Nov. 29, 1960 K. E. SHAPIRO ET AL 2,961,803

CONTRACTION JOINT AND SEAL FOR CONCRETE STRUCTURES

Filed March 21, 1957 2 Sheets-Sheet 1

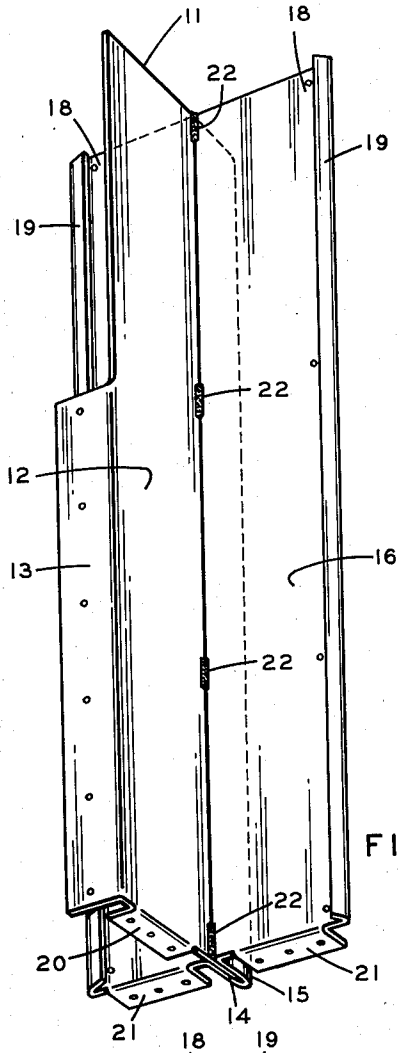


FIG. 1

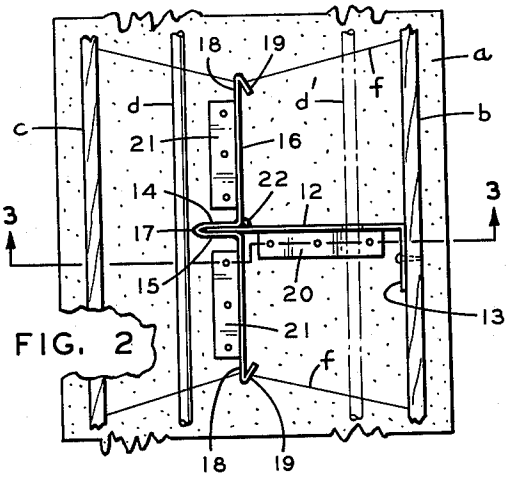


FIG. 2

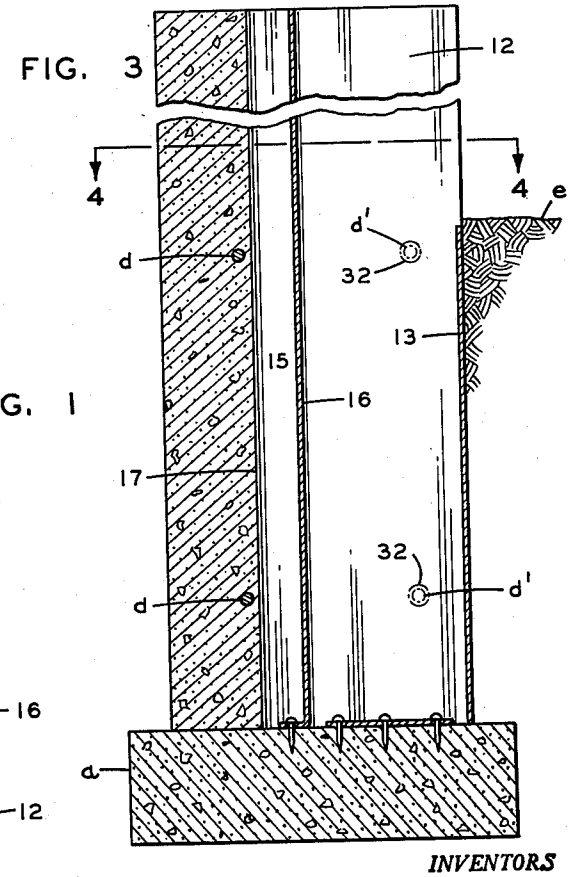


FIG. 3

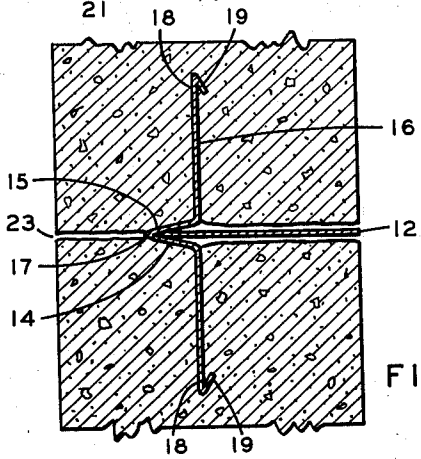


FIG. 4

INVENTORS

KENNETH E. SHAPIRO,
MORRIS SHAPIRO & STANLEY SHAPIRO

BY Jerome A. Gross,

ATTORNEY

Nov. 29, 1960 K. E. SHAPIRO ET AL 2,961,803

CONTRACTION JOINT AND SEAL FOR CONCRETE STRUCTURES

Filed March 21, 1957 2 Sheets-Sheet 2

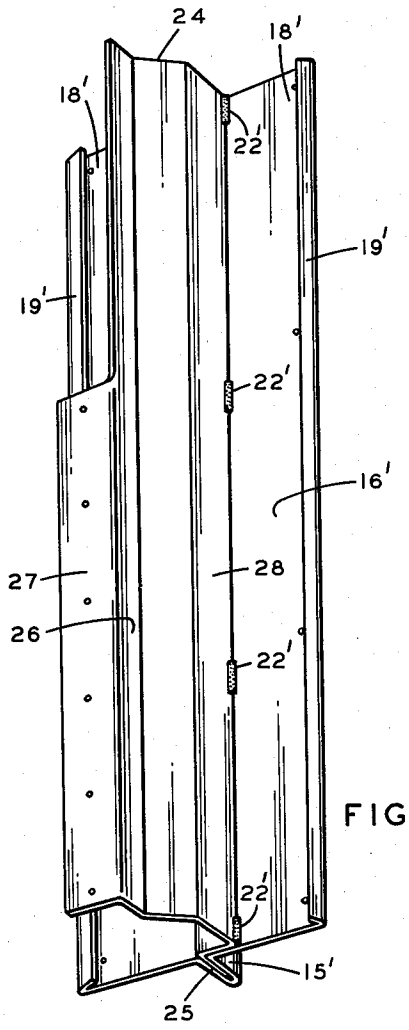


FIG. 5

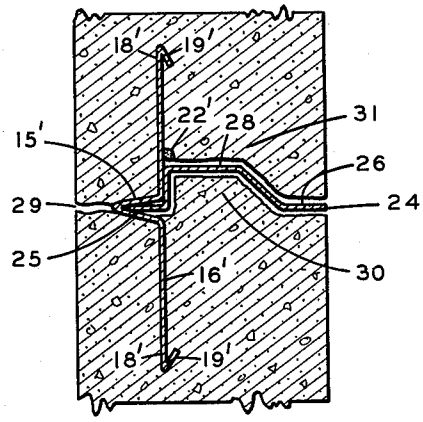


FIG. 6

INVENTORS

KENNETH E. SHAPIRO,
MORRIS SHAPIRO & STANLEY SHAPIRO

BY

Jerome A. Gross,

ATTORNEY

United States Patent Office 2,961,803 Patented Nov. 29, 1960

2,961,803

CONTRACTION JOINT AND SEAL FOR CONCRETE STRUCTURES

Kenneth E. Shapiro, 930 Jeanerette Drive; Morris Shapiro, 400 Alta Dena Court; and Stanley Shapiro, 400 Alta Dena Court, all of University City, Mo.

Filed Mar. 21, 1957, Ser. No. 647,668

5 Claims. (Cl. 50—186)

This invention relates to contraction joints for poured concrete structures, and particularly to the provision of sealed joints which will hold back the flow of water through such joints in foundation walls, swimming pool walls, and the like.

Poured or cast concrete foundation walls which extend upward from sub-grade footings are widely used, as in the construction of small residence buildings. When such walls enclose basement or living quarters, it is important that they be substantially waterproof. However, the contraction of concrete attendant curing, with the shrinkage that results as the water content decreases in the concrete, normally results in some cracking.

If no reinforcing steel is used, there may be large, random contraction cracks which will admit water, and in some cases could seriously impair the strength of the wall. However, such large cracks can be fairly well sealed by tuckpointing.

On the other hand, if reinforcing steel is used to hold the wall integral despite contraction cracking, the steel tends to distribute the contraction as minute cracks throughout a large portion of the wall. Such cracks are difficult to seal.

The objects of the present invention are: To supply a simple contraction joint-former combined with a sealer or water barrier; by the use thereof to create vertical contraction joints at pre-selected wall locations, which joints are straight and internally sealed; to permit further expansion and contraction without affecting the seal; to utilize the water barrier as an aid in the formation of the contraction joint; and, for unreinforced construction, to provide a contraction joint which leave the adjacent wall portions structurally interlocked with each other.

We achieve these purposes and others, which will be apparent from this specification, utilizing the embodiments illustrated in the drawings, in which:

Figure 1 is a perspective view, taken from the outer side and partly from below, of a combined joint-former and water barrier;

Figure 2 is a top view of the article shown in Figure 1 as held in place between forms prior to casting of the concrete;

Figure 3 is a view as seen along line 3—3 of Figure 2 after the concrete has been poured and the forms removed;

Figure 4 is a sectional view taken along line 4—4 of Figure 3, showing the wall after contraction cracking and the resultant opening or expansion of the mid-portion of the water barrier;

Figure 5 is a perspective view, corresponding to that of Figure 1, of an alternate embodiment of the present invention, especially suited for use in unreinforced concrete walls;

Figure 6 is a sectional view similar to Figure 4, showing the embodiment of Figure 5 in place within a cast concrete wall after contraction cracking thereof.

Referring first to Figure 2, there is shown, fragmentarily, a footing *a* upon which forms have been erected, including an outer form *b* and an inner form *c* for the outer and inner surfaces respectively of the vertical concrete foundation wall to be cast therebetween. Horizontally-extending continuous steel reinforcing rods *d* (shown also in Figure 3) are located inwardly of the center of the wall so as to withstand tension accompanying bending under pressure of the mass of earth and moisture to be found at the outer side of the wall after filling to the grade *e* shown in Figure 3.

At such location in the wall where a vertical contraction joint may be most desirable (which location and use should in questionable cases be selected by a licensed structural engineer) we locate between the forms *b* and *c* and upon the footing *a* the combined joint-former and water barrier, generally designated **11**, shown in Figure 1. The combined article is formed of bent-up sheet metal, preferably either galvanized steel or copper; because of the corrosion-resistant quality which is desired for the water barrier function and for smooth surfaces which permit easy separation of the concrete on contraction. Materials other than metal, having these characteristics to a satisfactory extent, may also be used. Referring to Figures 1 and 2, the article **11** consists of a joint-former strip **12** erected vertically between the forms *a* and *b* and having an outer flange **13** bent at right angles and extending upward from the bottom of the joint-former strip **12** a substantial distance, which may conveniently be to about the level of the grade *e*. The outer flange may be pre-perforated, as shown in Figure 1, for convenient nailing to the inner surface of the outer form *b* for purpose of erection, as shown in Figure 2.

The joint-former strip **12** has inwardly-presented edge **14** spaced from the inner surface of the wall to be cast, the strip **12** being of lesser width than the thickness of the wall. The inner edge **14** is accommodated within a flattened, sharply-creased V-shaped fold **15** at the midportion of a vertical water barrier strip **16**, the fold **15** having an apex **17** extending toward the inner surface of the wall and spaced therefrom just outwardly of the reinforcing steel *d*. Since the apex **17** is presented inwardly, away from the wall surface from which water will enter, the V-fold **15** is sometimes referred to herein as the central trough portion of the water barrier strip **16**, whereas the imperforate barrier strip portions adjacent it on either side are referred to as the shield portions. Save for the portion included in the V-shaped fold **15**, the water barrier strip **16** extends vertically with its portions adjacent the fold **15** preferably in a plane parallel to the inner surface of the wall. At its extremities, however, the water barrier strip **16** has edge portions adapted for bonding to the concrete. To serve this function, such edge portions (hereinafter sometimes called the bonding edges **18**) may conveniently include anchoring flanges **19** bent back outward at sharply acute angles to secure retention within the wall and stoppage of any possible water passage around ends.

At the base of the joint-former strip **12**, midway between its outer flange **13** and its inwardly-presented edge **14**, there is provided a pre-perforated nailing flange **20** formed at a 90° angle to the strip **12**. Similar nailing flanges **21** are provided at the base of the water barrier strip **16** at each side of the V-shaped fold **15**. These are nailed into the footing as shown in Figure 3 preliminary to erection. The bonding edges **18** may likewise be pre-perforated, as shown in Figure 1; and these may be rigged into place, preparatory to pouring the concrete, by wires *f*, shown in Figure 2, whose ends are fastened to the forms *b* and *c* by nailing or in any other convenient manner. Wires *f* thus hold the combined article **11** in desired position during pouring the concrete, as do the flanges **13**, **20** and **21**.

Further to facilitate handling and erection, the water barrier strip **16** and joint-former strip **12** are furnished to the job connected together by soldered tacks or connection points 22 as shown in Figures 1 and 2. The connection points **22** are located at intervals and on one side only where the joint-former strip **12** enters the V-fold **15**.

After the concrete is cast within the forms *a* and *b*, these are removed and the soil at the outer wall filled into the grade *e* as shown in Figure 3. The flange **13** is not continued above this point because such continuation might mar the outer appearance of the wall, and nailing the short flange **13** is adequate for purpose of temporary support.

As the concrete wall sets and cures, there is a substantial amount of contraction due both to the curing and to the drying out and shrinkage which accompanies it. If the article shown in Figure 1 is located near the midpoint of a fairly long wall, the outer surfaces of the V-fold **15** and of the joint-former strip **12** will provide a weak line along which it will crack and separate as in Figure 4. The bonding edges **18**, held by their anchoring flanges **19** within the wall portions which thus shrink away from each other, exert tension on the water barrier strip **16** so as to flex the V-shaped fold **15** from its flattened position as shown in Figures 1 and 2 to the open position shown somewhat exaggeratedly in Figure 4.

To secure these results, it is important that the concrete mix be formulated, designed, poured and cured in such manner as to achieve good strength properties.

The joint-former strip **12** may tend to "float" substantially midway in the contraction crack so formed, as shown in Figure 4, or may adhere to either side thereof. The soldered points **22** are readily frangible under the stresses which would accompany realignment of the parts attendant cracking, and they in no way interfere with the formation and propagation of the contraction joint **23**.

It is immaterial for purposes of the formation of the joint whether or not the joint-former strip **12** is made of corrosion-resistant material. However, the sealing function, provided by the water barrier strip **16**, is a continuing one. It should therefore have corrosion resistance at least equal to that of galvanized sheet metal; and under certain circumstances copper may be preferred.

The thickness of the metal used is necessarily somewhat exaggerated in the drawings. It is important merely that the corrosion-resistant metal shall flex its V-fold for contraction and expansion, to maintain a continuous water barrier from the footing to a portion of the wall up at least to the level of the grade.

The apex **17** of the V-fold **15** propagates the expansion joint inward to the inner surface of the wall where it appears as a substantially straight vertical joint, serves as the seal, and if desired for neatness, the crack may be tuckpointed at the inner side of the wall. Holes **32** may be provided in the joint-former strip **12**. These permit the use of additional reinforcing rods *d'* if specified as necessary. The holes **32** should be larger in diameter than the rods *d'*, so that the strip **12** acts independently of this additional reinforcing.

The alternative embodiment, shown in perspective in Figure 5, is intended principally for use within walls which are not reinforced with steel rods; but this embodiment may also be advantageously used with reinforcing rods. Where no reinforcing steel is used, the combined article, shown in cross-section in Figure 6, may extend from the outer surface of the wall to a point fairly closely adjacent the inner surface of the wall.

Referring first to Figure 5, the combined joint-former and water barrier there shown includes a water barrier strip **16'** which may in all respects be identical with that shown in Figure 1, although in certain instances it may be desired to alter the proportions thereof, such as by providing a flattened V-fold portion **15'** to serve as an expansible mid-portion of the barber strip **16'** and extend inward toward the inner surface of the wall. Adjacent such flattened V-fold **15'**, the portions of the water barrier strip **16'** are aligned substantially in a plane, as shown in Figure 6, and they terminate at their outer margins in bonding edges **18'** having acute angle anchoring flanges **19'**.

In the embodiment shown in Figure 5, however, we provide no base nailing flanges such as the nailing flanges **21** shown in Figures 1 and 2. Insetad (and this alternative might be used in the construction shown in Figure 1 also) we embed the combined joint-former and water barrier in the upper portion of the footing when it is poured. This embedding provides assurance that the water trapped within the V-fold **15'** will not travel downward and thence across the top of the footing to the inner side of the wall to be cast. Such construction may be particularly advantageous if the sealing off of water from the outside is a particularly difficult problem and article **11** may be conveniently cast with the footing.

The joint-former **24** illustrated in Figures 5 and 6 in connection with the water barrier strip **16'**, is conveniently furnished temporarily connected to the water barrier strip **16'** by a plurality of soldered tacks or connections **22'**, which, in the construction illustrated in Figures 5 and 6, are displaced from the V-fold **15'**, due to the unusual shape of the joint-former.

The joint-former **24** is hereinafter referred to as a tongue-and-groove joint-former strip and generally designated **24**. It includes an inwardly-presented edge **25** which nests within the flattened V-fold portion **15'** of the water barrier strip **16'**; also an outwardly-presented edge portion **26** which is preferably within the same plane as the inwardly-presented edge **25** and substantially transverse to the walls to be constructed, and which permissibly includes a sub-grade portion nailing flange **27** which coresponds to the nailing flange **13** of Figures 1, 2 and 3. Between the inwardly-presented edge **25** and the outwardly-presented edge portion **26**, the strip **24** is offset to one side, in order to provide the wall with a tongue to be cast within the offset and a groove on the outer side of the offset. Such offset, providing a tongue-and-groove contraction line, is referred to herein as a hat-section portion **28**, this term being used to describe the cross-sectional shape to which the strip **24** is formed, assuming the nailing flange **27** to be disregarded. Such hat-section portion **28** may be square-cut or rounded; and structural engineers will select the specific proportions suited for various applications. In the embodiment shown it is unsymmetrical and includes a pair of 90° angle offsets adjacent the water barrier **16'** so that the hat-section portion adjacent the inwardly-presented edge **25** may abut flatly against the outer surface of the water barrier strip **16'** for making the soldered tacks **22'**. As the concrete, poured about the joint-former and water barrier, cures and dries, the contraction stresses cause the wall portions on either side of the joint-former strip **24** to shrink away from each other, forming the tongue-and-groove contraction crack line **29** shown in Figure 6. Inasmuch as the soldered tacks **22'** are frangible there may be a separation of the joint-former strip **24** from the water barrier **16'** as shown in Figure 6, although the flexibility of the sheet-metal permits the contraction to take place without such fracture. The crack line **29** propagates itself through to the inner wall substantially straight, vertical and clean-cut so that it may be tuckpointed to present a finished appearance.

The wall so formed has a mechanical tongue-and-groove interlock, as shown in the horizontal section view, Figure 6. The portion of the concrete which extends within the hat-section portion **28** of the joint-former strip **24** comprises a tongue wall portion **30**; the wall portion on the opposite side of the hat-section portion **28** constitutes the groove portion **31** in which the tongue portion **30** is interlocked. Expansion and contraction may thereafter occur without further affecting the structural integ-

rity of the interlocking tongue-and-groove wall portions 30, 31.

While the proportions of the parts illustrated in Figures 1 and 5 are such that the vertical joint-former strips 12, 24 form the line of separation for a greater portion of the wall thickness than do the V-fold portions 15, 15', the proportions may be varied. The V-fold portions 15, 15' themselves, by their inward projection, contribute substantially to provide a line of weakness to locate the shrinkage crack in the wall. Thus the water barrier strips 16, 16' contribute substantially to the function of joint-forming; and were there any reason to do so, they could be used in connection with other joint-forming means than the joint-former strips 12, 24, or in certain applications independently.

The invention can be applied to contraction joints found in road pavements and other types of slabs, where it is desirous to hold back the flow of water through the slab. Other modifications of the present invention will occur to those familiar with the problems of constructing cast concrete foundation walls and similar structures in which the present invention may be readily utilized. Accordingly, this invention is not to be construed narrowly, but as fully co-extensive with the claims which follow.

For purposes of the claims, the term "outer" refers to the wall surface which is likely to be first permeated by water; and the term "inner" to the surface through which water ought not be permitted to flow. Thus, for use in such applications as swimming pools, the "outer" wall would be the surface at which the water is presented (in this case actually the inside of the pool).

We claim:

1. The combination comprising an elongated, corrosion resistant sheet metal water barrier having a substantially flattened V-shaped trough fold, imperforate shield portions at both sides of said fold and lying in a plane and flanges along the long edges of said shield portions and at one end thereof, together with a joint-former strip of the same length and having one long edge inserted within the V-fold, a flange along the other long edge, and an end flange at the end corresponding to the ends of the shield portion which are flanged.

2. The method of providing a water barrier-protected vertical contraction joint in a vertical poured concrete wall, comprising the steps of inserting one long edge of an elongated joint former strip into the fold of a V-fold elongated water barrier and attaching said parts, then erecting said parts vertically endwise upon a footing between parallel-spaced inner and outer forms, presenting the V-fold apex toward and spacedly inward of the inner surface of the inner form, and attaching the other long edge of said strip vertically along the inner surface of the outer form, then pouring the concrete, then permitting the concrete to harden and removing the forms, and permitting the concrete to continue to cure and contract and open the V-fold and separate along the surface of the joint former strip from the surface formed by the outer form to the V-fold of the water barrier thereby propagating a vertical crack from the apex of the V-fold to the surface formed by the inner wall form.

3. The method of providing a water barrier-protected vertical contraction joint in a vertical poured concrete wall, comprising the steps of inserting one long edge of an elongated joint former strip into the fold of a V-fold elongated water barrier and attaching said parts, then erecting said parts vertically endwise upon a footing between parallel-spaced inner and outer forms, presenting the V-fold apex toward and spacedly inward of the inner surface of the inner form, and attaching the other long edge of said strip vertically along the inner surface of the outer form, then supporting a reinforcing rod horizontally in the space between the V-fold apex and the inner form, then pouring the concrete, then permitting the concrete to harden and removing the forms, and permitting the concrete to continue to cure and contract and open the V-fold and separate along the surface of the joint former strip from the surface formed by the outer form to the V-fold of the water barrier thereby propagating a vertical crack from the apex of the V-fold to the surface formed by the inner wall form.

4. In the construction of poured concrete foundations and the like, the combination comprising a footing, a poured concrete wall thereon having parallel inner and outer surfaces, a vertical elongated sheet metal water barrier in said wall having a V-shaped trough fold including an apex located spacedly inwardly of the inner wall surface, the barrier further having imperforate shield portions at both sides of said fold lying in a plane parallel to the wall surfaces, the lower ends of the shield portions having attachment means secured to the upper surface of the footing, together with a similarly elongated metal joint-former strip having one long edge within the fold thereof and having along the opposite long edge attachment means extending to the outer wall surface whereby securement to an outer form may be effected preliminary to the pouring of the wall.

5. Reinforced concrete wall construction as defined in claim 4, together with a horizontal reinforcing steel rod embedded in the poured wall inwardly of the fold apex.

References Cited in the file of this patent

UNITED STATES PATENTS

639,961	De Man	Dec. 26, 1899
676,785	Toelpe	June 18, 1901
1,100,531	Cahill	June 16, 1914
1,318,405	Perott	Oct. 14, 1919
1,530,105	Bufton	Mar. 17, 1925
2,103,337	Oury	Dec. 28, 1937
2,192,570	Bitney	Mar. 5, 1940
2,254,769	Bitney	Sept. 2, 1941
2,282,829	Schurman	May 12, 1942

OTHER REFERENCES

Publication "Structural Highways," 1936 edition, Catalog and Manual of American Concrete Expansion Joint Company, LaSalle-Wacker Bldg., 221 N. LaSalle St., Chicago, Ill., page 19.

"Procedure Handbook of Arc Welding Design and Practice" (page 39), seventh edition, 1942, The Lincoln Electric Company, Cleveland, Ohio.