claim 1 wherein the enclosed length of the dowel-like bridging member is less than the length of the bore of the cup-like sleeve portion to thereby establish an air space at one end of the dowel.
10. A load transfer device as per claim 1 in which the dowel-like member has a close sliding fit in the bore of the sleeve portion of the major member with a tolerance in clearance which limits the deflection of the dowel in its bearing when under load to within the bending limits of the concrete.
11. A load transfer device as per claim 1, wherein the dowel-like member has a snug sliding fit in the bore of the sleeve portion of the major member and wherein the clearance between the dowel and its bearing is less than three one-thousandths of an inch.
12. A load transfer device as per claim 1 wherein the bearing of the enclosed dowel within the bore of the sleeve portion is greater in length than the diameter of the dowel.
13. A load transfer device as per claim 1 in which the bore section of each cup-like sleeve portion is of greater height than width and wherein the greater section modulus of the dowel opposes the bending moment and shear produced by the loading forces.
14. A load transfer device as per claim 1 which includes two latch elements respectively housed by the sleeve portions of the major members, each of which latch elements latchingly engages the dowel member.
15. A load transfer device as per claim 1 which includes locking members engaged with said dowel-like members to prevent the relative rotation of said dowel members with respect to the cup-like sleeve portion of the major members.
16. A load transfer device as per claim 1 which includes locking members engaged with said cup-like sleeve portions of said major members to prevent the separation of the assembled device.
17. A load transfer device for bridging a gap between the adjacent end faces of two substantially horizontally aligned concrete slabs, comprising a relatively rigid major member consisting of a unitary casting having its integrated parts adapted to be imbedded in one of the two slabs, said member comprising a cup-like sleeve portion opening at the end face of the slab in which that member is imbedded and adapted to have the axis of its bore horizontal and at right angles to said slab end and substantially within the neutral plane of the slab, integral anchors extending outwardly from the outer wall of the cup-like sleeve portion of said member and adapted to enter into the body of the slab within which it is adapted to be imbedded, a dowel-like bridging member adapted to seat within and slidably engage the bore of the cup-like sleeve portion of said major member and adapted to project beyond the end face of its respective slab and to bridge the gap intervening between the adjacent end faces of the adjoining slabs and enter and engage the opposite or opposed slab.
18. A load transfer device for bridging a gap

between the adjacent end faces of two substantially horizontally aligned concrete slabs, comprising two counterpart and relatively reversed rigid major members each consisting of a single unitary casting having its integrated parts adapted to be imbedded in its respective slab, each major member comprising a cup-like sleeve portion opening at the end face of the slab in which that member is imbedded and adapted to have the axis of its bore horizontal and at right angles to said slab end and substantially within the neutral plane of the slab, integral anchors extending outwardly from the outer wall of the cup-like sleeve portion of each major member and into the body of the slab within which it is adapted to be imbedded, a dowel-like bridging member adapted to seat and have bearing in the bore of the cup-like sleeve portion of one major member and adapted to project beyond the end face of its respective slab and to bridge the gap intervening between the adjacent end faces of the adjoining slabs and to extend into and slidably engage the bore of the cup-like sleeve portion of the other associated major member, and said anchors having their axes in a common horizontal plane with the axis of the dowel-like bridging member.

19. A load transfer device for bridging a gap between the adjacent end faces of two substantially horizontally aligned concrete slabs, comprising two counterpart and relatively reversed rigid major members each consisting of a single unitary casting having its integrated parts adapted to be imbedded in its respective slab, each major member comprising a cup-like sleeve portion opening at the end face of the slab in which that member is imbedded and adapted to have the axis of its bore horizontal and at right angles to said slab end and substantially within the neutral plane of the slab, integral anchors extending outwardly from the outer wall of the cup-like sleeve portion of each major member

and into the body of the slab within which it is adapted to be imbedded, said anchors comprising a plurality of spaced apart fins substantially concentric, integral with and encircling the sleeve portion, and a dowel-like bridging member adapted to seat and have bearing in the bore of the cup-like sleeve portion of one major member and adapted to project beyond the end face of its respective slab and to bridge the gap intervening between the adjacent end faces of the adjoining slabs and to extend into and slidably engage the bore of the cup-like sleeve portion of the other associated major member.

20. A load transfer device for bridging a gap between the adjacent end faces of two substantially horizontally aligned concrete slabs, comprising two counterpart and relatively reversed rigid major members each consisting of a single unitary casting having its integrated parts adapted to be imbedded in its respective slab, each major member comprising a cup-like sleeve portion opening at the end face of the slab in which that member is imbedded and adapted to have the axis of its bore horizontal and at right angles to said slab end and substantially within the neutral plane of the slab, integral anchors extending outwardly from the outer wall of the cup-like sleeve portion of each major member and into the body of the slab within which it is adapted to be imbedded, a dowel-like bridging member adapted to seat and have bearing in the bore of the cup-like sleeve portion of one major member and adapted to project beyond the end face of its respective slab and to bridge the gap intervening between the adjacent end faces of the adjoining slabs and to extend into and slidably engage the bore of the cup-like sleeve portion of the other associated major member, and each of said anchors being disposed in a vertical plane transverse to the horizontal axis of the dowel-like bridging member.

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