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Kerschner

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[54] **SEALING MEMBER**

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[52] **U.S. Cl.** **404/64;** 52/403; 49/498

[51] **Int. Cl.**[2] **E01C 11/10**

[58] **Field of Search** 404/69, 68, 66, 64, 48, 404/47, 49; 49/475, 498; 52/403, 573, 396

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[57] **ABSTRACT**

A resilient sealing member for use in an expansion joint comprising a tubular structure having an internal supporting construction including a pre-formed compression bar extending transversely between the sealing member side walls to control the reaction forces generated in the sealing member and facilitate the controlled collapse thereof.

9 Claims, 4 Drawing Figures

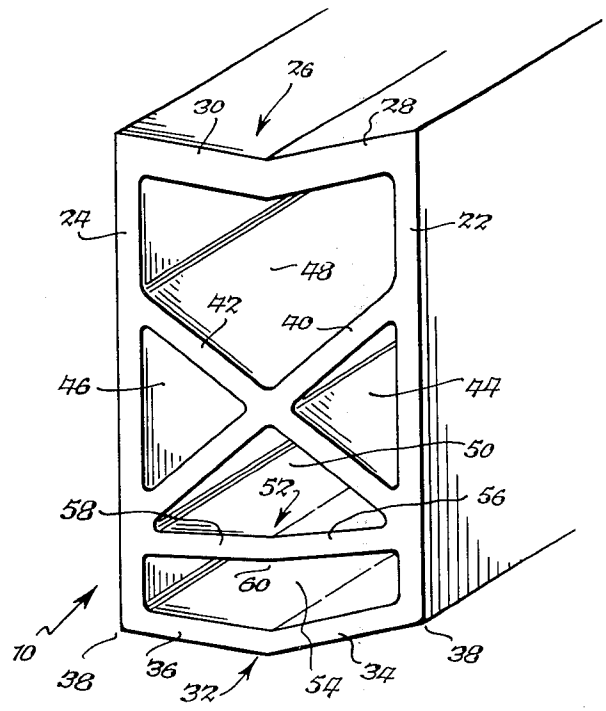


Fig. 1.

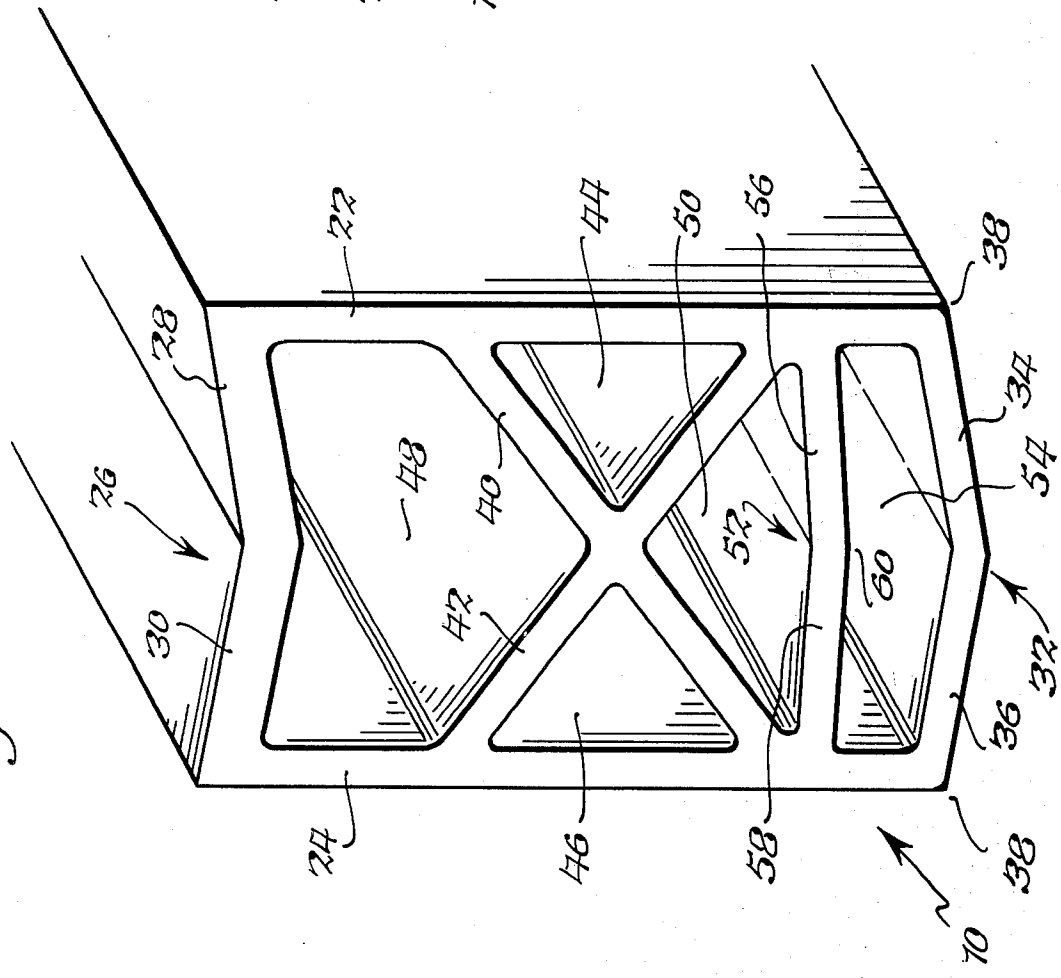

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Fig. 2.

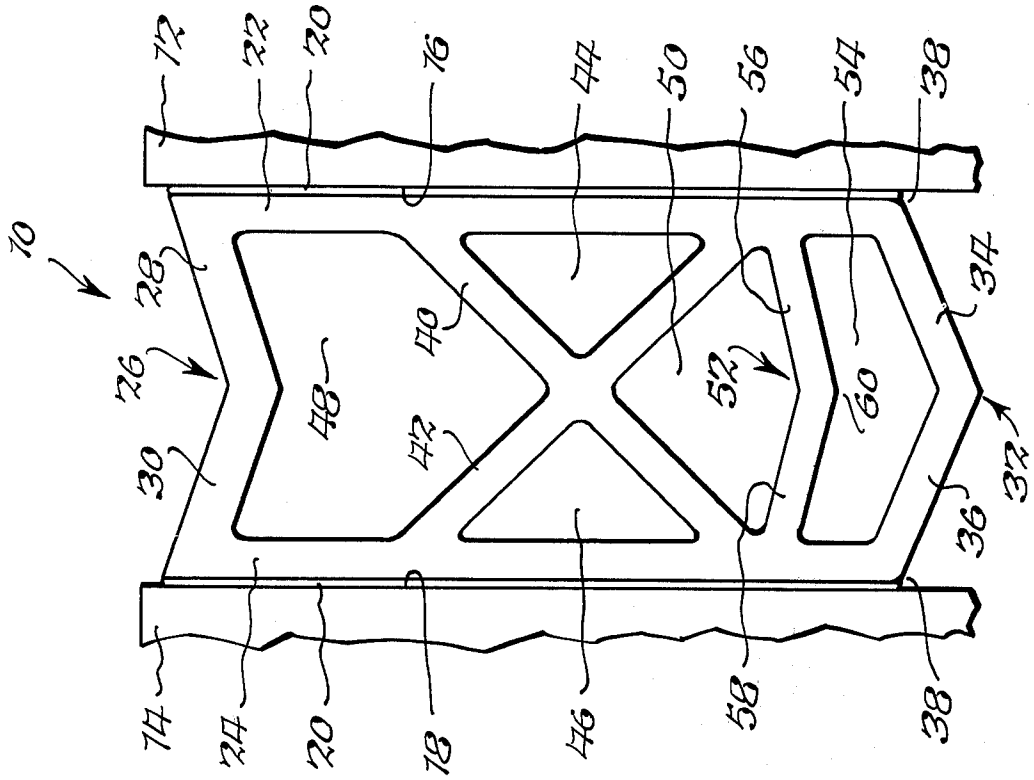

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Fig. 4.

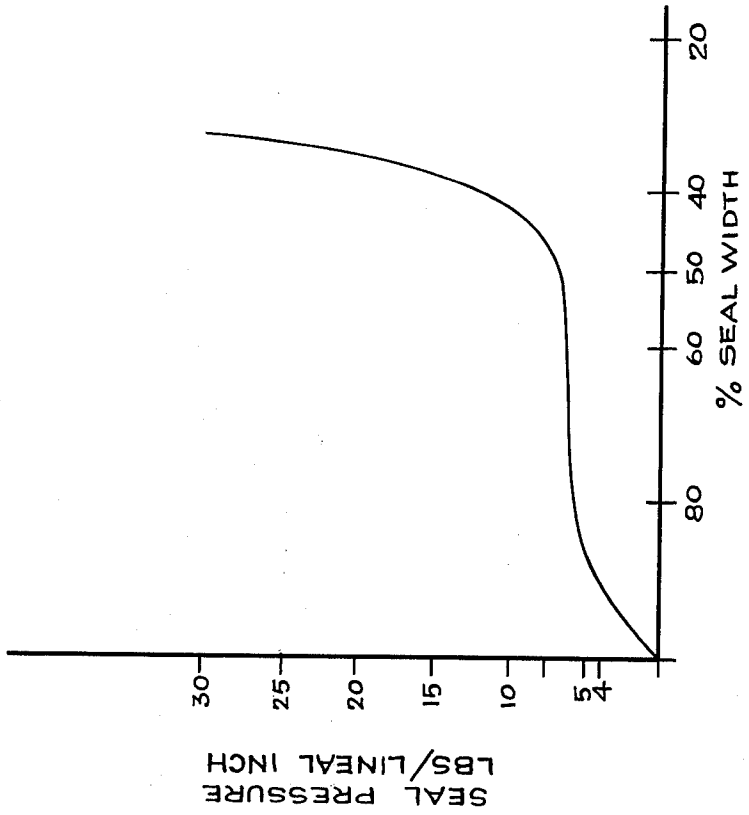
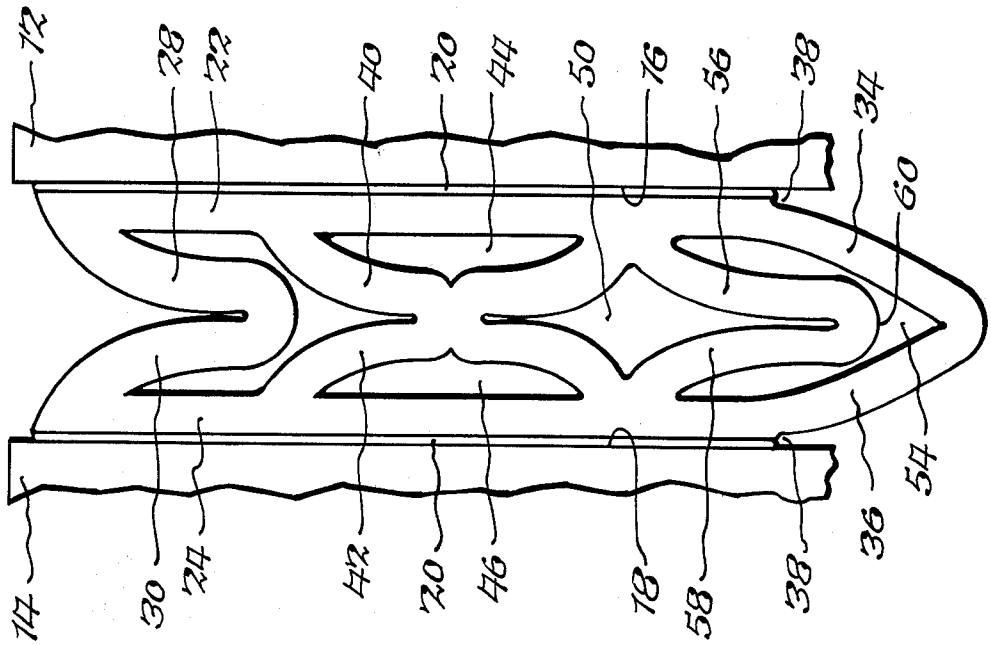

SEAL PRESSURE
LBS/LINEAL INCH
30
25
20
15
10
5
4
20
40
50
60
80
% SEAL WIDTH

Fig. 3.


10
12
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22
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44
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SEALING MEMBER

BACKGROUND OF THE INVENTION

This invention relates to sealing members and, more particularly, to sealing members employed in expansion joints which are disposed in grooves formed between adjacent pavement blocks.

In the construction of highways, bridges, architectural concourses, airport runways and the like in which pavement sections or slabs of concrete or other paving materials are used, provision must be made for the expansion and contraction of such sections due to variations in temperature. Conventionally, grooves are provided between adjacent pavement sections to accommodate the expansion and contraction thereof, such grooves being sealed to preclude the entry of liquids and solid materials therein and to prevent such foreign matter from passing through the grooves and beneath the pavement. These grooves often are sealed by means of hollow, resilient, elastic strips or seals which can be compressed and expanded in accordance with the expansion and contraction of the pavement material.

Often, these hollow strips are provided with internal supporting truss structures comprising a network of ribs and cross bars which generate reaction forces to maintain sealing engagement of the seal side walls with the adjoining surfaces of the pavement sections during expansion and contraction thereof. Often, these internal truss constructions present problems where specification requirements limit minimum and maximum reaction force generation by such seals during various ranges of compression. For example, where the internal supporting truss structure is designed to generate adequate reaction forces initially under slight compression to meet the minimum reactive force requirement, such structure often generates an increasing reactive force with increased compression and often reaches a maximum far in excess of the limits allowed, rendering the seal difficult to install in an expansion groove. Also, premature surface contact between the various internal components of the seal contribute to early failure as a result of permanent deformation thereof.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved tubular sealing member having a simple internal supporting truss construction providing requisite sealing pressure while permitting an increased range of compression.

It is another object of this invention to provide the foregoing sealing member with internal compression means generating substantially uniform reaction forces after initial folding in a manner facilitating controlled collapsing of the sealing member.

The sealing member of the present invention is characterized by the provision of an internal supporting structure incorporating a compression member extending transversely between the sealing member side walls to provide controlled reaction forces and to facilitate controlled collapsing thereof.

The foregoing and other objects, advantages and characterizing features of this invention will become clearly apparent from the ensuing detailed description of an illustrative embodiment thereof, taken together with the accompanying drawing wherein like reference numerals denote like parts throughout the various views.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. 1 is a perspective view of one end of a sealing member constructed in accordance with this invention and shown in its uncompressed state, being broken away to indicate indeterminate length;

FIG. 2 is an end elevational view of the sealing member of FIG. 1, shown in one compressed condition between adjacent structural sections which are broken away for convenience of illustration;

FIG. 3 is a view similar to FIG. 2, illustrating the sealing member in a further compressed condition; and

FIG. 4 is a diagrammatic view illustrating the reaction forces generated in the sealing member of this invention on a graph correlating the force applied in pounds per lineal inch of seal to the degree of compression in percentages.

DETAILED DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

Referring now in detail to the illustrative embodiment depicted in the drawing, there is shown in FIG. 1 an elongated, resiliently yieldable sealing member, generally designated **10**, constructed in accordance with this invention. Sealing member **10** is shown in its natural, uncompressed condition in FIG. 1. FIG. 2 illustrates sealing member **10** in a partially compressed condition to about 80% of its normal width and disposed between a pair of spaced structural members **12** and **14** having opposed vertical surfaces **16** and **18** defining a groove therebetween. Structural members **12** and **14** can be pavement slabs or metal members partially embedded in concrete or other construction material to accommodate a single sealing member **10**. Members **12** and **14** also can represent laterally spaced beams extending longitudinally in the expansion groove between adjacent slabs for separating and supporting a series of laterally spaced sealing members **10** in a composite compression sealing system. The insertion of sealing member **10** into the groove defined by members **12** and **14** is facilitated by the application to surfaces **16** and **18** of a thin layer of a suitable lubricant-adhesive **20** which, when set, cements sealing member **10** in place.

Sealing member **10** preferably is composed of an elastomeric material, such as neoprene for example, or any other suitable resiliently yieldable material having similar properties of durability and high abrasion resistance, adequate compression and expansion capabilities, and capable of withstanding temperature extremes, sunlight, weathering, oxidation and deleterious chemicals. Sealing member **10** is extruded as a unitary, one-piece construction and can take various outside dimensions to conform to the width of the groove in which it is to be used and can be of any length. While the sealing member of this invention is especially adapted for use in expansion joints formed in airfield runways in compliance with specific specification requirements, it should be understood that sealing member **10** has general utility in various expansion joint applications including, without limitation, bridges, highways, sidewalks, architectural concourses, and the like.

Sealing member **10** comprises side walls **22** and **24** which are substantially parallel and straight from end to end and from top to bottom. The upper edges of side walls **22** and **24** are connected to a top wall **26** having downwardly sloping portions **28** and **30** which con-

verge to form a V-shaped recess and which facilitates downward movement of top wall **26** when the side walls **22** and **24** of sealing member **10** are pressed toward each other, thereby avoiding the extension of any portion of sealing member **10** above the top surface of the adjacent members **12** and **14.** As used herein, the terms upper, lower, top, bottom, vertical, horizontal and the like are applied only for convenience of description with reference to the drawing and should not be taken as limiting the scope of this invention.

The lower edges of side walls **22** and **24** are connected to a bottom wall **32** having downwardly sloping portions **34** and **36** which converge to form a V-shaped bottom wall. Top and bottom walls **26, 32** are formed integral with side walls **22** and **24** to form corners therewith and define a tubular structure. The junctures or intersections of side walls **22** and **24** with bottom wall **32** preferably are somewhat rounded as shown at **38** in FIG. **1.**

Sealing member **10** is provided with an internal supporting truss structure comprising a pair of intersecting cross bars **40** and **42** which extend diagonally from side walls **22** and **24** downwardly to the opposite side walls **24** and **22.** The upper ends of cross bars **40** and **42** intersect side walls **22** and **24** at regions spaced below top wall **26** and the lower ends of cross bars **40** and **42** intersect side walls **24** and **22** at regions spaced above bottom wall **32.** These cross bars **40** and **42** intersect approximately midway between their respective opposite ends defining a pair of relatively large triangularly shaped spaces **44** and **46** on opposite sides of a central vertical plane cut through the axis of sealing member **10** into which various portions of sealing member **10** can collapse when compressed. The upper portions of cross bars **40** and **42** are spaced substantially below top wall **26** and define with side walls **22, 24** and top wall **26** a space **48** in the upper half of sealing member **10** into which the sloping portions **28** and **30** of top wall **26** can fold when side walls **22** and **24** are pressed toward each other. Also, the lower portions of cross bars **40** and **42** define a triangularly shaped space **50** in the lower half of sealing member **10** into which other portions of sealing member **10** can collapse when laterally compressed.

A significant feature of this invention resides in the provision of internal compression means offering resistance to prevent inward buckling of side walls **22** and **24** upon compression and quickly generating at least a minimum reaction force to maintain pressure sealing between sealing member side walls **22, 24** and the adjoining support surfaces **16, 18** under initial compression. Upon further compression, this compression means yields to limit the extent of resistance or reaction forces generated thereby within desired limits enabling sealing member **10** to readily collapse under compression. Such means are herein provided in the form of a compression bar **52** extending transversely from side wall **22** just below the lower end of cross bar **42** to the lower portion of side wall **24** just below the lower end of cross bar **40** in spaced relation to and above bottom wall **32,** defining a space **54** therebetween. Compression bar **52** comprises a pair of angularly related portions **56** and **58** extending inwardly and downwardly from side walls **22** and **24** at a slight angle to a horizontal plane cut through sealing member **10** and joined together at an angular juncture **60.** The angle formed by portions **56** and **58** at juncture **60** is only slightly less than 180°, such as 177° for example. Compression bar **52** is important in providing support for side walls **22** and **24** to prevent inward buckling thereof and in providing a force acting laterally outwardly against side walls **22** and **24** to preclude displacement thereof away from the adjoining support surfaces **16** and **18** during expansion of sealing member **10** upon contraction of adjacent structural members **12** and **14.** At the same time, the angular juncture **60** between compression bar portions **56** and **58** defines a knee or bend which facilitates the folding of compression bar **52** into the space **54** in the lower end of sealing member **10** during the compression thereof. Because of this knee juncture **60,** compression bar **52** offers substantially less resistance to the inward movement of side walls **22** and **24** during compression of sealing member **10** than it would if such bar were straight. As a result, side walls **22** and **24** and the overall sealing member body are not unduly stressed, thereby limiting the maximum reactive force exerted by sealing member **10** in normal usage.

Spaces **44, 46, 48, 50** and **54** define relatively large open areas available for the reception of the folded top wall **26,** intersecting cross bars **40** and **42** and portions **56** and **58** of compression bar **52** when sealing member **10** is in a compressed state as shown in FIG. **3** to permit substantial inward movement of side walls **22** and **24** and compression of sealing member **10** beyond 50% of its normal width. FIG. **3** illustrates sealing member **10** compressed to approximately 50% of its normal width, such compression generally representing the maximum under substantially all specification requirements and the maximum to which most seals are subjected. However, it can be seen that, unlike many seals having a complex internal network of bars and ribs, there is no surface contact between the various folded portions of sealing member **10** in this 50% compressed condition so that the latter could be still further compressed before any such contact takes place, thereby insuring avoidance of the possibility of the seal being permanently deformed by premature surface contact.

Pre-forming a break or knee in compression bar **52** at juncture **60** is not only important in facilitating collapse of sealing member **10** to reduce the reactive force thereof, but also is important in controlling the folding of bar **52** into space **54** which also becomes distorted in a controlled downward direction upon folding of bottom wall **32** thereby avoiding any undesirable surface contact prior to maximum compression.

A sealing member as described above satisfactorily met a pressure generation specification requiring a seal having a width of ⅝ inches in the normal, uncompressed state to produce a minimum reaction force of 4 pounds per lineal inch when compressed to a width 80% of its normal width and to produce a maximum reaction force not to exceed 12 pounds per lineal inch when compressed to a width 50% of its normal width. This latter requirement is not met by many conventional seals which generate a maximum reaction force considerably in excess of that.

FIG. **4** illustrates the pressure generation characteristics of the sealing member **10** of this invention on a graph which correlates the force applied in pounds per lineal inch of seal to the degree of compression in percentages. The reactive forces or pressure generation of sealing member **10** is represented by curve A. It will be observed that a reactive force of 4 pounds per lineal

inch is rapidly obtained upon initial compression of sealing member **10** prior to being compressed to 80% of its normal width and that such reactive force substantially levels off with only a minimal increase of from about 5 to 10 pounds through compression from about 85 to 50% of the normal width of sealing member **10.** Thus, it is clearly seen that the specification requirements, hereinbefore mentioned, can be easily met. As a result, sufficient reaction forces are quickly attained to provide adequate pressure sealing along side walls **22** and **24** during initial compression due to the resistance offered by compression bar **52** and cross bars **40** and **42** and such reaction forces are maintained at a relatively low level without a significant increase therein upon further compression of sealing member **10** due to the controlled and uniform folding of compression bar **52** and cross bars **40** and **42.** This controlled folding of compression bar **52** and cross bars **40** and **42** enables sealing member side walls **22** and **24** to move inwardly against a relatively small and substantially uniform resistance permitting sealing member **10** to be readily compressed through a relatively large range well beyond the usual 50% limit before the reaction forces sharply increase as a result of surface contact between the various folded components of sealing member **10.** In contrast, typical seals, incorporating internal supporting structures, generate a reaction force which increases steadily with increased compression and internal surface contact occurs before 50% compression of the seal.

From the foregoing, it is apparent that the objects of the present invention have been fully accomplished. The provision of a pre-formed compression member extending between the sealing member side walls controls the extent of reaction forces generated in the sealing member and facilitates the controlled collapse thereof through an increased compression range while providing adequate pressure sealing against adjoining support surfaces.

A preferred embodiment of this invention having been described and illustrated in detail, it is to be understood that this has been done by way of illustration only.

I claim:

1. A sealing member comprising: a resiliently yieldable tubular body having a top wall, a bottom wall and opposite side walls, an internal supporting truss structure within said body and formed integral therewith, said internal truss structure including a pair of cross bars extending downwardly at an angle from said side walls at points spaced below the upper ends thereof to the opposite side walls at points spaced above the lower ends thereof, said cross bars intersecting intermediate their opposite ends, a generally horizontally extending compression bar extending transversely from one of said side walls to the other of said side walls below the intersection of the lower ends of said cross bars with said side walls in spaced relation to said bottom wall for preventing buckling of said side walls upon compression and facilitating the controlled collapse of said body.

2. A sealing member according to claim **1** wherein said top wall has downwardly sloping portions forming a V-shaped recess and adapted to fold into the upper space defined by said intersecting cross bars when said side walls are pressed toward each other.

3. A sealing member according to claim **1** wherein said compression bar includes a pair of angularly related portions extending inwardly and slightly downwardly from said side walls and joined together at a common juncture at an angle slightly less than 180°.

4. A sealing member according to claim **1** wherein said compression bar defines with said bottom wall an open space into which said compression bar folds upon compression of said body.

5. A sealing member according to claim **1** wherein said cross bars and said compression bar define with said walls of said body relatively large open spaces into which portions of said sealing member can collapse during compression thereof.

6. A sealing member according to claim **1** wherein said compression bar includes a pair of angularly related portions extending inwardly and slightly downwardly from said side walls and joined together at a common juncture at an angle slightly less than 180°, said top wall having downwardly sloping portions forming a V-shaped recess and adapted to fold into the upper space defined by said intersecting cross bars when said side walls are pressed toward each other.

7. A sealing member according to claim **6** wherein said compression bar defines with said bottom wall an open space into which said compression bar folds upon compression of said body.

8. A sealing member according to claim **7** wherein said cross bars and said compression bar define with said walls of said body relatively large open spaces into which portions of said sealing member can collapse during compression thereof.

9. A sealing member as set forth in claim **1,** wherein said top wall is spaced from said internal truss structure.

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