Dec. 13, 1938. D. ROBERTS 2,139,851

EXPANSION JOINT

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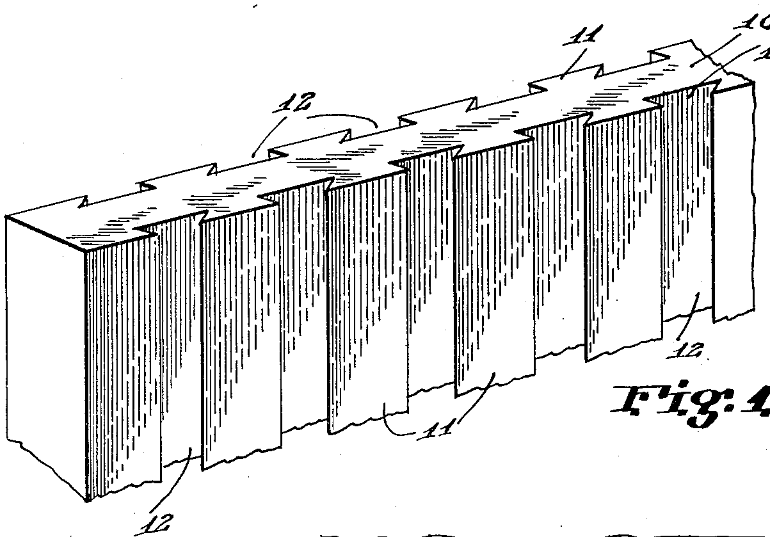

Fig. 1

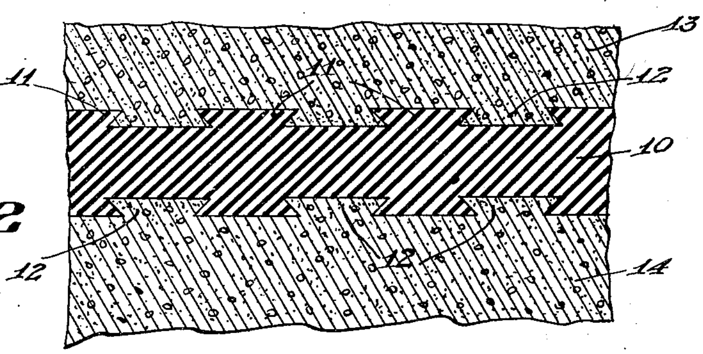

Fig. 2

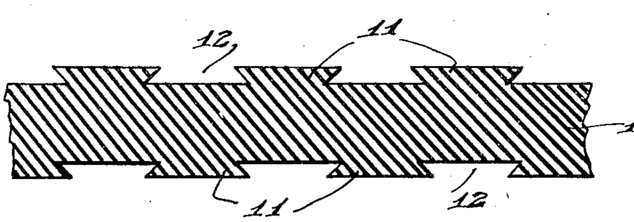

Fig. 3

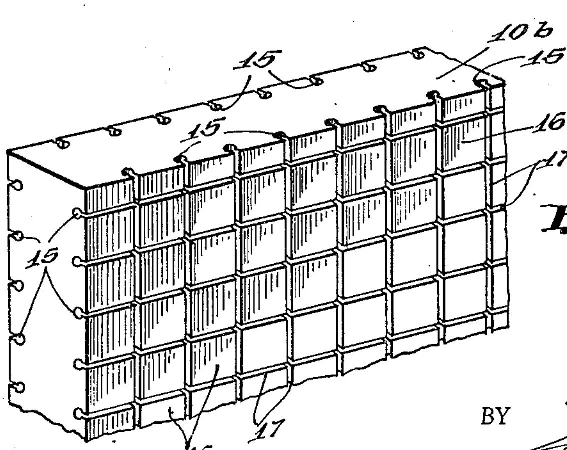

Fig. 4

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EXPANSION JOINT

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6 Claims. (Cl. 94—18)

This invention relates to expansion and contraction joint fillers.

In the building of concrete roads, it is the practise to construct sections ranging from thirty to one hundred feet in length and permit a break or space between adjacent sections ranging from one-half to one inch wide transverse across the road.

The sectioning of concrete roadways is made necessary by the expansion and contraction characteristics of the concrete according to temperature. The length of and spacing between the sections is dependent upon the latitude and climate conditions of the locality. Wide temperature variations produce correspondingly large variations in the length of a section as is well known in the art. The spacing or breaks between the sections permit the concrete to expand without bulging, distorting or cracking its flat surface.

The spaces provided by the concrete road sections are preferably filled with suitable elastic members to prevent pebbles, dirt, refuse and other solid materials from accumulating therein to defeat the purpose for which the spacing is intended. Furthermore ice, water and watery dirt which may collect between the sections, expand during freezing and exert forces between the sections which would crumble and crack the concrete surfaces adjacent thereto.

Expansion joint fillers of various types have heretofore been proposed having defects as follows:—Asphaltum used as a filler between sections extrudes and presents transverse lumps in the roads when increased temperature elongates the concrete sections to compress the asphaltum. Asphaltum is not sufficiently elastic to return to its normal conformation and therefore the extruded material must be removed. Wood and cork have been utilized but they are readily compressed beyond their elastic limit and do not re-expand or return to their original thickness, thereby permitting openings within the joint. Sponge rubber has been used in recent years. Since the cells of this material intercommunicate and in some cases communicate with the external air or atmosphere, the effect is to render the product non-moisture proof and also to permit relatively rapid deterioration. The accumulation of moisture or liquid would expand and otherwise destroy the joint upon freezing thereof.

The recent patent to H. C. Jussen, No. 2,023,529 of December 10, 1935, utilizes a joint filler having a core of rubber with independent air cells. A water-proof seal or enclosure is provided about this core. The presence of the oxygen in the air cells acts to limit the useful life of the rubber core.

It is equally important for the joint filler to expand at the time the concrete sections contract in order to keep the increasing spacing between them completely sealed. Metal flanges have been imbedded in rubber joint fillers which project into the concrete section ends adjacent thereto so that the filler will be forced to expand during the contraction stages of the concrete section maintaining the spacing therebetween filled in. It is necessary to insure a joint that is at all times water-proof so that water may not collect therein where it may freeze to crack the concrete. By providing a joint filler which has a high degree of expandibility and contractibility, in other words, having a high degree of elasticity and providing means for securing adjacent surfaces of concrete and filler material together, the joint will remain impervious under wide variations of temperature with correspondingly relatively wide variations of the joint spacing length.

I have discovered that I can construct a joint filler which is moisture proof, has a high degree of elasticity to accommodate relatively wide contraction and expansion variations, that is simple and cheap to manufacture and employ. The material which I use for my novel joint filler is a gas expanded rubber having an individual inert gas cellular structure. The inert gas is forced into the rubber dough during the manufacture thereof under very high pressure of the order of 3000 pounds per square inch. The process for manufacturing this rubber is described in application Ser. No. 717,550, filed March 27, 1934, of which I am a joint applicant.

Accordingly, an object of my invention is to provide a novel joint filler.

Another object of my invention is to provide a novel expansion and contraction joint filler.

A further object of my invention is to provide a novel expansion and contraction joint filler of unitary construction.

Still another object of my invention is to provide a novel joint filler which is water-proof under all conditions of service.

Still a further object of my invention is to provide a novel joint filler having a high degree of elasticity.

Another object of my invention is to provide a novel joint filler which is cheap and simple to manufacture and employ.

Still another object of my invention is to provide a novel joint filler made of sealed cellular rubber having a relatively long useful life.

There are other objects of my invention which together with the foregoing will appear in the detailed description which is to follow in connection with the drawing, in which:—

Figure 1 is a partial perspective illustration of a preferred embodiment of a joint filler slab according to my invention.

Figure 2 is a plan view of the joint filler in position between two sections of concrete.

Figure 3 is a plan view of a modification for a joint filler.

Figure 4 is a partial perspective view of a further modification of a joint filler according to my invention.

In general, my invention contemplates the construction of a joint filler of a rubber material having a sealed cellular structure. The material contains cells of nitrogen or other inert gas and is constructed in a manner to be hereinafter described. This cell-tight rubber material is water-proof. A surface fracture will not permit water to enter the material even though under the action of pressure exerted during any conditions to which the material might be subjected to in practice. The moisture proof material accordingly makes a protective water proof seal or enclosure unnecessary for the joint filler. The joint filler according to my invention is constructed using only the sealed cellular rubber material.

The ingredients entering into the product are mixed in approximately the following percentages by weight:

	Percent
Washed pale crepe or smoked rubber	40–75
Sulphur	6–30
Light calcined magnesia	3– 5
Ground gilsonite	12
Lower melting bituminous substances	12

The base ingredient of the product is the rubber which is preferably of a pale crepe rubber, obtained in sheets about $\frac{1}{32}''$ to $\frac{1}{16}'' \times 10'' \times 20''$. These sheets of rubber are passed through masticating mills consisting of two rollers rotating in opposite directions as in the case of meshing gears.

After the rubber is thoroughly masticated, it is gassed in such a manner as to form a substantially non-porous inert gas expanded closed cell material. The rubber is non-porous in the sense that it does not absorb water as does a sponge and contains very small closed cells of inert gas distributed throughout its mass.

The gassing of the rubber may be accomplished by placing the rubber in a closed chamber and subjecting it to an inert gas, such as nitrogen, under pressure of about 150 to 200 atmospheres, after the chamber has been evacuated of air. This nitrogen gas permeates into the rubber and is distributed as microscopic bubbles in solution throughout the rubber. In order to obtain the closed cell structure, the rubber should be vulcanized either before, during or just after the gassing operation so that the rubber is given sufficient fibre strength to keep the gas from escaping, thus forming the closed cell structure. Preferably the rubber is cured before it is placed in the chamber or concurrently with the gassing operation. Then the pressure of the gas is reduced and the gas is entrapped in the form of closed cells within the rubber, the fibre strength of the rubber preventing its escape.

The rubber may also be gassed by incorporating within it certain chemicals adapted to decompose and release nitrogen or a similar inert gas, and the same precautions must be taken to prevent the escape of the formed gas from within the rubber, since it is necessary to entrap the gas in the form of closed cells within the rubber. This may be effected, as set forth above, by partial vulcanization before the gassing, during the gassing, or just after the gassing. It is important that the gas be inert with respect to the rubber, since, if a gas containing available oxygen, such as air, be used, it would rapidly attack and decompose the rubber. Nitrogen has been found to be very suitable for this purpose. It is further desirable that this inert gas be relatively insoluble in the rubber so that there will be little tendency for the gas to diffuse out into the atmosphere.

There are a variety of methods by which closed cell gas expanded rubber can be made. There has been set forth above the two main methods, that is gassing by gas externally applied, and gassing by gas internally developed. With respect to the expansion joint of my invention, it is important that a cellular rubber be obtained in which the cells are closed so that the rubber has the desired elasticity and resiliency and also that it be inherently water resistant. Although rubber has been specifically set forth, any elastic material or rubber like material may be employed. Thus rubber, bituminous materials, and mixes thereof may be employed to form the closed cell gas expanded elastic material. After the rubber has been gassed and preferably partially cured, as set forth above, it is necessary that it be shaped to the desired form for expansion joints.

The partially cured rubber is now placed in molds suitably constructed to form joint filler shapes to be hereinafter described, and which are illustrated in the figures. The rubber in the molds is now subjected to the final vulcanization. Each mold is placed in a mold of the desired dimensions. Each mold is placed between platens and saturated steam is applied at ninety-five pounds for about forty to forty-five minutes. This is the final stage of the process of the curing and expansion. The rubber expands to the size of the molds and at the same time complete curing or vulcanization of the rubber is obtained. The steam is now turned off and the product permitted to cool. If desired, cooling may be hastened by applying cold water. The end product is an expanded cellular inert gas filled product. The density of the completed rubber product depends upon the composition employed in its manufacture. I prefer to use a density approximating 15 pounds per cubic foot for the expansion and contraction joint fillers according to my invention.

A preferred construction of a joint filler slab is illustrated in Figure 1 in partial perspective. The sealed cellular rubber material is molded into slabs 10 having wedge shaped ridges 11 and corresponding grooves 12 adjacent the concrete section ends. The length of the joint filler slabs 10 are made to correspond to the width of the concrete section it is to be used with, generally about ten feet in length. The height of the slab 10 is made to correspond to the thickness of the concrete layer and may range between six and ten inches. The thickness of the slab 10 corresponds to the desired spacing between the concrete section ends of the roadway ranging for example between a half inch and an inch according to the local climate conditions and road designs.

The joint fillers 10 are laid transverse across the roadway. Figure 2 illustrates the appearance of the concrete section ends 13 and 14 poured to enclose the adjacent sides of the joint filler 10. The concrete accordingly fills in the grooves 12 to form a rigid wedge shaped mechanical connection between the joint filler and the concrete sections as will be understood by those skilled in the art. The purpose of this rigid mechanical junction between the concrete sections and the joint filler is to insure a faithful contraction and expansion of the joint filler 10 corresponding to the expansion and contraction of the concrete sections 13 and 14 which decreases or increases the spacing between them.

The sealed inert gas cellular structure of high pressure gas prevents the rupture of the cells under wide variations of compression or expansion of the slab in practice. I have found that the joint filler may be compressed to as much as half of its original thickness and will return to its normal thickness in use with no cell rupturing or other deleterious effect occurring in the rubber material comprising the expansion joint. By using the grooved surface structure for the joint filler 10, the contracting concrete sections will assist the compressed air in the cellular structure in expanding to return the slab of rubber to its proper relation with the concrete surfaces. Furthermore, when the concrete sections 13 and 14 contract to less than normal length, increasing the spacing therebetween, the original thickness of the joint filler is accordingly increased due to the mechanical bonding between the filler 10 surfaces and the concrete sections. When the concrete sections return to normal size, they aid in compressing the joint filler 10 to return to its normal shape. The sealed gas cells constructed under high pressure as hereinbefore described permit relatively wide dimension variations and accordingly, the rubber material used in my present invention is ideal as an expansion joint filler.

Since an inert gas such as nitrogen is used as the gas in the cellular rubber, the rubber joint filler will accordingly not deteriorate due to oxygen content and will have a relatively long life.

Figure 3 is a modification of the joint filler 10*a* according to my invention, having the grooves 12 and corresponding ridges 11 staggered. This construction permits a relatively narrow joint filler utilizing the groove structure described in connection with Figure 1 for mechanical bonding with the concrete and yet maintain a uniform predetermined minimum cross sectional area for maximum strength with a minimum over all thickness.

Figure 4 illustrates a partial sectional view of a further modification of a joint filler which is less costly to manufacture and operates as effectively as the hereinbefore described modifications. The rubber slab 10*b* has a wire mesh imbedded near the surface on both sides of the joint filler. After the rubber slab is finally cured, the wire mesh is forcibly pulled apart from the slab leaving a mosaic 13 having undercut edges 14. When the slab 10*b* is inserted between the adjacent concrete sections, the concrete will enter the undercut spaces 14 comprising the mosaic structure 13 and serve to mechanically bond the joint filler 10*b* to the concrete section ends as will be evident to those skilled in the art.

Although I have described in detail several modifications for constructing an expansion and contraction joint filler, it will be evident to those skilled in the art that variations may be made which will fall within the spirit and scope of my invention and I do not intend to be limited, for example, by the construction of the ridges or grooves on the joint filler sides or by the shape of the joint filler or by its application to roadways or concrete sections, except as set forth in the following claims.

I claim:

1. A preformed expansion joint adapted to be positioned between adjacent bodies of material having the characteristics of expansion and contraction under changing temperature or moisture conditions comprising a substantially non-porous, inert gas expanded closed cell elastic material.

2. A preformed expansion joint adapted to be positioned between adjacent bodies of material having the characteristics of expansion and contraction under changing temperature or moisture conditions comprising a substantially non-porous inert gas expanded closed cell rubber like material.

3. A preformed expansion joint adapted to be positioned between adjacent bodies of material having the characteristics of expansion and contraction under changing temperature or moisture conditions comprising a substantially non-porous inert gas expanded closed cell rubber.

4. A preformed expansion joint adapted to be positioned between adjacent bodies of material having the characteristics of expansion and contraction under changing temperature or moisture conditions comprising a substantially non-porous, inert gas expanded closed cell elastic material, the surface of said expansion joint having projections and depressions to engage the adjacent bodies between which it is interpositioned.

5. A preformed expansion joint adapted to be positioned between adjacent bodies of material having the characteristics of expansion and contraction under changing temperature or moisture conditions comprising a substantially non-porous inert gas expanded closed cell rubber like material, the surface of said expansion joint having projections and depressions to engage the adjacent bodies between which it is interpositioned

6. A preformed expansion joint adapted to be positioned between adjacent bodies of material having the characteristics of expansion and contraction under changing temperature or moisture conditions comprising a substantially non-porous inert gas expanded closed cell rubber, the surface of said expansion joint having projections and depressions to engage the adjacent bodies between which it is interpositioned.

DUDLEY ROBERTS.