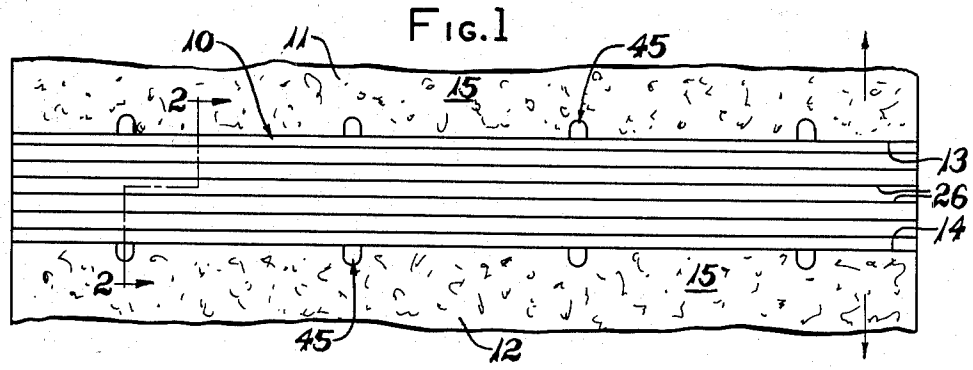
Dec. 10, 1963 W. R. RINKER 3,113,493

EXPANSION JOINT

Original Filed July 2, 1958

FIG. 1



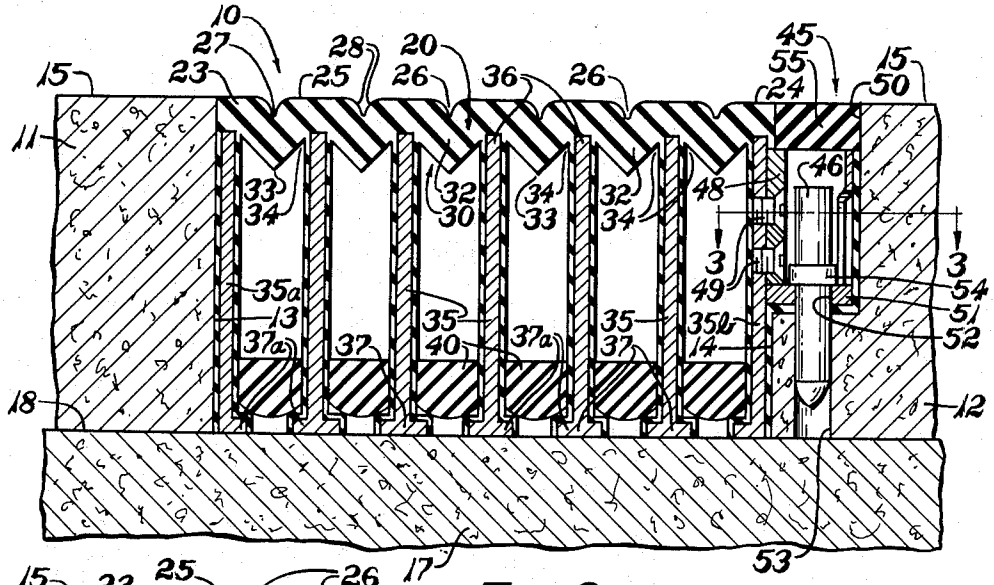


FIG. 2

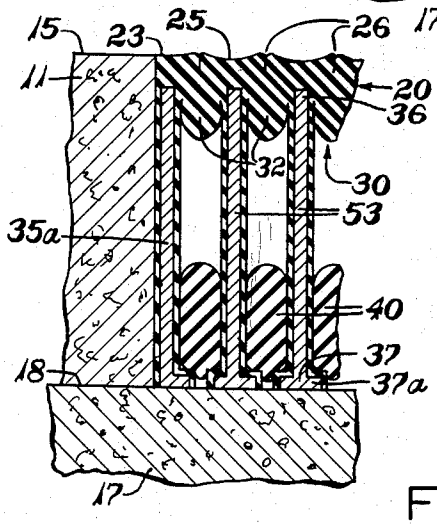


FIG. 4

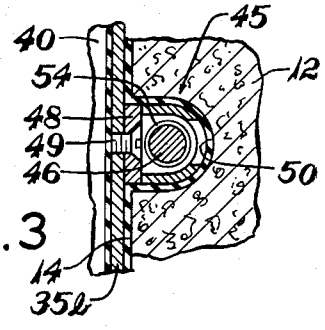


FIG. 3

INVENTOR.

WILLIAM R. RINKER

BY John D. Haney

ATTY.

United States Patent Office 3,113,493 Patented Dec. 10, 1963

3,113,493
EXPANSION JOINT

William R. Rinker, Cuyahoga Falls, Ohio, assignor to The B. F. Goodrich Company, New York, N.Y., a corporation of New York

Continuation of application Ser. No. 746,205, July 2, 1958. This application Oct. 3, 1960, Ser. No. 59,958
3 Claims. (Cl. 94—18)

This invention relates to expansion joints useful to compensate for expansion and contraction in buildings, bridges, paving and various masonry or machine structures, and is a continuation of my application Serial No. 746,205, filed July 2, 1958, now abandoned. The joints of this invention are especially useful in the construction of concrete roads to compensate for thermal expansion or contraction of roadway slabs. More particularly, the joint of this invention embodies improvements in a joint of similar characteristics forming the subject matter of the copending application, Serial No. 659,354 of W. R. Rinker and Robert G. McGilvrey, now Patent No. 3,055,279.

The expansion joint described in the aforesaid Patent No. 3,055,279 includes, in general, a "pleated" body of resilient flexible composition adapted for bridging an expansion gap between adjoining structural parts such as the opposing spaced ends of roadway slabs. The pleated body may be supported at the mouth of the expansion gap by one or more laterally spaced parallel rigid support members, preferably metal plates extending lengthwise of the gap. These supporting plates are arranged relative to the pleat portions of the body such that when the width of the gap is reduced, the pleat portions are adapted to fold and bulge into the regions between the supporting members maintaining the upper surfaces of the rubber body substantially flush with the roadway surfaces of the adjoining slab.

The parallel support members are interconnected with each other and with the side walls of the expansion gap by a series of resilient rubber spacers which are laterally compressed between the pleats when the gap is reduced in width by expansion of the adjacent parts. The spacers are arranged so that as they are compressed they are adapted to urge their respective supporting members downwardly from the body portion to offset or oppose the jacking effect on these supporting members which results from the bulging of the pleated portions of the upper body.

According to the present invention, the improvement provided comprises forming the resilient spacers and the portions of the supporting members with which these spacers cooperate so that they interact when the spacers are distorted to exert a downward force on the supporting members of very much larger magnitude than was provided in the earlier construction to oppose the jacking effect of the pleated body portion.

Details of an expansion joint asembly embodying this invention is illustrated in the accompanying drawing in which:

FIG. 1 is a plan view showing a joint of this invention between a pair of concrete road slabs;

FIG. 2 is a sectional elevational view taken along the line 2—2 of FIG. 1 showing the joint in expanded condition;

FIG. 3 is a detailed sectional view taken along line 3—3 of FIG. 2; and

FIG. 4 is a fragmentary sectional view similar to FIG. 2 but showing the joint in a contracted condition.

Referring to FIG. 1, an expansion joint 10 in accordance with this invention is installed in an expansion gap of substantial width between two concrete road slabs 11 and 12 having opposing vertical end faces 13 and 14, respectively, defining the lateral sides of the expansion gap (see also FIG. 2 for numerals 13 and 14). The expansion joint 10 extends across the width of the gap between faces 13 and 14 and for the full length and depth of the gap, transverse to the roadway surfaces 15 of the slabs. These surfaces 15 may extend for hundreds of feet in the direction of the arrows in FIG. 1. As shown in FIG. 2, the opposing ends of slabs 11 and 12 are jointly supported on the subgrade by an underlying sleeper slab 17 having an upper smooth plane surface 18 defining the bottom of the expansion gap. The end faces of slabs 11 and 12 are adapted for movement relative to the sleeper slab to vary the width of the gap as a result of thermal expansion and contraction of the slabs.

In its structural detail, the expansion joint 10 includes a body 20 of flexible resilient rubber-like material which covers the open mouth of the expansion gap. The body 20 includes longitudinal margins 23 and 24 engaging end faces 13 and 14, respectively, of the gap and has an upper road surface 25 flush with the roadway surface 15 of the slabs. The upper surface 25 is striated with a series of grooves 26 which are narrow and shallow and which extend lengthwise along the outer surface 25 in laterally spaced parallel relation. The portions of the outer surface between grooves 26 are plane. Each groove 26 has opposing convexly rounded side surfaces 28 which blend smoothly into the plane outer surface portions between the grooves and which converge to a narrow bottom surface 27.

The side of the body directed into the gap, i.e. its inside surface 30, is formed with a series of lengthwise corrugations 32, the crests 33 of which are disposed opposite corresponding grooves 26 of the outer surface. In the valleys 34 medially between the crests 33 there is attached to the rubber body 20 the upper edges of a series of flat vertical rigid metal plates 35 which support the rubber body in the gap. The plates 35 extend longitudinally of the body 20 between successive crests 33 and are arranged so that each plate has its upper longitudinal edge 36 seated in its respective valley 34. Along the lower longitudinal edge of each plate there is provided a foot member 37 which in the assembly rests slidably on the surface 18 of the sleeper slab. Each foot member 37 projects laterally as at 37*a* on opposite sides of the plate to provide a broad supporting base for the plate. Each plate is preferably rubber-covered as shown to protect it from corrosion and the upper longitudinal edge 36 of each plate is fastened integrally to the rubber body, for example, by vulcanization when the rubber body is cured.

Near their foot members 37, the supporting plates 35 are laterally separated one from another in parallel relation by a series of resilient rubber spacers 40 which extend lengthwise between the plates. The spacers are located close to the foot members 37 to engage their laterally projecting portions 37*a* when the spacers are distorted. Thus as the spacers 40 are distorted by contraction of the gap width, they flow downwardly and exert an intense concentrated load on portions 37*a* which presses the feet portions firmly against slab 17. There is a substantial gap between the feet portions 37*a* of adjoining plates to permit lateral displacement of the plates toward each other to effect distortion of the spacers. The spacers 40 are preferably resilient rubber and it is convenient to extrude these spacers and vulcanize them prior to their assembly between the plates 35. Preferably the spacers are cemented between the plates after vulcanization or final molding of the body 20 with the plates properly positioned thereon.

The end-most plates 35*a* and 35*b* which respectively support the margins 23 and 24 of the rubber body 20 fit flat against the end faces 13 and 14 of the slabs and, inasmuch as the expansion joint 10 is laterally compressed

when installed as is subsequently explained, the end plates 35*a* and 35*b* are in pressure engagement with the end faces of the slabs. To prevent leakage of moisture between these endmost plates and the slabs, preferably the end plates 35*a* and 35*b* are cemented tightly to the end faces 13 and 14 when the expansion joint is installed. The end plates 35*a* and 35*b* are additionally secured firmly to the side faces 13 and 14 by means of a series of anchor lugs 45 (see also FIG. 1) attached to the end plates 35*a* and 35*b* at spaced intervals lengthwise of the strip. The anchor lugs 45 are connected to the slabs by vertical dowel pins 46 as shown in FIG. 2. The lugs 45 are rigid metal tubes of generally D-shaped cross section which are fastened with their flat sides 48 abutting their respective end plates by screws 49. The tubes are rubber covered and are open at their upper ends to receive the dowels 46. Each lug 45 fits into a corresponding D-shaped socket 50 molded in the adjoining concrete slab with the bottom piece 51 of the lug resting on the bottom of its socket 50 so that a hole 52 in the bottom piece 51 registers with a hole 53 in the bottom of the socket. The dowel 46 is then driven through the bottom piece and into hole 53 until an annular shoulder 54 on the dowel is seated on bottom piece 51. The open mouth of the socket 50 is then covered by a thick rubber plug 55 having an upper surface flush with the roadway surface 15 of the slabs.

The expansion joints 10 are normally installed in a highway after the slabs including slab 17 are set up firmly. The width of the expansion gap is controlled when the slabs are poured so that the gap will have an appropriate width for the existing temperature conditions. As noted in the preceding discussion, the expansion gap for this joint is normally very much wider than the conventional narrow expansion gaps which have been previously used in this art. With this joint, the width of the expansion gap may range normally from about six to about twelve inches, and the amplitude of the thermal expansion and contraction of the concrete slabs may be as much as three to four inches or more.

The expansion joint 10 may be made in many different sizes depending on the amplitude of the expansion and contraction of the expansion gap, and the joint may include any number of plates 35 as may be desirable to provide the necessary vertical support for the body portion 20. For modern highways, it may be assumed for design purposes that the road surface 25 of the rubber body is subjected by traffic to vertical pressure force of about 125 pounds per square inch which force must be transmitted through plates 35 to the sleeper slab. With considerations such as these in mind, the optimum number of plates 35 and the size of the joint can be easily determined by those familiar with the road-building art.

At installation, the joint is laterally compressed as it is inserted into the expansion gap, and preferably the joint is designed so that its rubber parts are maintained under lateral or "static" compression even at the widest position of the gap. Ordinarily the "static" compression for the widest gap size will be in the order of about 10% of the width of the joint when its rubber parts are uncompressed. This amount of compression is generally desirable to compensate for permanent set of the rubber parts. Preferably the rubber parts will be suitably compounded and treated by techniques familiar to those skilled in the rubber compounding art to minimize permanent compressive set.

When the road slabs 13 and 14 expand longitudinally to reduce the width of the gap, the opposing side plates 35*a* and 35*b* are subjected to intensive opposing compressive forces which tend to laterally deform the expansion joint. FIG. 4 shows the approximate condition of the several parts of the joint when the joint is laterally compressed to about its minimum width. As the joint is laterally compressed, the corrugated rubber portions 32 projecting between the plates are distorted and caused to bulge downwardly between their respective pairs of plates 35. At the same time the grooves 26 tend to close or become progressively narrower so that the upper surface 25 of the rubber body 20 approaches the condition of a plane. The body 20 is designed so that there is practically no distortion or bulging of the portion of the rubber body 20 in the region immediately above the upper edges 36 of plates 35 throughout the range of compression to which the expansion joint is subjected.

As the body 20 is laterally compressed, the spacers 40 are also subject to lateral compression and thereby displace the plates 35 sideways in parallelism along surface 18 toward the center of the gap. In response to this compression, the spacers are distorted downwardly against the feet portion 37*a* of the plates to maintain the feet portions 37 of the plates seated firmly on the sleeper slab surface 18. Thus, by this arrangement of these spacers 40 the medial portions of the joint are prevented from being displaced upward from the gap, and arching of the body 20 or fanning out of the plates 35 between the side faces 13 and 14 as a result of such compression is avoided.

The term "pleat portion" as used herein and in the claims refers to the portions of the rubber body 20 between any two adjoining plates which undergoes downward distortion when the joint is laterally compressed, and includes the portions of the rubber body 20 bounding the grooves 26. It is to be understood, however, that the invention is not limited to the particular shape of the pleat portions in the illustrated embodiment of the invention, and various shapes may be provided for the portion of the rubber between the plates to cause these portions to bulge downwardly when the joint is compressed.

The downward thrust exerted on the foot portions 37*a* by the spacers 40 may be further augmented by using a rubber compound for the spacers of higher durometer (which is therefore stiffer) than that for the rubber body 20. For example, the rubber body 20 may be about 45–60 Shore A durometer, and the spacers 40 may be about 60–80 Shore A durometer, in hardness. With this improvement, however, the rubber spacers may be the same compound as the body portion, and still exert adequate force on foot portions 37*a* to oppose upward displacement of the plate.

When the concrete slabs contract to widen the expansion gap, the spacers 40 expand to separate the vertical plates and the pleat portions of the rubber body 20 likewise expand widthwise as the lateral compressive force is relieved. Since the end plates 35*a* and 35*b* are positively secured to the side faces 13 and 14 by the dowels 46, the joint will expand laterally with the end plates seated snugly against these walls.

The terms "rubber" or "rubber-like" as used herein and in the claims include both tree-grown substances and various man-made materials having the characteristic elasticity and extensibility of natural rubber. Preferably the rubber body 20 and the spacers 40 are made of a synthetic oil-resistant, sunlight-resistant vulcanizable compound such as neoprene, or the like. The body 20 is preferably compounded for durability about equivalent to that of conventional tire treads.

Variations in the construction disclosed may be made within the scope of the invention as it is defined in the appended claims.

I claim:

1. An expansion joint assembly comprising:

(A) two members having ends laterally spaced to provide opposing sides of an expansion gap;

(B) a third member forming a bottom for said gap;

(C) a body of flexible resilient elastomeric composition covering the mouth of said gap;

(D) means for connecting lengthwise margins of said body to the sides of said expansion gap;

(E) said body having a substantially plane upper sur-

face substantially flush with the adjoining surfaces of said two laterally-spaced gap members;

(F) rigid body-supporting members extending lengthwise of said body intermediate the lengthwise margins thereof,

(1) said support members being supported on said bottom of said gap and

(2) being connected to the lower surface of said body to support said body against sagging between its lengthwise margins and

(3) the support members being in spaced relation one from another;

(G) resilient elastomeric spacer means between adjoining support members at locations on the members intermediate said body and said bottom;

(H) means laterally extending from said support members and underlying said spacers on the side of said spacers toward the bottom of the expansion gap;

(I) means for transmitting compressive force from the sides of the gap to the outermost support members separated by said spacer means;

(J) said spacer means being

(1) adapted to resiliently oppose lateral movement of adjoining support members toward each other in response to widthwise compression of said body as the gap becomes narrower, and

(2) shaped to distort under said widthwise compression against said underlying means extending laterally from said support members to oppose displacement of said support members away from the bottom of the gap; and

(K) said body including lengthwise portions between the locations on the body engaged by said support members which lengthwise portions are shaped for distortion into the region between adjoining support members to maintain said upper surface of said body substantially plane during said widthwise compression of said body.

2. An expansion joint assembly according to claim 1 in which said laterally extending means in clause (H) of claim 1 is a foot member integral with each rigid support member and which is seated on said bottom of the gap.

3. An expansion joint comprising:

(A) a body of flexible resilient elastomeric composition,

(1) which body is generally thin compared with its length and width, and

(2) said body having a substantially plane upper surface in which there is a series of grooves extending lengthwise of the body, and

(3) said body having a lower surface on which there is a series of lengthwise ridges substantially opposite corresponding grooves of said outer surface;

(B) a series of parallel rigid body-support members connected to said lower surface between said ridges,

(1) said members being disposed alternately with said ridges and substantially perpendicular to said upper surface;

(C) means for connecting lengthwise margins of said body to the opposing sides of an expansion gap in which said joint is installed; and

(D) means for retaining all said rigid members in supporting relation with said body and against displacement toward said body in response to lateral compressive forces on the sides of said body, said retaining means including

(1) means integral with said rigid members and projecting laterally therefrom at a location remote from said body; and

(2) resilient elastomeric spacer elements separating adjoining rigid members one from another and including outer spacer elements on the outwardly directed faces of the outermost rigid members,

(*a*) all said spacer elements being located between said body and said means laterally projecting from said rigid member;

(E) said means for connecting said lengthwise margins being adapted to transmit lateral compressive force to said body to distort said body at said ridges and grooves into the regions between said rigid members with said upper surface of the body remaining substantially plane;

(F) said outermost spacer elements being adapted to transmit lateral compressive force to the outermost rigid members from the adjoining sides of said expansion gap in which said joint is installed to effect lateral displacement of said rigid members against the resistance to compression of said spacer elements, and

(G) said spacer elements being shaped for distortion against said laterally-projecting means on said rigid members to oppose displacement of said rigid members toward said body during said widthwise compression of said body.

References Cited in the file of this patent

UNITED STATES PATENTS

2,043,571	Bargreen	June 9, 1936
2,220,628	Stedman	Nov. 5, 1940
2,230,303	Leguillon	Feb. 4, 1941

FOREIGN PATENTS

593,996	Great Britain	Oct. 30, 1947
933,157	Germany	Sept. 22, 1955