United States Patent

Cole

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[54] EXPANSION JOINT

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[51] **Int. Cl.** **E04b 1/68,** E04f 15/14

[58] **Field of Search** 52/573, 470, 466, 396, 395, 52/346, 109; 94/18

[56] **References Cited**

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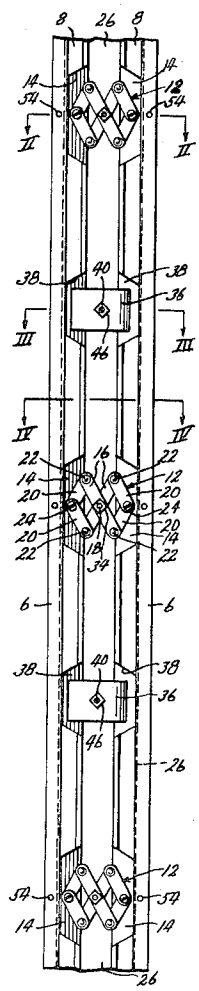
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[57] **ABSTRACT**

An expansion joint for structural panels adapted to bridge gaps between adjoining panels and to permit relative movement therebetween, said joint including a pair of side bars adapted to be affixed respectively to the contiguous edges of said panels and having smooth surfaces normally coplanar with said panels, a cover plate bridging the gap between said side bars, with its edges resting respectively in sliding engagement with the smooth surfaces of said bars, and linkages interconnecting said side bars at intervals along their lengths, each of said linkages having a center point always disposed midway between said side bars regardless of the spacing therebetween, said cover plate being attached to these center points whereby to be maintained in centered bridging relationship to said gap.

4 Claims, 4 Drawing Figures



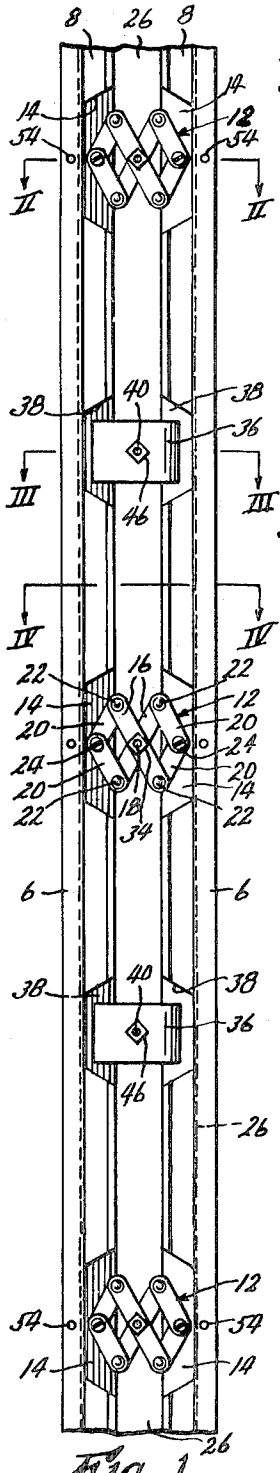


Fig. 1

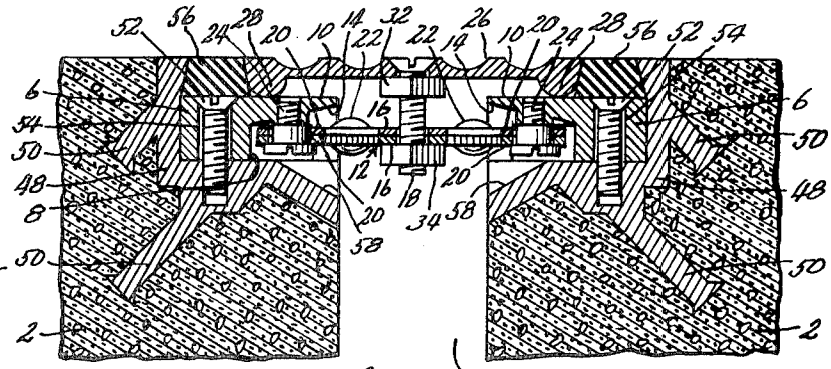


Fig. 2

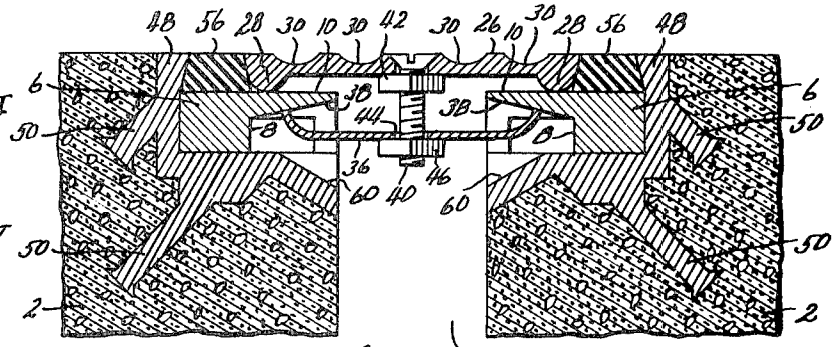


Fig. 3

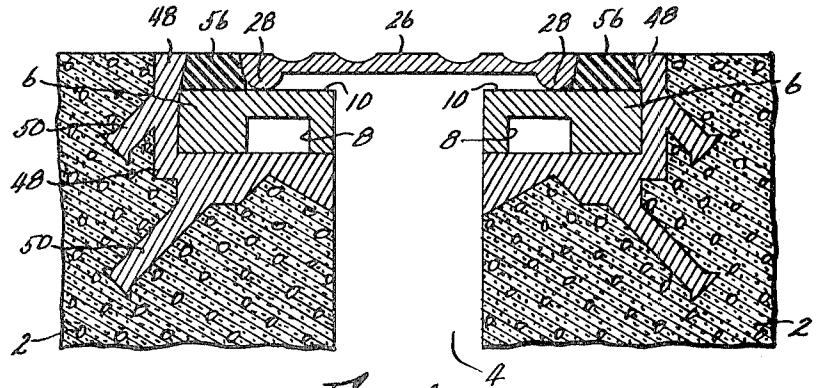


Fig. 4

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EXPANSION JOINT

This invention relates to new and useful improvements in expansion joints, and has particular reference to expansion joints such as are commonly used to connect adjoining panels of floor, wall, and ceiling panels in building construction.

The primary object of the present invention is the provision of an expansion joint of the general character described which provides a cover plate effectively concealing and bridging any gaps between contiguous edges of adjoining floor, wall, or ceiling panels in building constructions, but which nevertheless permits relative movement of said panels. Such relative movement of structural panels occurs as a result of thermal expansion and contraction of said panels, settling of the buildings or of the earth on which it is built, seismic disturbances and the like, and in buildings utilizing panel construction wherein the panels are essentially rigid, gaps must be left between the panels to accommodate these relative movements.

Another object is the provision of an expansion joint of the character described having novel means whereby the cover plate though necessarily movable relative to the joined panels to permit relative movement of said panels, is nevertheless maintained at all times in centered, bridging relationship to the gap between said panels regardless of the movements of said panels.

A further object is the provision of an expansion joint of the character described which will accommodate relative movements of adjoining panels in directions normal to their contiguous edges, longitudinally of said edges, and normally to the planes of said panels.

Generally, these objects are accomplished by the provision of an expansion joint including a pair of elongated side bars adapted to be affixed respectively to the contiguous edges of normally spaced-apart adjoining structural panels, each having a smooth support surface parallel to the plane of said panels, an elongated cover plate overlying and bridging the gap between said panels and having each longitudinal edge thereof resting on the support surface of one of said side bars for sliding movement normal to said edge and rocking movement about an axis parallel to said edge, resilient means urging said cover plate against said side bars, lazy-tong linkages interconnecting said side bars at intervals along their lengths, each linkage having a midpoint always disposed midway between said side bars, and means attaching said cover plate to the midpoints of said linkages.

Other objects are simplicity and economy of construction, efficiency and dependability of operation, and adaptability for use in a wide variety of applications wherever an expansion joint is required.

With these objects in view, as well as other objects which will appear in the course of the specification, reference will be had to the accompanying drawing, wherein:

FIG. 1 is an inverted plan view of a length of an expansion joint embodying the present invention,

FIGS. 2, 3, and 4 are enlarged sectional views taken respectively on lines II—II, III—III, and IV—IV of FIG. 1, showing the joint operatively installed to connect adjoining concrete panels of a floor structure.

Like reference numerals apply to similar parts throughout the several views. The expansion joint will, purely as an example of its usage, be shown and described as connecting adjoining concrete slabs 2 of a floor construction, a gap or space 4 necessarily being left between the contiguous edges of said slabs, as previously discussed, in order to permit the relative movement therebetween which will inevitably result from thermal expansion, settling of the structure, seismic disturbances or the like.

An inverted plan view of an expansion joint embodying the present invention is shown in FIG. 1. It includes a pair of elongated side bars 6 of indeterminate length disposed in a normally parallel relation. Each side bar is generally rectangular in cross-sectional contour, with its major axis disposed horizontally, although the lower surface of each may be longitudinally grooved as indicated at 8 to reduce weight. They

are preferably formed of aluminum or other noncorrosive metal, and are adapted to be fixed respectively to the contiguous edges of slabs 2 at the respective sides of gap 4, by means to be described hereinbelow. When so affixed, their smooth, planar upper support surfaces 10 are normally coplanar, and parallel to the upper surfaces of slabs 2. Side bars 6 are interconnected at intervals along their lengths by a series of lazy-tong linkages 12 each extending transversely to said side bars, as best shown in FIGS. 1 and 2, and connected to the side bars beneath the level of their upper surfaces, the lower surfaces of said side bars being provided with sockets 14 opening toward each other to accommodate the end portions of said linkages. Each of said linkages includes a pair of center links 16 arranged horizontally in X form and pivotally connected at their midpoints by a vertical bolt 18, each pair of corresponding ends of said center links having a pair of end links 20 pivoted thereto at 22. The outer ends of each corresponding pair of end links are pivoted coaxially on a vertical shouldered screw 24 threaded upwardly into the associated side bar within sockets 14 thereof. Each linkage is freely pivotal in a horizontal direction with relation to the side bars, since screws 24 are disposed in the midline of the linkage. Bolt 18 is also disposed in the midline of the linkage, and will remain centered between the side bars regardless of any change in the distance between said side bars.

A cover plate 26 bridges the gap between side bars 6. Said cover plate is narrow and elongated in a direction longitudinal of gap 4, being coextensive with side bars 6. It is generally planar in form, except that it is provided along each of its longitudinal edges with a continuous, rounded depending rib 28. Each of said ribs rests in sliding and rocking engagement with the smooth upper support surface 10, of one of the side bars. The cover plate is also preferably formed of noncorrosive metal, and decorative grooves 30 may be formed in the upper surface thereof. Bolts 18 extend upwardly from linkages 12 and are secured in cover plate 26 at the longitudinal midline thereof. As shown, each bolt 18 is secured in cover plate 26 at the longitudinal midline thereof. As shown, each bolt 18 is secured in cover plate 26 by a nut 32, extends downwardly to form the pivotal connection between the center links 16 of the associated linkage, and has a nut 34 threaded thereon beneath said linkage.

Intermediate each successive pair of linkages 12, a generally rectangular leaf spring 36 is disposed to bridge the gap between side bars 6, its ends extending into sockets 38 formed in the lower surfaces of said side bars. In connection with each spring, a bolt 40 is affixed in cover plate 26 by a nut 42, extends vertically downwardly through a hole 44 formed therefor centrally in the spring, and has a nut 46 threaded thereon beneath said spring. By tightening nut 46, the ends of the spring are urged upwardly against the side bars within sockets 38, and cover plate 26 is urged firmly but yieldably against said side bars.

Side bars 6 are affixed respectively to the contiguous edges of slabs 2 at either side of gap 4 by any suitable means. As shown, metal angles members 48, preferably of a noncorrosive metal, are fixed in the concrete slabs at the time said slabs are poured, being provided withoutwardly extending ribs 50 for anchoring them firmly in the concrete. Said angles are substantially L shaped in cross-sectional contour, opening upwardly and toward each other. Each side bar 6 is affixed in one of angles 48 by a series of screws 52 (see FIG. 2) inserted through holes 54 provided therefor in each side bar at intervals along its length, and threaded into the associated angle 48. If it is desired that the upper surface of cover plate 26 be flush with the upper surfaces of slabs 2, the internal depth of angles 48 should be equal to the combined thickness of the cover plate and one of side bars 6. The space between each edge of cover plate 26 and the adjacent vertical wall of the associated angle 48 may be filled with a filler strip 56 of rubber or other resiliently compressible material. It will be seen that the edges of the cover plate, and the inner surfaces of the vertical walls of the angles, are bevelled to provide dovetail

grooves for receiving said filler strips, so that they may be compressed and snapped into position, and will thereafter be held firmly in place. If in any particular installation it is not objectionable that cover plate **26** project above slabs **2**, angles **48** could be made only sufficiently deep to receive side bars **6**, so that the upper surfaces of said side bars would be flush with the slabs. Filler strips **56** would not then be required. Obviously, other means than angles **48** could be devised for attaching side bars to contiguous slabs **2** if said slabs are not concrete, but of wood or other material, or to slabs or panels of any type in wall or ceiling panels, since the only basic requirement so far as the present invention is concerned is that said side bars be affixed to said panels.

Angles **48** are provided with sockets **58** in the upper surfaces of the horizontal legs thereof, directly below and corresponding to sockets **14** of side bars **6**. Sockets **14** are inclined upwardly and inwardly, and sockets **58** are inclined downwardly and inwardly, as best shown in FIG. **2**, so that linkages **12** may be angled vertically relative to the planes of slabs **2** without interference by bars **6** or angles **48**, in the event the slabs should move to slightly different elevations. Similarly, angles **48** are provided with sockets **60** directly beneath and corresponding to sockets **38** of side bars **6**, as best shown in FIG. **3**, to permit vertical angling of leaf spring **36**.

In operation, it will be seen that with the expansion joint installed as shown, any relative movement of slabs **2** toward or away from each other, resulting from thermal expansion, shifting or settling of the building structure, seismic disturbances or any other causes will be accommodated by the joint, within reasonable limits, and preserve the centered bridging relationship of cover plate **26** relative to gap **4**. If the relative movement of the slabs or panels **2** leaves said slabs in coplanar relation, and merely changes the distance therebetween to increase or decrease the width of gap **4**, linkages **12** merely are extended or retracted freely, in the manner of lazy tongs, to change the distance between end pivot bolts **24** thereof. At the same time pivot bolt **18** of each linkage remains precisely midway between bolts **24**, and hence centered relative to gap **4**, and cover plate **26**, being attached to and guided by bolts **18**, also remains centered relative to gap **4**. In other words, while the relative movement of side bars **6** forces cover plate **26** to slide transversely of its length on surfaces **10** of said side bars, linkages **12** cause the movement of said cover plate to be equal with respect to each of said side bars. This increases the degree of separating movement of the side bars which can be accommodated with no possibility that the cover plate could slide off of or be separated from either side bar, and preserves the neat, centered appearance of the joint from above. In this connection, it will be noted that the precise number of links in each linkage **12** is immaterial, except that it should be an odd number, and no less than three, as shown, in order that it will have a center pivot **18** which will always be centered between the side bars.

As the joint expands or contracts as described above, filler strips **56** expand or contract correspondingly by reason of their own resilence, whereby, within reasonable limits, to maintain the smooth upper surface of the joint, coplanar with the upper surfaces of slabs **2**. The joint will also accommodate coplanar relative movements of slabs **2** in which side bars **6** are moved into nonparallel, acutely angled relation since there is no necessity that the various linkages **12** yield equally, each being free to yield to the necessary degree independently of any other linkage. It will be seen also that leaf springs **36**, being attached by bolts **40** to cover plate **26**, will also be maintained centered with respect to the side bars.

The joint will also accommodate coplanar relative movement of slabs **2** in a direction longitudinal of the gap **4** therebetween. In this movement, cover plate **26** slides longitudinally, but oppositely, on the side bars, while linkages **12**, in addition to their longitudinal extension or retraction as already described, also pivot horizontally on their end pivots **24** into acutely angled relation to the side bars. For this purpose, it is necessary that said end pivots be the center pivot of one of the X-links of the linkage, and be disposed in the longitudinal midline of the linkage, as shown.

The joint will also accommodate relative movements of slabs **2** into noncoplanar relation, for example, the lowering of one slab relative to the other, or the tilting of one slab relative to the other about an axis lying substantially along the expansion joint. In this case the ribs **28** rock tiltably on surfaces **10** of the side bars, as well as sliding thereon, so that the cover plate, while no longer precisely coplanar with either slab **2**, will still form a smooth transitional incline interconnecting said slabs. Vertical angling of linkages **12** on bolts **24** is permitted by a loose fit of said linkages on said bolts, and also by the fact that the linkages are formed of resilient, sufficiently thin metal strips that the linkage itself may be flexed vertically. Sockets **14** and **58** increase the possible degree of movement of this type which can occur without interference by the side bars or mounting angles **48** with vertical tilting of the linkages. Sockets **38** and **60** perform the same function for leaf springs **36**. The depending form of ribs **28** of the cover plate permit vertical tilting of said cover plate without interference by the confronting edges of the side bars with the body portion of the cover plate.

The joint will also accommodate relative movements of slabs **2** in which the contiguous edges of said slabs, while remaining in the same vertical planes, become vertically tilted relative to each other longitudinally of gap **4**. This movement twists or skews cover plate **20**, but is possible since the cover plate, while quite rigid in spans thereof as short as the transverse width thereof, may in the much longer spans of its length be sufficiently flexible to permit twisting thereof to maintain its edges in full contact with the side bars, especially if springs **36** are strong enough to supply the twisting torque. Especially in floor joints, this may require springs **36** which are relatively strong and closely spaced, since in floor joints the cover plates must obviously be sufficiently strong and rigid to carry any traffic load imposed thereon. However, in wall and ceiling joints such strength is not required, so that the cover plates can be of relatively light weight and more flexible, with the result that greater accommodation of this type can easily be provided.

Finally, it is of course seldom that relative movements of adjoining panels or slabs in building structures occur as only one of the possible movements discussed above, such relative movements usually involving a combination of any number or even all of said individual movements. It will be readily appreciated that the present expansion joint will accommodate any relative movement of the slabs or panels involving any combination of said individual movements.

While I have shown and described a specific embodiment of my invention, it will be readily apparent that many minor changes of structure and operation could be made without departing from the spirit of the invention.

What I claim as new and desire to protect by Letters Patent is:

1. An expansion joint for connecting spaced-apart contiguous edges of adjoining floor, wall, or ceiling panels in building structures, said joint comprising:

a. a pair of elongated, generally parallel side bars,

b. means for affixing said side bars respectively to said contiguous panel edges,

c. an elongated cover plate bridging the space between said side bars, the plane of said cover plate being normally parallel to the plane of said panels, and each longitudinal edge of said cover plate resting slidably against a surface of one of said side bars which is parallel to the plane of said panels, and

d. connecting means joining said side bars and said cover plate whereby said cover plate is maintained in transversely centered relation relative to the space between said side bars, said connecting means comprising a plurality of linkages extending transversely between and interconnecting said side bars at intervals along their lengths, each linkage being freely extendable and retractable in length

to permit variation of the space between said side bars, and having a midpoint always spaced midway between the ends thereof, means connecting said cover plate to the midpoints of said linkage, each of said linkages constituting a lazy-tong linkage having an odd number of pivot points along the longitudinal midline thereof, the endmost of said midline pivots being connected respectively to said side bars by means permitting pivotal movement of said linkage relative to each side bar in a plane parallel to the planes of said panels, and the center of said midline pivots of each linkage being connected to said cover plate, and resilient means urging each longitudinal edge of said cover plate yieldably against its associated side bar.

2. An expansion joint as recited in claim 1 wherein each longitudinal edge of said cover plate is tiltable on its associated side bar about said edge as an axis, and wherein each of the endmost midline pivots of each of said linkages is connected to its associated side bar by means permitting pivoting of said linkage relative to said side bar in a plane normal to the planes of said panels.

3. An expansion joint as recited in claim 1 wherein said resilient means urging said cover plate yieldably against said side bars comprises a series of leaf springs extending between said side bars, the ends of each spring engaging surfaces of said side bars which face generally oppositely from the surfaces thereof engaged by said cover plate, and means connecting the center point of each of said springs to said cover plate, whereby said spring is maintained in transversely centered relation to said side bars.

4. An expansion joint as recited in claim 1 wherein said cover plate is torsionally flexible about its longitudinal axis whereby to accommodate movement of said bars into nonparallel relation in a direction normal to the planes of said panels, said springs being operable to apply torsional stress to said cover plate to maintain the edges thereof in continuous contact with said side bars despite the said nonparallel relation of the latter.

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