April 29, 1969 R. F. DILL 3,440,934

METHOD AND JOINT STRUCTURE IN MONOLITHICALLY-POURED CONCRETE

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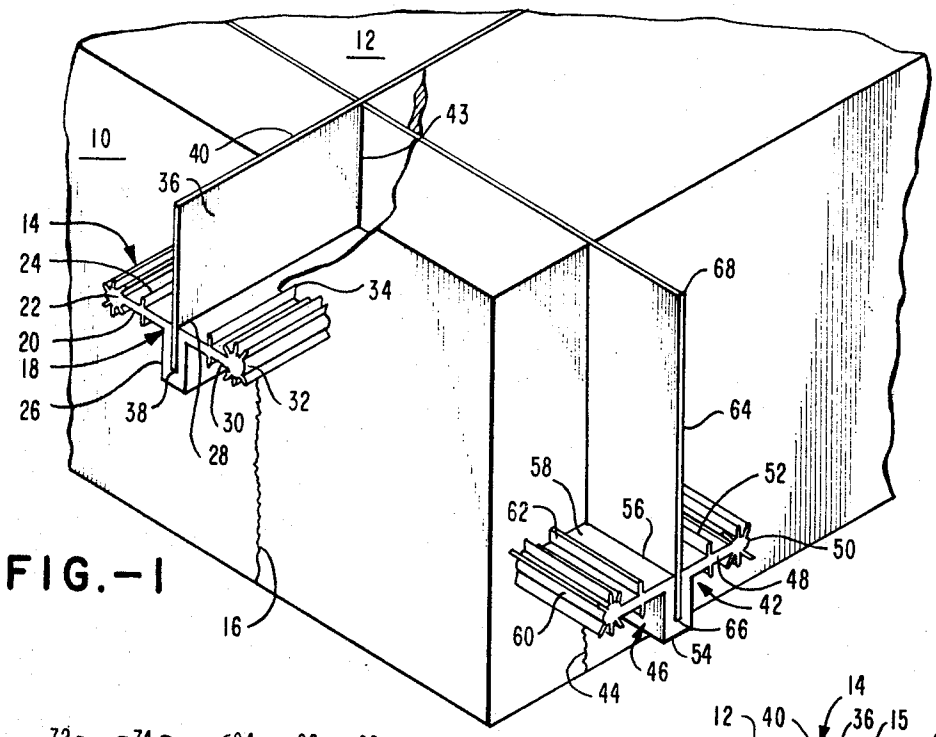


FIG.—1

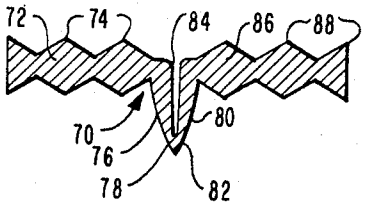


FIG.—4

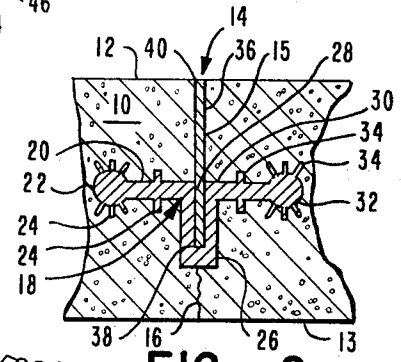


FIG.—2

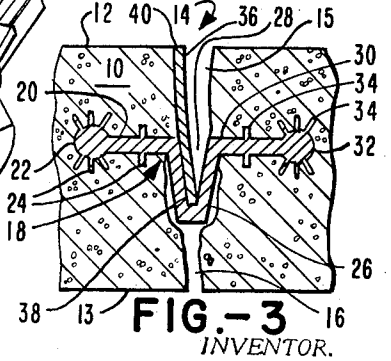


FIG.—3

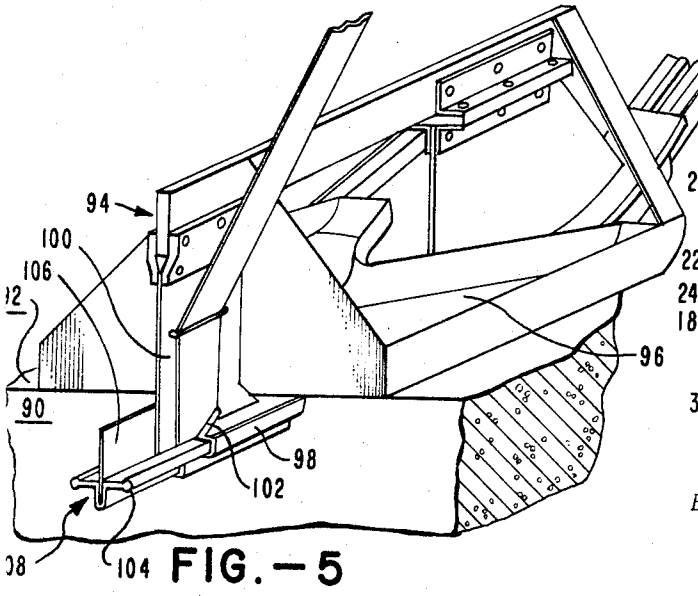


FIG.—5

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METHOD AND JOINT STRUCTURE IN MONOLITHICALLY-POURED CONCRETE

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ABSTRACT OF THE DISCLOSURE

A combined joint former and waterstop structure of generally uniform shaped cross section for use in a monolithically-poured concrete slab, and intersecting joint forming structures which are not discontinuous at their points of intersection.

This invention relates to joints in concrete structures. more particularly, this invention relates to joints in monolithically-poured concrete masses, and to methods for preparing these joints.

Broadly, this invention relates to a structure in which a joint forming structure is positioned within an uncured monolithically-poured concrete slab. The joint structure is of two parts, namely a supple, resilient, water-impervious seal and a supple fracturing strip. The seal has an elongated configuration extending generally horizontally to the upper surface of the concrete slab with an upwardly opening channel disposed between the edges of the seal. The lower edge of the fracturing strip is positioned in this channel and the fracturing strip extends vertically adjacent the seal upwardly to approximately the upper surface of the concrete slab. The fracturing strip and the seal are separate from one another and are inserted separately into the uncured concrete. The seal and fracturing strip are brought together in their final location beneath the surface of the slab. Alternatively, the joint structure may be inverted so that the fracturing strip extends downwardly from the seal toward the bottom surface of the slab.

It is well known that monolithically-poured concrete slabs or masses will fracture during cure and afterwards due to expansion and contraction caused by curing stresses or temperature cycling. These fractures will occur at random unless some provision is made for providing weakened planes at which fracturing will occur preferrentially. One of the major problems with random fractures is that there is no way of preventing water from passing through the fractures so as to soften the supporting soil and eventually undermine the slab. This is a particularly acute problem in reservoirs and canals where water is present on the upper surface of the concrete slab continuously.

Where a weakened vertical plane is deliberately provided in a monolithically-poured concrete mass some provision must be made for preventing the passage of water from the top surface of the concrete mass through the resultant fracture to the bottom surface of this mass. Preferably the means for weakening the concrete mass in a vertical plane and the seal or water barrier are placed in one single operation so as to simplify and reduce the cost of operations. A weakened vertical plane is caused by the fracturing strip of the joint structure according to this invention and the resultant fracture is rendered water impervious by the seal.

Advantageously the seal or water barrier is placed as deeply as possible in the concrete mass so as to protect it from injury and deterioration.

In panel or form-poured concrete slabs a given section of concrete is poured within a defined form and

joints may be positioned at the edges of the forms simply by placing them there prior to the pouring of the concrete.

In monolithically-poured slabs the mass of concrete is poured over such a large area that joints must be made between the boundaries of the slab. In order to simplify and reduce the cost of operations it is generally preferred to insert the joint in the monolithically-poured slab simultaneously with the performance of some other operation which must necessarily be performed. The joint is preferably inserted during the placement of the concrete mass or during the finishing operation.

The fracturing strip is generally a flat strip or sheet of material which extends vertically from the seal to approximately the upper surface of the concrete mass. It has been found that if the fracturing strip does not reach to the approximate upper surface of the concrete mass the mass may fracture at random in preference to the desired location. The use of a fracturing strip which is separate from the seal permits the use of one size of seal with different widths of fracturing strip to locate the seal at any desired depth. It may be necessary to insert seals at various depths beneath the upper surface of the concrete slab because of variations in the thickness of the slab or to provide for intersecting joints.

According to this invention it is possible to prepare intersecting joints in a concrete mass without cutting, breaking or otherwise interrupting either of the seals at the intersection. This is accomplished by inserting one seal at a greater depth than the other. At the intersection of the joints the upper joint or the one which is inserted last is passed through the fracturing strip of the first joint above and out of contact with the seal in the first joint. Thus both seals continue through the joint uninterrupted.

Both joints may be of the same construction or they may be of different construction. The joint forming structure of this invention is preferably utilized as the lower joint and it may also be used as the upper joint. The upper joint may be formed, for example, by sawing the concrete before it is fully cured and filling the joint with a synthetic elastomer. Other seals and/or fracturing members may be used to form the upper joint if desired. When the joint forming structure of this invention is used to form the upper joint it may be placed so that the fracturing strip extends upwardly from the seal toward the upper surface of the concrete slab, or so that the fracturing strip extends downwardly from the seal toward the lower seal. For this latter configuration the whole joint forming structure is inverted and the outer end of the central member is placed at approximately the upper surface of the concrete slab.

In cross-section the joint of this invention has a generally cruciform configuration in which the cross-members and head are formed by the seal and the leg is formed by the fracturing strip. A channel extends from the upper surface of the seal into the head and the lower edge of the fracturing strip rests in this channel. The cross-members of the seal are firmly imbedded in the concrete mass on either side of the fracturing strip. The positioning of the lower edge of the fracturing strip in the channel in the seal guides the fracture in the concrete into this channel. When the concrete contracts, causing the seal to open, the effect on the seal is to spread the channel into a V-shaped groove rather than to place the seal itself in tension. Location of the fracture to one side or the other of the head would result in placing the seal in tension when the concrete contracts. Substantial movement of the two halves of the concrete section under these conditions might result in rupturing the seal.

For the purpose of further illustration reference is made to the accompanying drawings in which:

FIGURE 1 is a perspective view in partial cross sec-

tion of a concrete slab or mass in which intersecting joints appear;

FIGURE 2 is a cross-sectional view of a concrete mass containing a joint of this invention;

FIGURE 3 is an additional cross-sectional view of the joint shown in FIGURE 2 at full contraction;

FIGURE 4 is a cross-sectional view of one embodiment of the seal of this invention; and

FIGURE 5 is a perspective view partially in cross section of a joint being inserted in an uncured concrete mass.

Referring particularly to FIGURE 1 there is illustrated a monolithically-poured concrete mass **10** having an upper surface **12** and containing a first joint **14**. Associated with first joint **14** is first fracture **16** extending downwardly from seal **18**. Seal **18** is prepared of a supple, resilient material and has an elongated configuration comprising a first horizontal arm **20** having an enlarged outer edge **22** and a longitudinally extending anchoring projection **24**. U-shaped central member **26** is connected at one upper edge to first horizontal arm **20** and at the other upper edge to second horizontal arm **30**. Central member **26** is provided in the interior thereof with an upwardly opening channel **28**. Second arm **30** is provided with an enlarged outer edge **32** and a longitudinally extending anchoring projection **34**. Elongated fracturing strip **36** is positioned vertically adjacent to seal **18** and has its lower edge **38** positioned in chanel **28**. The upper edge **40** of fracturing strip **26** extends to approximately upper surface **12**. Second joint **42** and its attendant second fracture **44** intersect with first joint **14** at intersection **43**. Second joint **42** comprises an elongated supple, resilient seal **46**. Seal **46** is provided with a first horizontal arm **48** which has an enlarged outer edge **50** and a longitudinally extending anchoring projection **52**. U-shaped central member **54** is attached at its upper outside edges respectively to first arm **48** and second arm **58**. Central member **54** is provided in the interior thereof with a channel **56** which opens upwardly. Second arm **58** is provided with an enlarged outer edge **60** and a longitudinally extending anchoring projection **62**. Fracturing strip **64** extends vertically adjacent seal **46** and has its lower edge **66** positioned in channel **56**. The upper edge **68** of fracturing strip **64** extends to approximately the upper surface **12** of monolithically-poured concrete mass **10**.

FIGURE 2 is a cross-sectional view of first joint **14** taken at right angles to elongated seal **18**. The lower surface of monolithically-poured concrete mass **10** is indicated at **13**. The upper fracture of joint **14** is indicated at **15** and the lower fracture is indicated at **16**. As shown in FIGURE 2 both upper fracture **15** and lower fracture **16** of joint **14** are completely closed.

In FIGURE 3 the joint illustrated in FIGURE 2 is shown in the fully contracted or open configuration at upper fracture **15** and lower fracture **16**. Even at full contraction the seal is not stretched but rather has only opened into a V.

A further embodiment of the seal of this invention is illustrated in FIGURE 4. Seal **70** is provided with a first arm **72** on which are provided longitudinally extending anchoring projections **74**. A first vertical side **76** is provided with a smooth exterior side which tapers downwardly to lower edge **78**. A second vertical side **80** is likewise provided with a smooth exterior side which tapers downwardly to lower edge **82**. Lower edge **78** is joined to lower edge **82**. A generally vertically extending channel **84** is defined between sides **76** and **80**. Second arm **86** is provided with longitudinally extending anchoring projections **88**.

Referring particularly to FIGURE 5 there is illustrated a monolithically-poured concrete mass **90** having an upper surface **92**. A joint-laying device **94** is provided with troweling member **96** which rides on and smooths or otherwise finishes upper surface **92**. A seal guide tube **98** is disposed adjacent to troweling member **96** and is adapted to carry a seal from above mass **90** into a position beneath upper surface **92**. A strip inserting blade **100** provided with eye **102** is adapted to carry a fracture strip from above monolithically-poured concrete mass **90** into mass **90** vertically adjacent to the seal placed by guide tube **98**. Strip inserting blade **100** and its method of operation are more particularly described in U.S. Patent No. 3,269,282, patented August 30, 1966. Joint **108** in mass **90** is composed of seal **104** and fracture **106**.

In one preferred mode of practicing this invention the apparatus for inserting the joint of this invention is positioned on a concrete finishing machine. As the finisher moves along over the surface of the monolithically-prepared concrete mass both fracture strip **106** and seal **104** are fed from rolls, coils or other suitable dispensers to the joint-laying device **94**. Seal **104** moves down seal guide tube **98** until it is in the desired location beneath upper surface **92**. Before, or as it is being discharged from guide tube **98**, seal **104** is combined with fracture strip **106**, which is fed down blade **100** and folded through eye **102**. The finishing machine smooths over the surface of the concrete mass containing the joint.

The positioning of the upper edge of fracturing strip **106** need not be accurately controlled to exactly the upper surface **92**. Since fracturing strip **106** is composed of a very supple material it will not interfere with the finishing operation even if it projects slightly above the surface **92**.

Generally both longitudinal and transverse joints are laid in monolithically-poured concrete masses. The longitudinal joints are inserted with the finishing machine and a separate operation is carried out to insert the transverse joints. In general these joints intersect one another at 90 degrees, forming a grid pattern. The transverse joints are laid as described above so that they pass above the seal on the longitudinal joint. While the transverse joints are being laid it is not necessary to stop the movement of the joint-laying device since the front part of the seal guide tube merely bends or tears a small hole in the fracturing strip of the longitudinal joint as it moves through the concrete mass. The small disturbance of the concrete upper surface caused by the insertion of the transverse joint is smoothed with a suitable troweling device preferably attached to the joint-laying device.

The fracturing strip is composed of a supple material which may be bent, twisted or folded without injury. Suitable materials from which this strip may be prepared include synthetic plastics, such as polyvinylchloride, polyurethane, polyethylene and the like. Various cloths and paper products may also be employed if desired.

The seal is composed of some water impervious, supple, resilient material which is preferably capable of being bent, twisted or folded without injury and has the ability to recover its shape quickly after the deforming force has been removed. Suitable materials include, for example, synthetic plastics, such as polyvinylchloride, polyurethane, polyethylene and the like. Preferably the water impervious material from which this seal is prepared has some elastomeric properties so that it is capable of being stretched to some extent without rupturing.

Generally the horizontal arms of the seal are provided with anchoring enlargements and longitudinal projections or ribs which are sharply angular in order to firmly anchor these arms in the concrete mass and prevent the flow of water along the surface of the seal. In contrast to this the exterior surface of the central member is preferably as smooth as possible so that it will move with ease upon the expansion and contraction of the concrete mass.

In general the central member is so proportioned that it extends downwardly for a vertical distance greater than its width. A convenient configuration for storage, transportation and handling purposes is that wherein the central member has a vertical height approximately equal to the length of one horizontal arm. The upwardly opening channel contained within the central member is so proportioned that it has a depth greater than its width. The

channel opens upwardly at about the plane of the top surface of the horizontal arms. The sides of the channel generally extend parallel to each other. The channel is quite narrow, although wide enough to receive the lower edge of the fracturing strip.

The joint forming structure may be placed in an uncured slab which extends along a steep slope. Under these conditions the finishing operation may tend to cause some of the uncured concrete near the surface to creep downslope carrying the fracturing strip with it. The channel for use under these conditions should have a depth of at least about one-quarter inch so as to retain the lower edge of the strip within the channel even though the upper part of the strip may drift downslope.

The exterior surfaces of the channel may taper downwardly to a common point or they may extend generally parallel to an end wall which terminates the central member. The configuration in which the exterior surfaces meet at a common point tends to locate the crack in the slab exactly at the center of the seal. The configuration on which the central member terminates in an end wall is advantageous when a considerable head of water is present on the upper surface of the seal. When the crack in the slab is open as shown in FIGURE 3 the water pressure forces the central member out against the walls of the surrounding cavity. The ledge in this cavity which is formed by the end wall of the central member supports this end wall against the water pressure and thus tends to prevent its rupture.

The suppleness and configuration of the seal are such that it readily lends itself to being packaged for transportation, storage and handling in reels and coils. The configuration of the fracturing strip is such that it is readily rolled into tape-like rolls for storage, transportation and handling.

The joint of this invention is particularly well suited for use in concrete lined reservoirs and canals. It has been found that in such uses these joints need not be sealed with any further material.

When the joint structure of this invention is to be placed in the inverted position with the fracturing strip extending downwardly from the seal the strip is inserted into the concrete first or at the same point as the seal and the apparatus shown in FIGURE 5 is rearranged accordingly.

Although this invention has been described with reference to concerte structures it is also applicable to other structures such as asphaltic or synthetic plastic structures.

What is claimed is:

1. The structure comprising:

a concrete slab;

a joint forming structure within said slab, said joint forming structure comprising a supple, electomeric, resilient, water impervious seal consisting essentially of a synthetic plastic material and a supple fracturing strip;

said seal having a first horizontal arm extending generally parallel to the upper surface of said slab and joined at one edge to a first vertical side, said first side extending generally vertically and being joined at its outer edge to a second vertical side, said second side extending generally vertically and being joined to one edge of a second horizontal arm, said second arm extending in generally the same plane as said first arm, and a generally vertically extending channel defined between said sides, said channel opening between said arms;

said fracturing strip being separate from said seal and extending generally vertically with one edge of said strip being positioned in said channel, said strip extending outwardly from said seal to approximately a surface of said slab.

2. The structure comprising:

a monolithically-poured concrete mass;

intersecting first and second joint forming structures within said mass, each of said joint forming structures comprising an elongated seal within said mass and an elongated fracturing strip separate from and extending outwardly from said seal;

each of said elongated seals being supple, resilient and water impervious and having two generally horizontally extending arms, a generally vertical extending U-shaped central member, the first of said arms being attached to the top outside edge on one side of said central member, the second of said arms being attached to the top outside edge on the second side of said central member, and a channel defined by said central member;

each of asid elongated fracturing strips being supple and each of said strips extending outwardly from one of said seals with one edge positioned in the channel of said seal from which it extends outwardly, said first fracturing strip extending outwardly to approximately a surface of said mass; and

said second seal passing uninterrupted through the fracturing strip of said first joint, out of contact with the seal of said first joint at the intersection of said joints.

3. The structure of claim **2** wherein the first fracturing strip extends upwardly to approximately an upper surface of said slab, and the second fracturing strip extends downwardly.

4. A joint forming structure comprising:

a supple, elastomeric, resilient, water impervious seal consisting essentially of a synthetic plastic material and a supple fracturing strip adapted to be positioned in a monolithically-poured concrete slab;

said seal having a first arm adapted to extend generally parallel to the upper surface of said slab and joined at one edge to a first side, said first side extending generally perpendicular to said first arm and being joined at its remote edge to a second side, said second side extending generally perpendicular to said first arm and being joined to one edge of a second arm, said second arm extending in generally the same plane as said first arm, and a channel defined between said sides said channel opening outwardly between said arms;

said fracturing strip being separate from said seal and adapted to extend generally vertically within said slab with the lower edge of said strip being positioned in said channel, said strip being adapted to extend upwardly to approximately an upper surface of said slab.

5. The structure of claim **4** wherein the surfaces of said arms are provided with anchoring projections and the exterior surfaces of said central member is smooth.

6. The structure of claim **4** wherein said central member extends vertically for a height greater than its width and said channel opens outwardly at about the plane of said arms and extends downwardly for a distance greater than its width.

7. The structure of claim **4** wherein the exterior surfaces of said central member taper downwardly.

8. The method of preparing a first joint in an uncured monolithically-poured concrete mass comprising:

inserting an elongated first seal beneath the surface of said uncured mass, said seal being supple and resilient and having an upwardly opening channel disposed between the edges of said seal;

inserting separately from said seal an elongated, supple first fracturing strip into said uncured mass vertically adjacent said first seal;

combining said seal and said strip within said mass by positioning the lower edge of said strip in said channel and the upper edge of said strip at approximately an upper surface of said mass to form said first joint; and

smoothing the upper surface of said uncured mass containing said joint.

9. The method of claim 8 including preparing a second joint comprising:

inserting an elongated second seal beneath the surfaces of said uncured mass at an intersecting angle to said first joint, said second seal being supple and resilient and having an upwardly opening second channel disposed between the edges of said seal;

inserting separately from said seal an elongated, supple second fracturing strip into said uncured mass vertically adjacent said second seal;

positioning the lower edge of said second strip to said second channel and the upper edge of said second strip at approximately an upper surface of said mass to form said second joint;

passing said second seal through said first fracturing strip above and out of contact with said first seal at the intersection of said joints; and

smoothing the upper surface of said uncured mass containing said intersecting joints.

10. The structure comprising:

a monolithically-poured concrete mass;

intersecting first and second joint forming structures within said mass, said first joint forming structure comprising an elongated seal and an elongated fracturing strip separate from and extending outwardly from said seal;

said seal being supple, resilient and water impervious and having two arm extending outwardly in opposite directions, a generally U-shaped central member extending generally perpendicularly to said arms, the first of said arms being attached to the outside of one side of said central member, the second of said arms being attached to the outside of the second side of said central member, and a channel defined by said central member, said channel opening outwardly between said arms;

said elongated fracturing strip being supple and extending outwardly from said seal to approximately a surface of said mass, one edge of said strip being positioned in said channel;

said second joint forming structure passing uninterrupted through said fracturing strip out of contact with said seal at said intersection.

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U.S. Cl. X.R.

52—309, 396; 94—22, 51