Dec. 11, 1951 C. P. KRUPP ET AL 2,578,140

STRETCHABLE DIAPHRAGM

Filed Sept. 12, 1946 2 SHEETS—SHEET 1

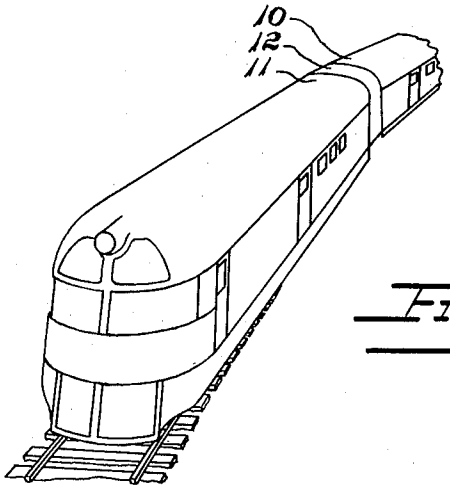


Fig-1

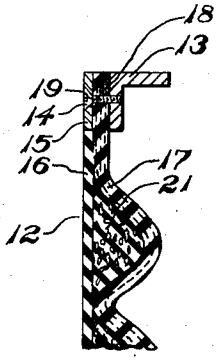


Fig-4

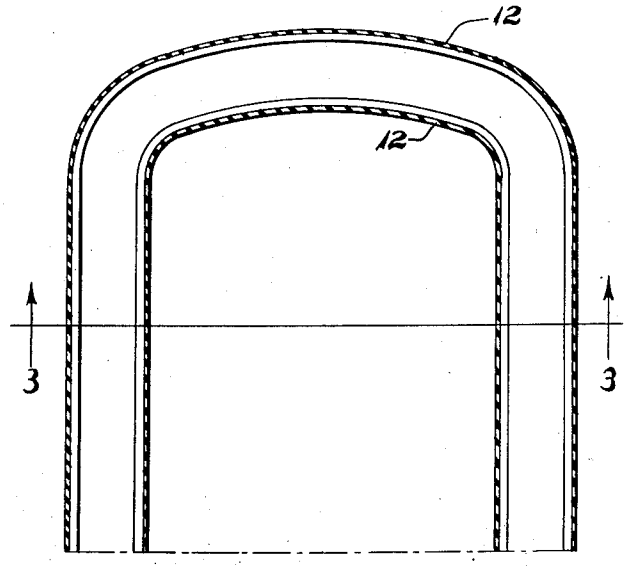


Fig-2

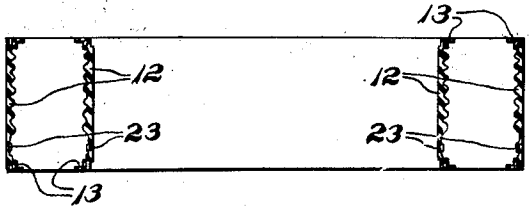


Fig-3

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STRETCHABLE DIAPHRAGM

Filed Sept. 12, 1946 2 SHEETS—SHEET 2

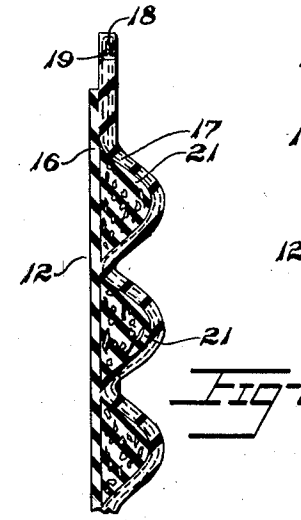
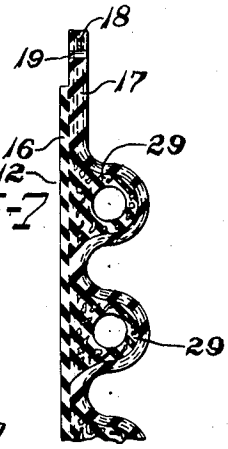


Fig-6



Fig-7



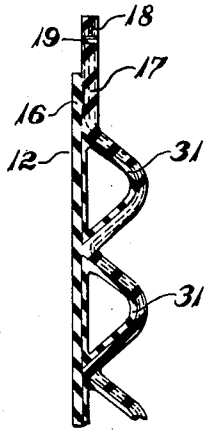


Fig-8

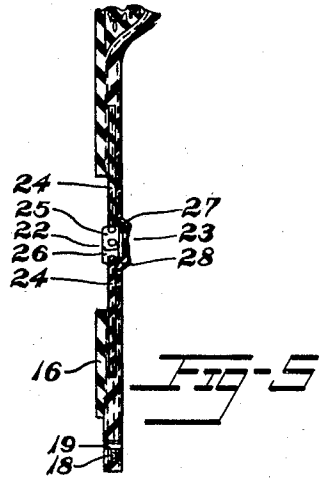


Fig-5

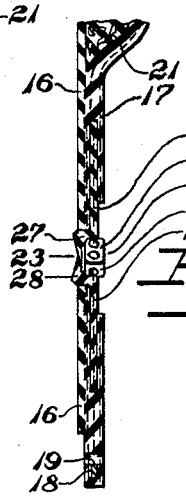


Fig-5a

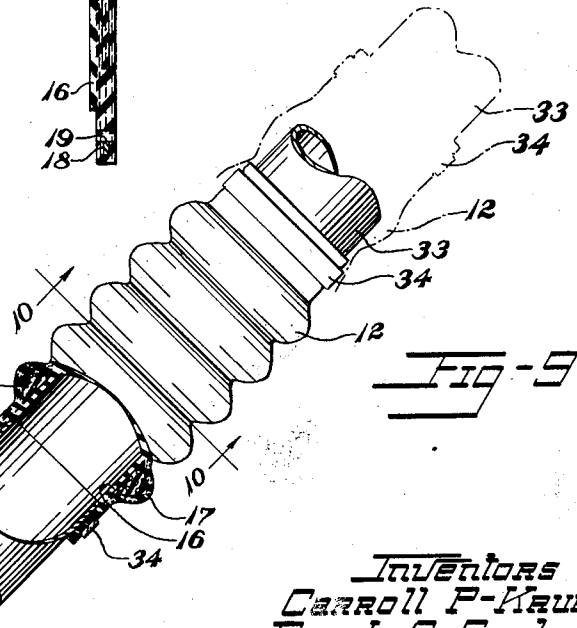


Fig-9

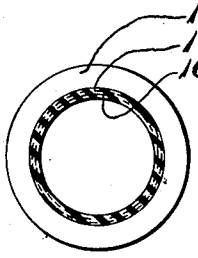


Fig-10

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STRETCHABLE DIAPHRAGM

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Application September 12, 1946, Serial No. 696,532

8 Claims. (Cl. 105—15)

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This invention relates to stretchable walls or diaphragms and especially to walls for enclosing the spaces between articulated members of streamlined trains or the like. The invention in some of its aspects is useful also in other structures, as for example, joints in ducts and other fluid passages.

Objects of the invention are to provide an effective seal against weather, smoke and dust; to provide a smooth surface between connected members; to maintain the smooth surface while accommodating movement of connected members; to provide for such accommodation by stretchability of the wall; to provide reinforcement to resist excessive stretching of the wall; to provide for retaining firmness of the structure; to provide durability and long wear; to provide for ease of attachment and detachment and to provide for convenience of construction and installation.

These and further objects will be apparent from the following description, reference being had to the drawings in which:

Fig. 1 is a perspective view of a train including a connecting diaphragm constructed in accordance with an embodying the invention.

Fig. 2 is an end view of the diaphragm wall construction.

Fig. 3 is a section of the wall construction taken along line 3—3 in Fig. 2, mounting brackets being included.

Fig. 4 is a view on an enlarged scale of a portion of Fig. 3.

Fig. 5 is a sectional view of an inner wall member prior to mounting, parts being broken away.

Fig. 5*a* is a sectional view of an outer wall member prior to mounting, parts being broken away.

Fig. 6 is a view of the wall shown in Fig. 5 in an elongated condition, parts being broken away.

Fig. 7 is a view like Fig. 5, but showing a modified construction.

Fig. 8 is a view like Fig. 7, but showing a further modified construction.

Fig. 9 is a still further modified construction adapted to connect conduit sections.

Fig. 10 is a section taken along the line 10—10 in Fig. 9.

The stretchable sealing diaphragm structure constructed in accordance with the invention may be used to connect articulated members 10 and 11 of a railroad train, as shown in Fig. 1. The structure comprises stretchable walls 12, which extend over the top and sides of the train members 10 and 11 to enclose space between such walls, and over the top and sides of the passageway between the train members, and which are attached thereto by suitable fasteners, such as angles 13, bolts 14 and battens 15.

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Each wall 12 comprises an elastic facing sheet member 16 of highly stretchable material, preferably of resilient rubber or other rubber-like material, but this may be of stretchable tricot fabric or stretchable bandage cloth of cotton, rayon, nylon or other suitable material suitably rubberized. The sheet member 16 may be colored to match the color of the train to enhance the appearance of the train. A sheet backing member 17 of stretchable fabric, preferably comprising plies of fabric embedded in resilient material such as rubber or rubber-like material overlies the first-mentioned sheet member 16, and is gathered to form folds or corrugations extending in the transverse direction of the train, in which direction occurs the least extent of the articulated movement. The corrugations are disposed at the inner side of the outer wall and at the outer side of the inner wall to present a smooth surface at the outside of the train and a smooth surface facing the passageway between the members of the train. The sheets 16 and 17 are adhered one to the other at spaced-apart positions between the corrugations, preferably by a bond resulting from vulcanization of the rubberized assembly.

Apertures 19 for receiving the bolts 14 are provided in the member 17 at spaced-apart positions along the edges of the wall 12 transverse of the direction of the train. Reinforcing strips 18 or beads of wire or the like are interposed between the edges of the walls and the apertures 19 and embedded in the sheet member 17.

The spaces enclosed by the corrugations of the sheet member 17 may be occupied by cores of porous material 21, such as sponge rubber or other suitable material, preferably having voids therein for giving the wall assembly a desirable amount of stiffness and for maintaining the shape of the assembly while at the same time permitting a high degree of stretchability.

To facilitate the operation of coupling and decoupling the articulated members 10 and 11 of the train and of mounting and demounting the diaphragm slide fasteners 22 with self-sealing closures 23, such as those shown and described in the patent of Carroll P. Krupp No. 2,385,816,

issued October 2, 1945, are incorporated in the wall assembly parallel to and in the proximity of an edge of each wall.

Rubber-coated fabric margins 24 of the slide fasteners are mounted between the sheet members 16 and 17 of the joined portions of the walls 12 and bonded thereto in a suitable manner, preferably by vulcanization. The slide fastener elements 25 and 26 are secured desirably at the opposing edges of the margins 24 and runners or slide mechanisms are provided for bringing the elements 25 and 26 together. Sealing elements 27 and 28 are secured to the margins 24 by a vulcanized bond and are disposed so as to overlap when the fasteners 22 are closed and to provide a seal by lip-action of the edges of elements 27 and 28, one against the other. It is preferable that the sealing elements 27 and 27 of each wall be mounted on the face which is exposed to the greatest pressure to obtain maximum sealing action. Thus, the sealing elements are mounted on the inner diaphragm at the side thereof having the corrugations as shown in Fig. 5 and are mounted on the outer diaphragm at the smooth face thereof opposite the corrugations as shown in Fig. 5*a*.

The wall assemblies 12 are installed between the articulated members 10 and 11 of the train, preferably under tension, in the direction longitudinally of the train so that each sheet member 16 provides a smooth surface at substantially all positions of the articulated members, 10 and 11. To install each wall assembly 12 the slide fastener is opened, and the two portions of the wall are mounted on the articulated members 10 and 11 by means of the fastenings 13, 14 and 15. Then when the portions of the wall are securely fastened to their proper, respective locations, tension is applied to the portion at the starting end of the fastener 22 to bring the two portions of the fastener together and thus permit their being joined under tension by the slide mechanism. Along the entire remaining length of the wall its two portions may be drawn together and placed under tension by simply moving the slide mechanism along the slide fastener to its other end. When disconnecting the articulated members of the train, the wall portions may be parted by moving the slide mechanism from one end of the fastener 22 to the other end, thereby disengaging the fastener elements 25 and 26.

When the train travels around a curve, the articulated members 10 and 11 move relative to each other, and the sections of the wall assemblies 12 facing the outside of the curve will be elongated and the elastic sheet members 16 will be stretched in tension and the stretchable fabric members 17 will be urged toward the elastic members 16, causing the cores 21 to be compressed in the manner shown in Fig. 6. After a substantial elongation of the walls 12 has taken place, the stretchable sheet backing members 17 will be straightened and tensioned and will limit the elongation of the wall assembly.

During elongation of the wall, the elastic member 16 will present a substantially smooth surface which is desirable at the outside of the streamlined train and around the passageway between the articulated members of the train.

Modifications wherein the cores are of different material and shapes are shown in Fig. 7 and Fig. 8. In some cases it is desirable to have the voids formed by the corrugations of the sheet members unoccupied, and in other cases it may be desirable only to partly fill the voids with

sponge rubber, for example, as in Fig. 7, wherein annular apertures extend longitudinally of the core 29. In Fig. 8 an extruded body of flexible material, such as rubber or rubber-like material 31, is used, which may be of the shape shown in Fig. 8 or of any other desired shape for accommodating elongation of the wall member with a substantially small distortion of the surface of the elastic member 16.

A modification of a wall built in accordance with and embodying the invention and adapted for connecting fluid-conducting passages is shown in Fig. 9 and Fig. 10. The wall assembly 12 is interposed between fluid-conducting passages, such as conduit sections 32, and 33. The edge portions of the stretchable fabric member 17 of the wall 12 overlap the edges of the conduit sections and wrap around the sections forming a tubular body. The elastic member 16 is disposed within the stretchable fabric member 17 and may abut the edges of the conduit sections forming a continuous inner wall surface from one conduit section to the other. The corrugations are disposed transverse of the axis of the conduit sections and form annular spaces between the sheet members 16 and 17 in which cores 21 of porous compressible material such as sponge rubber are enclosed. The overlapping portion of the wall assembly 12 may be mounted on the sections of conduits 32 and 33 by annular strap members 34 or by other suitable mounting means.

In operation, when the conduit section 33 is moved relatively away from the conduit section 34, the wall members 16 and 17 will react as described for elongation of the flat sheet hereinabove, and the wall assembly 12 will assume a shape as shown in dot and dash line in Fig. 9. The elastic sheet member 16 will present a substantially smooth inner surface during elongation.

Variations may be made without departing from the scope of the invention as it is defined in the following claims.

We claim:

1. A stretchable diaphragm having attaching edges at opposite ends for connecting articulated railroad members, said diaphragm comprising a sheet elastic member, a backing member secured to said elastic member at a plurality of positions spaced from the edges of the diaphragm in a direction longitudinally of the railroad members, said backing member being corrugated with corrugations extending continuously transversely of the railroad members throughout the extent of said backing member in a manner such that said elastic member is extensively stretchable before full extension of said backing member is effected, and bodies of resilient material having voids therein disposed in spaces formed by said corrugations between said elastic member and said backing member throughout the length of the corrugations, said bodies accommodating the stretching action and consequent flattening of said corrugations by distortion of said resilient material and also by virtue of the compressibility of said bodies in total volume as permitted by said voids in said resilient material.

2. A stretchable tubular diaphragm having attaching edges at the ends for connecting fluid-conducting passages, said diaphragm comprising a tubular inner sheet elastic member and a backing member having a sinuous configuration and disposed along said elastic member at spaced-

apart positions spaced from the edges of said diaphragm longitudinally of the axis of the diaphragm in a manner such that said elastic member is extensively stretchable before full extension of said backing member is effected when the diaphragm is elongated in the axial direction.

3. A stretchable diaphragm having attaching edges at opposite ends for connecting articulated rail members, said diaphragm comprising a sheet elastic member, a backing member secured to said elastic member at a plurality of positions spaced from the edges of the diaphragm in a direction longitudinally of the railroad members, said backing member being corrugated with corrugations extending continuously transversely of the railroad members throughout the extent of said backing member in a manner such that said elastic member is extensively stretchable before full extension of said backing member is effected, and tubular bodies of resilient material disposed in spaces formed by said corrugations between said elastic member and said backing member throughout the length of the corrugations, said bodies accommodating the stretching action and consequent flattening of said corrugations by distortion of said resilient material and also by virtue of the compressibility of said bodies in total volume as permitted by the hollow center of said tubular bodies of resilient material.

4. A stretchable tubular diaphragm having attaching edges at the ends for connecting fluid conducting passages, said diaphragm comprising a tubular inner sheet elastic member and a backing member secured to said elastic member at a plurality of positions spaced from the edges, said backing member being corrugated with corrugations extending continuously circumferentially about the diaphragm in a manner such that said elastic member is extensively stretchable before full extension of said backing member is effected, and bodies of resilient material having voids therein disposed in said corrugations between said elastic member and said backing member throughout the length of the corrugations, said bodies accommodating the stretching action and consequent flattening of said corrugations by distortion of said resilient material and also by virtue of the compressibility of said bodies in total volume as permitted by said voids in said resilient material.

5. A stretchable diaphragm having attaching edges at opposite ends thereof, said diaphragm comprising a sheet elastic member, a backing member secured to said elastic member at a plurality of positions spaced from the edges in the direction of stretch of the diaphragm, said backing member being corrugated with corrugations extending continuously transversely of the direction of stretch and throughout the extent of the diaphragm in a manner such that said elastic member is extensively stretchable before full extension of said backing member is effected, and bodies of resilient material having voids therein disposed in said corrugations between said elastic member and said backing member throughout the length of the corrugations, said bodies accommodating the stretching action and consequent flattening of said corrugations by distortion of said resilient material and also by virtue of the compressibility of said bodies in total volume as permitted by said voids in said bodies of resilient material.

6. A stretchable diaphragm having attaching edges at opposite ends thereof, said diaphragm comprising a sheet elastic member, a backing

member secured to said elastic member at a plurality of positions spaced from the edges in the direction of stretch of the diaphragm, said backing member being corrugated with corrugations extending continuously transversely of the direction of stretch and throughout the extent of the diaphragm in a manner such that said elastic member is extensively stretchable before full extension of said backing member is effected, and tubular bodies of resilient material disposed in said corrugations between said elastic member and said backing member throughout the length of the corrugations, said bodies accommodating the stretching action and consequent flattening of said corrugations by distortion of said resilient material and also by virtue of the compressibility of said bodies in total volume as permitted by said voids in said bodies of resilient material.

7. A stretchable sealing diaphragm having attaching edges at opposite ends for connecting relatively movable structures, said diaphragm comprising a sheet elastic member continuous throughout the extent of said elastic member, a sheet backing member having a sinuous configuration and being disposed along said elastic member and secured to said elastic member at a plurality of positions spaced from the edges in the direction of stretch of the diaphragm in a manner such that said elastic member is extensively stretchable before full extension of said backing member is effected, means for mounting said diaphragm between said relatively movable structures and a slide-fastener structure at adjoining margins of adjacent portions of said diaphragm and including cooperating spaced-apart slide-fastener elements and a runner for detachably uniting the same, a pair of flexible closing elements positionable in overlapping relation with one another upon the uniting of said fastener elements, and one of said closing elements having a resilient marginal portion tapering to an edge for sealing by lip-action of said edge in contact with the other of said elements.

8. A stretchable sealing diaphragm structure having attaching edges at opposite ends for connecting articulated railroad members, said structure comprising a pair of walls spaced-apart transversely of the railroad members and comprising outer sheet elastic members continuous throughout the extent of said elastic members, inner backing members secured to said elastic members at a plurality of positions spaced from the edges of the diaphragm in a direction longitudinally of the railroad members, said backing members being corrugated with corrugations extending continuously transversely of the railroad members throughout the extent of the backing members, said corrugations facing the other of said walls and providing extensibility of said walls in a manner such that said elastic members are extensively stretchable before full extension of said backing members, and bodies of resilient material having voids therein disposed in said corrugations between each said elastic member and its backing member throughout the length of said corrugations, said bodies accommodating the stretching action and consequent flattening of said corrugations by distortion of said resilient material and also by virtue of the compressibility of said bodies in total volume as permitted by said voids in said bodies of resilient material, slide-fastener means at adjoining margins of adjacent portions of said structure including cooperating slide-fastener elements and runners for detachably uniting the same, pairs of clos-

ing elements positionable in overlapping relation with one another upon closure of said fastener elements, one of each pair of closing elements having a resilient marginal portion tapering to an edge for sealing by lip-action of said edge in contact with the other of said elements, and means for attaching said walls in their spaced-apart relationship to the ends of the railroad members.

CARROLL P. KRUPP.
FRANK G. GERBER.

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