Oct. 22, 1963 T. D. NATHAN 3,107,377

BRIDGE PAD AND ITS USE

Filed Sept. 18, 1959 2 Sheets-Sheet 1

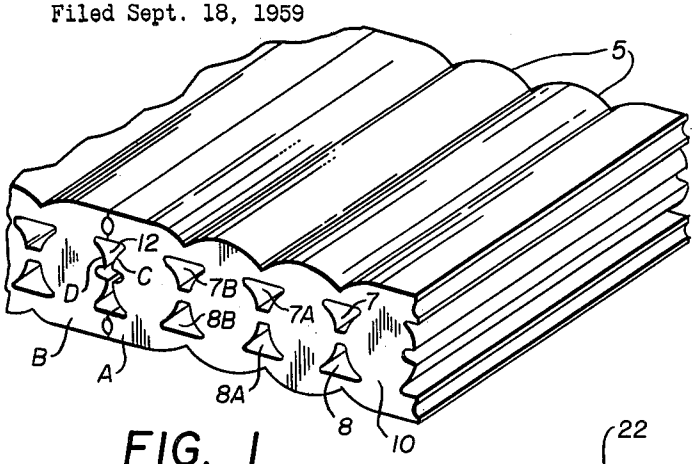


FIG. 1

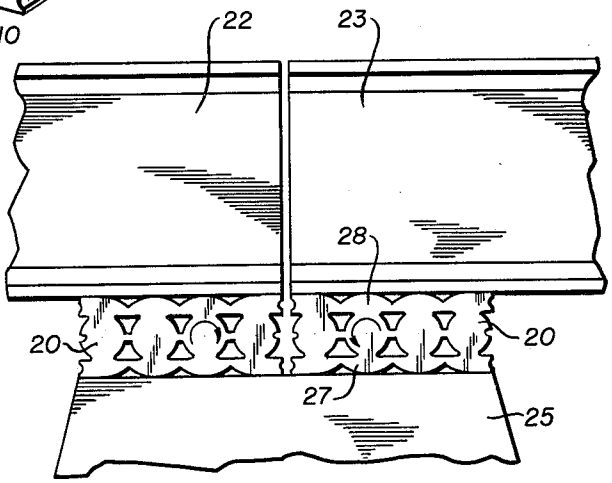


FIG. 2

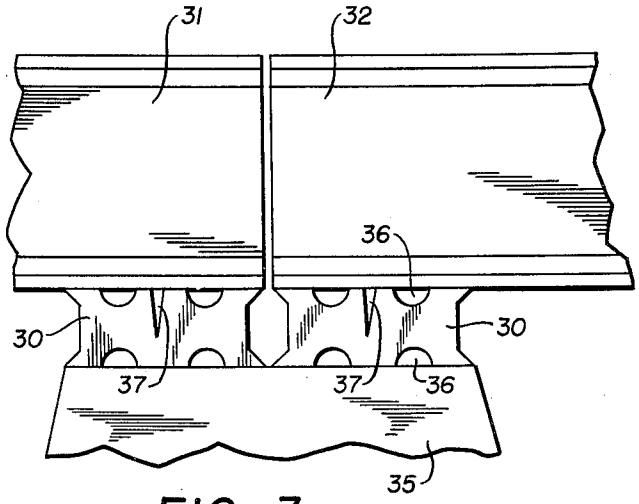


FIG. 3

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BRIDGE PAD AND ITS USE

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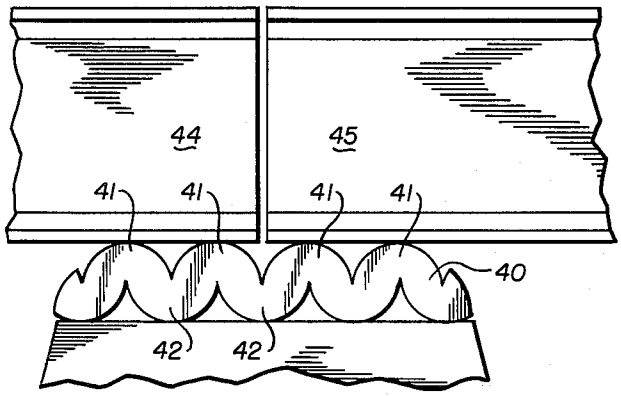


FIG. 4

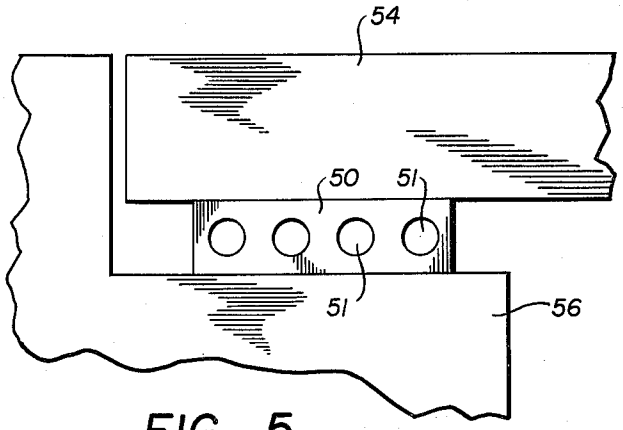


FIG. 5

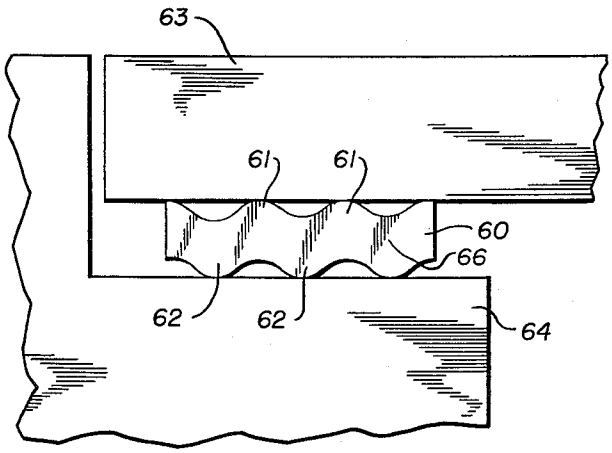


FIG. 6

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3,107,377
Patented Oct. 22, 1963

3,107,377

BRIDGE PAD AND ITS USE

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Filed Sept. 18, 1959, Ser. No. 840,934
5 Claims. (Cl. 14—16)

This invention relates to elastomeric pads to be located between a load-carrying member of a bridge and its support. Such pads are located near one or both ends of the one or more load-carrying members of the bridge. The top of each such pad is movable longitudinally with respect to the bottom thereof to compensate for the expansion and contraction of the load-carrying member as it expands and contracts with changes in temperature.

The pad of this invention may be made of natural rubber, but is preferably made of neoprene or other elastomer which withstands weathering better than natural rubber. The load-carrying member may be a steel girder, a reinforced-concrete slab, etc.

The pad is extruded. It is provided with one or more openings extending through it, or one or more depressions in one or both of its surfaces. All such openings and depressions are referred to herein as being openings within the general confines of the pad, assuming the pad to be generally rectangular in outline. The pad is incorporated in the bridge so that these openings extend laterally of the bridge structure. The openings permit greater longitudinal distortion within the pad structure than is possible with a solid pad of the same composition.

Openings in the pad are preferably located in such a way as to produce one or more post supports. A post support is a vertical section of the pad of weight-supporting width which is continuously solid from the load-carrying member to the support, or substantially so. A pad with one or more post supports in its structure readily lends itself to use as the length-compensating means in a bridge structure because the voids facilitate longitudinal movement of the upper portion of the pad with respect to the lower portion. A post support generally provides better support than a vertical section with one or more voids in it.

The preferred pad of this invention which will be described in detail in what follows, combines a number of sections each of which includes a plurality of substantially cylindrical supports separated by generally triangular openings arranged vertically in pairs, one opening being directly above another. These sections are held together by tenuous webs of the plastic which are easily broken or otherwise severed to obtain a pad containing any desired number of sections for use in any one location. A pad containing many such sections may be rolled for shipment or storage, and one or more of the sections may be utilized in a bridge as a unit. This preferred pad construction will be more fully explained in what follows.

Since there is appreciable expansion and contraction of the span of a bridge, it might be supposed that for the best results a bridge pad must be installed at about the average temperature prevailing at the bridge site, rather than assembling the bridge parts when the temperature is near the maximum or the minimum. However, this is not necessary if the bridge is constructed to permit slippage of the parts, especially during the first extremely hot or extremely cold period following the construction of the bridge. Also, any subsequent extremely hot or extremely cold weather may cause slippage.

Slippage generally occurs between the top of the pad and the bottom of the load-carrying member. However, if the pad is cemented or otherwise fastened to the bottom of the load-carrying member the slippage will occur between the bottom of the pad and the top of the stationary support.

To prevent creepage of the pad in one direction or the other due to repeated expansion and contraction of the load-carrying member, stop means may be provided on the bottom of the load-carrying member or on the top of the stationary support, or both, which stop means are spaced longitudinally of the bridge beam a distance somewhat wider than the width of the pad, to retain the pad in one general location, viz. between the stop means. In that event slippage may occur at both the top and bottom surfaces of the pad.

Relatively small contact areas between the pad and the adjacent surface of the bridge structure, spaced relatively large distances from one another in the longitudinal direction of the bridge, facilitate such slippage. These areas are preferably extruded into one or both surfaces of the pad, although the pad surfaces may be flat with the spaced contact areas projecting from the bottom of the load-carrying member or the top of the stationary support, or both. The contact areas are preferably, but not necessarily, contacts between a flat surface and a surface with spaced contact areas. The pad surface may be lubricated to facilitate slippage, especially the initial slippage which occurs during the first very hot or very cold weather that follows construction of the bridge.

The invention will be further described in connection with the accompanying drawings, in which—

FIG. 1 shows in perspective the preferred form of bridge pad;

FIG. 2 shows a cross section through a bridge, showing one of the preferred bridge pads under each of the adjacent ends of abutting load-carrying members;

FIG. 3 is a section similar to FIG. 2, but using a different form of pad;

FIG. 4 is a section similar to that of FIGS. 2 and 3 but with a single pad supporting the abutting ends of load-carrying means;

FIG. 5 is a section showing a different type of support pad on a support at one end of a bridge beam; and

FIG. 6 is a similar view but shows a different type of support pad.

The bridge support pad of FIGURE 1 is made up of recurring sections A, B, etc. which are held together at very narrow, aligned unions along which the sections can be readily separated. Such a composite sheet permits manufacture and shipment of many pads as a unit, and the pads may be separated from one another into units of a single section or units of two or three sections each, as desired. Such separation may take place at the site where the bridge is formed, or in a warehouse immediately prior to shipment of the pads to the bridge site.

The pad is extruded of neoprene rubber or some other stretchable plastic, usually of about 75 to 80 durometer. The top and bottom surfaces are undulating to provide spaced narrow contact areas between the pad and the members of the bridge structure with which it makes contact. One such area 5 in which narrow contact is provided, is shown in both the top and bottom of the pad between each two post supports formed by the tiers of openings 7, 8, 7*a*, 8*a*, 7*b*, 8*b*, etc. These openings are formed during extrusion of the pad. They define the post supports 10 which in this pad are generally cylindrical. There is no necessity for there being any union of the cylindrical supports at their midpoints between each two tiers of openings, but this stabilizes the pad structure.

The adjacent ends C and D of adjoining sections are joined in tenuous unions. These ends and the adjacent openings 7 and 8 form additional relatively cylindrical post supports.

The cylindrical post supports roll in one direction or the other as the load-carrying means expands or contracts and moves the top of the pad relatively with respect to the bottom of the pad.

At the juncture between the two ends C and D there is a slight flaring of the juncture opening 12 to reduce the

surface tension on the curved surfaces of the post support when subjected to pressure.

The areas 5 of contact between the pad and the elements above and below it continue the idea of post supports between the top and bottom surfaces of the pad. The surfaces of the pad in these areas of contact are flattened somewhat as the weight of the bridge-carrying member is applied.

FIGURE 2 illustrates the use of two of the preferred pads **20** under the adjacent ends of the load-carrying members **22** and **23**. The pads need not be flush with the ends of the members **22** and **23**. The pads rest on the stationary support **25** which may be any suitable abutment. The load-carrying elements **22** and **23** are beams of steel or concrete or of any suitable composition and configuration.

As the temperature increases and the members **22** and **23** expand toward one another, the post supports in the different pads **20** roll toward one another, as indicated by the arrows. As the temperature drops, the elements **22** and **23** contract and the post supports in the pads roll in the direction opposite to that indicated by the arrows. The openings through the pads have blunt corners (flat or rounded) to prevent localizing the stresses.

The top and bottom surfaces **27** and **28** of the pads are arched to provide narrow areas of contact between the pads and the elements they contact. This facilitates slippage between the elements, if necessary.

The design of the bridge pad may be varied considerably. FIGURE 3 shows separate pads **30** supporting adjacent ends of the load-carrying members **31** and **32**. The pads rest on the support **35**. The hemispherical depressions **36** in the top and bottom surfaces of the pad are extruded and extend parallel to one another from one end of the pad to the other. They come within the confines of the pad, assuming it to be generally rectangular. The same is true of the slit openings **37**. These openings facilitate relative movement of the top and bottom surfaces of the pad longitudinally of the bridge beam as the members **31** and **32** expand and contract. The openings define support posts which extend from the load-carrying members **31** and **32** to the support **35**.

FIGURE 4 shows a pad **40** with undulating top and bottom surfaces which provide narrow contact areas **41** and **42** at the top and bottom of the pad. The undulations are made by openings through the pad, assuming the pad to be generally rectangular. The narrow contact areas facilitate slippage at the top and bottom surfaces of the pad. The pad **40** is extruded so that the undulations in its top and bottom surfaces extend from one side of the bridge beam to the other, and are parallel to one another. The pad does not provide post supports, although the design is such that the pad supports heavy loads without collapse.

Whereas FIGURES 2–4 illustrate the use of one and two pads at the juncture of two load-carrying members, the same or other pads may be used at the end of a bridge as illustrated in FIGURES 5 and 6, and the pads there shown may be used at the juncture between two load-carrying members.

In FIGURE 5 the pad **50** is substantially rectangular with flat top and bottom surfaces. The openings **51** are parallel and extend the length of the pad so that a post support is provided between each two openings. As the load-carrying member **54** expands and contracts, the top portion of the pad **50** moves one way or the other with respect to the bottom portion of the pad and the stationary support **56** on which it rests. The openings facilitate this movement. It will be understood that if some slippage is contemplated between the top or bottom surface of the pad **50** and the member **54** or the support **56**, the bottom or top surface of the pad, or both of these surfaces will be provided with spaced areas of support equivalent to those illustrated in the pads shown in FIGURES 2, 3 and 4. Instead of providing such spaced areas in the pad, the bottom of the member **54** or the top of the support **56** may be provided with spaced areas of contact.

The pad **60** of FIGURE 6 provides spaced areas of contact **61** and **62** for contact with the bottom of the load-carrying member **63** and the top of the support **64**, respectively. As in FIGURE 4, the areas of contact at the top of the pad are not directly above the areas of support at the bottom of the pad, so that there is no post support. However, the points of contact are so close to one another that the main body of the pad **66** between them does not bulge into contact with either as weight is applied. No harm is done if the main body does bulge into such contact.

The drawings illustrate only a few pad designs. Openings are extruded in the body of the pad, as in FIGURES 1, 2 and 4, or at least within the general confines of the pad to provide spaced supporting areas. The extruded openings are preferably arranged to provide post supports, especially cylindrical supports as in FIGURES 1 and 2, which rotate with expansion and contraction of the load-carrying members. Two or more such cylindrical supports may be arranged above one another. In pads with such supports the corners of the openings are preferably blunt to prevent the development of local stresses in the pad.

The drawings and description are illustrative. The invention is covered in the claims which follow.

What I claim is:

1. In a bridge in which a load-carrying member is carried by a support, the improvement which comprises a load-carrying elastomeric pad between the two within the general confines of which there are a plurality of parallel openings which extend laterally of the load-carrying member from one edge of the pad to the other, which openings define posts generally cylindrical where exposed to the openings, which posts tend to roll upon movement of the upper portion of the pad longitudinally of the load-carrying member relatively with respect to the lower portion of the pad as the load-carrying member expands and contracts.

2. A resilient elastomeric pad with parallel horizontal openings therethrough, which pad is of uniform cross section throughout its length, said openings outlining at least one substantially cylindrical, horizontal post support between the top and bottom surface portions of the pad, the surface portions of the pad being substantially imperforate.

3. The pad of claim 2 in which there are a plurality of post supports and there are two generally triangular openings between each two supports which outline the supports, the openings each having two corners adjacent one of said surface portions of the pad, which two corners are blunt to prevent localized stresses in the pad as the top and bottom surface portions are moved relatively to one another in a direction perpendicular to the direction of the openings.

4. The pad of claim 2 in which there are a plurality of such post supports and both surfaces of the pad are undulating with the axis of each convex undulation substantially intersecting the vertical axis of a post support.

5. In a bridge with a load-carrying member above a support, the pad of claim 2 on said support and one end of said load-carrying member on the pad.

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