Sept. 13, 1938. J. HUDDLESTON 2,129,932

FLEXURE MEANS FOR CEMENTITIOUS STRUCTURES

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Fig. 1

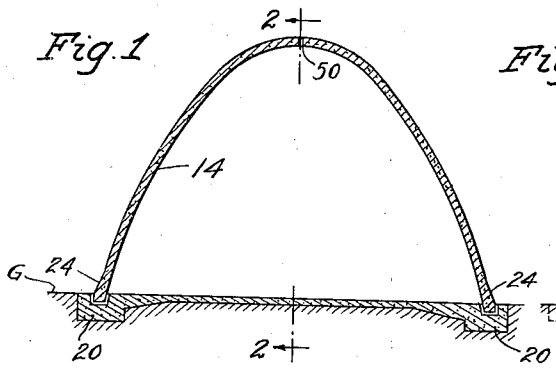


Fig. 2.

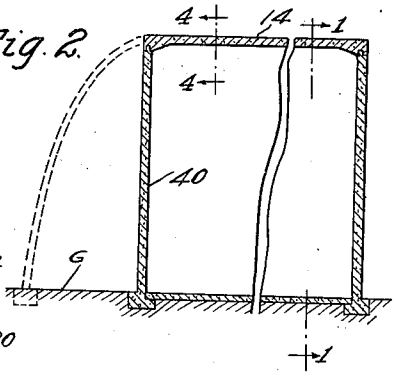


Fig. 3.

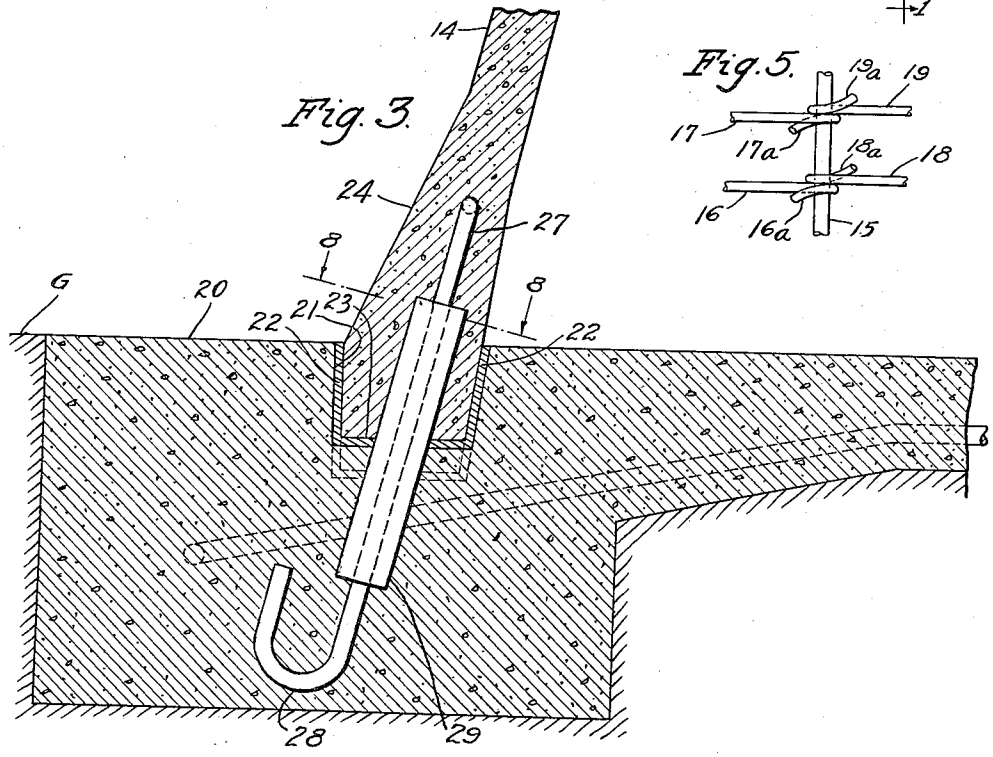
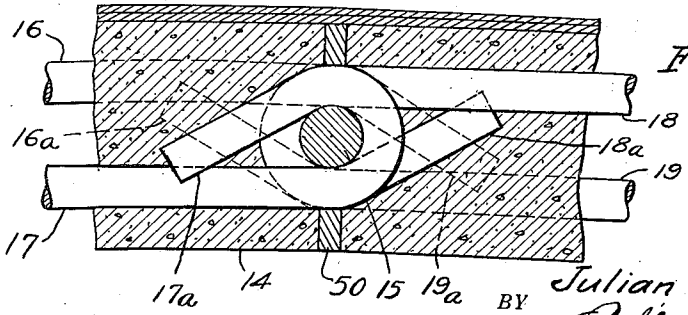


Fig. 5.

Fig. 4.



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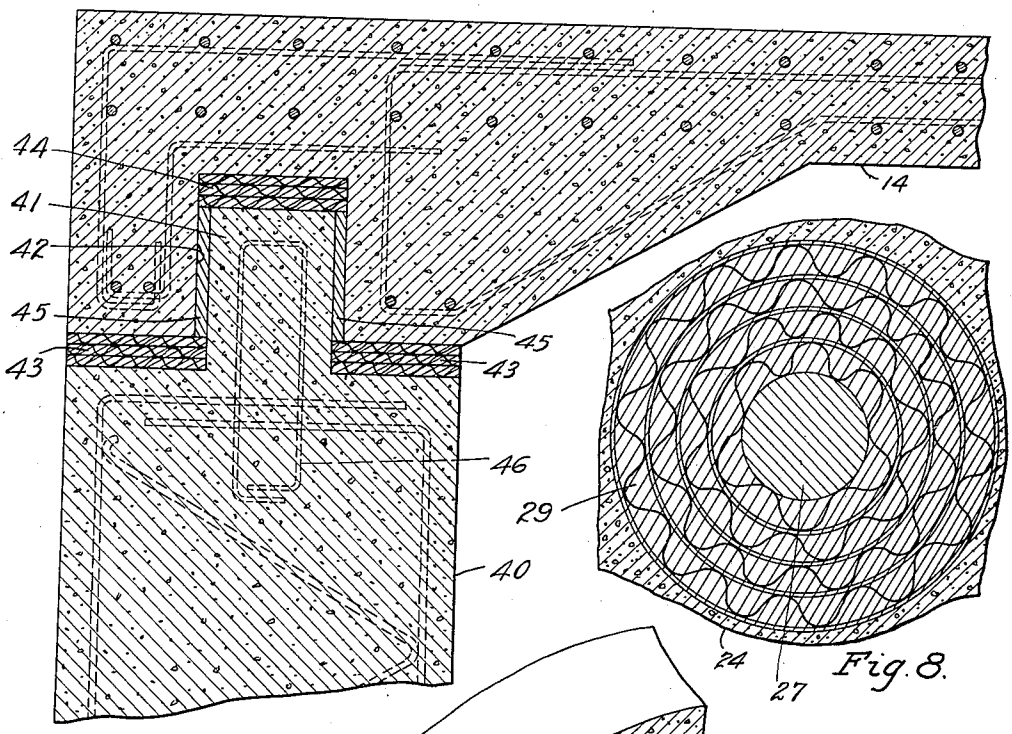


Fig. 6.

Fig. 8.

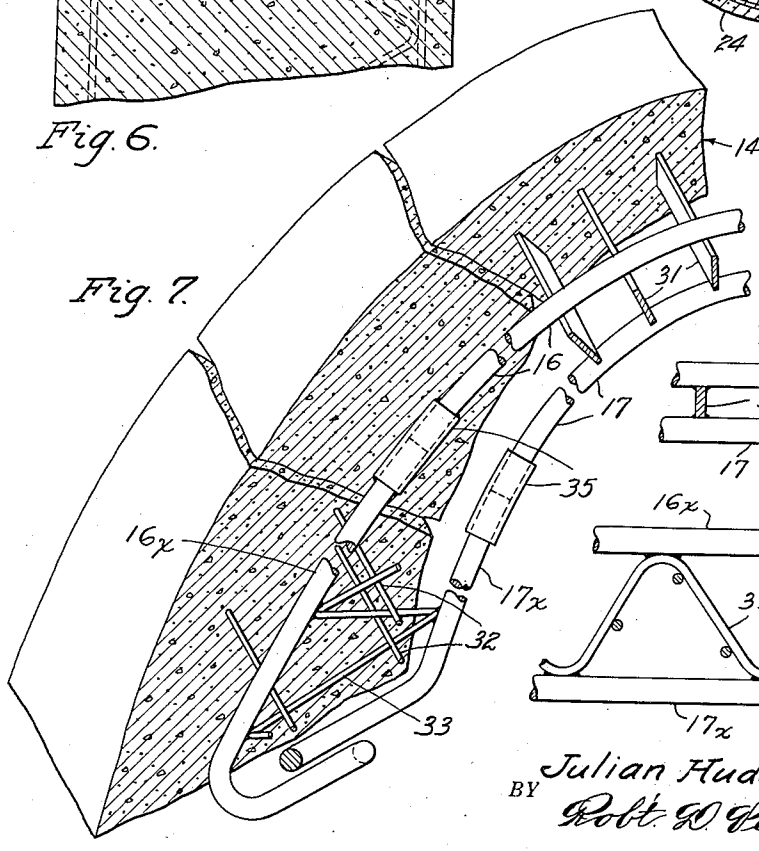


Fig. 7.

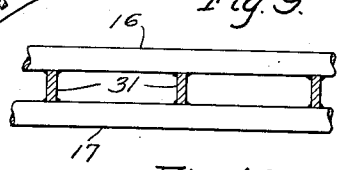


Fig. 9.

Fig. 10.

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FLEXURE MEANS FOR CEMENTITIOUS STRUCTURES

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4 Claims. (Cl. 72—77)

This invention relates to a reinforcing structure for cementitious materials.

An important object of the invention is to provide a reinforcing structure for concrete and other cementitious materials having joint portions or lines of limited flexure thus enabling the structure as a whole to accommodate itself to distortion to the extent that may be necessary to withstand earthquake shocks, compensation for unequal strains and to compensate for slight distortion because of temperature changes or other reasons.

Another object of the invention is to provide superior means for reinforcing cementitious materials of various shapes, more particularly when erected in an arch or dome or other structure having an upwardly directed convexity.

Other important features of the invention pertain to improved means for protecting a metallic rod in such a manner that the strain is distributed lengthwise thereof to a sufficient extent to prevent molecular fatigue occurring throughout a particular portion thereof and consequent weakening of the rod at such a place; to provide a superior arrangement of reinforcing elements for the cementitious material; and to provide an improved combination of highly resistant and less resistant building materials in a wall, arch or the like to give it a limited amount of flexibility without impairing its essential capacity for withstanding strain.

Other objects, advantages and features of invention will hereinafter appear.

Referring to the accompanying drawings which illustrate what are at present deemed to be preferred embodiments of the invention,

Fig. 1 is an end view of an arcuate structure constructed of reinforced cementitious material in accordance with the principles of the invention.

Fig. 2 is a vertical mid-section taken on line 2—2 of Fig. 1.

Fig. 3 is a reproduction, on an enlarged scale, of the lower left hand portion of Fig. 1, to disclose interior parts not shown in Fig. 1 on account of the smallness of the scale in the latter view.

Fig. 4 is a vertical section of the upper portion of the arcuate structure shown in Figs. 1 and 2, the plane of section being indicated by the line 4—4 on Fig. 2.

Figs. 3 and 4 are on a greatly enlarged scale as compared with the scale of Figs. 1 and 2.

Fig. 5 is a fragmental plan view illustrating certain reinforcing members shown in Fig. 4.

Fig. 6 is an enlarged sectional detail of an upper corner portion of the structure shown in Figs. 1 and 2, the scale in this view being greatly enlarged.

Fig. 7 is another view on an enlarged scale showing, partly in perspective and partly in section, the interior construction of a segment of the arcuate construction shown in Figs. 1 and 2.

Fig. 8 is an enlarged transverse sectional view through one of the anchor rods showing the means for distributing throughout a portion of the length of said rod strain which otherwise would be concentrated to too great an extent at one point in the length of said rod.

Fig. 9 is a sectional detail of the structure shown adjacent thereto in Fig. 7.

Fig. 10 shows a modification of the structure illustrated in Fig. 9.

Referring to the accompanying drawings, an important feature of the invention resides in the provision of joint or hinge portions in the cement capable of very slight flexion, these portions of cement being reinforced in such a manner as to safe-guard against the flexion being too great in extent. In Fig. 4 is illustrated the reinforcing joint or flexure afforded at the transversely extending stay rod 15 in combination with the four tension rods 16, 17, 18 and 19. Rod 18 is provided with a terminal loop portion 18*a* and adjacent to this rod and on the same side of the stay rod as viewed in Fig. 4, the tension rod 19 is provided with a like looped end portion 19*a*, both these loops passing snugly around the stay rod 15. At the opposite side of the stay rod the tension rods 16 and 17 are correspondingly provided respectively with the hooked or looped portions 16*a* and 17*a*.

The reinforcing joint structure which has just been described is located at the top of the upwardly arched structure 14 shown in Figs. 1 and 2, said horizontal stay rod 15 being imbedded in the cementitious material at the uppermost part of the arched structure. Various other reinforcing joint structures are provided at special points of strain in the cementitious structure shown in the drawings. One of these structures is shown in Fig. 3 where one limb or foot portion of the arcuate structure is shown extending below the ground level G up to which level there is imbedded a concrete footing 20 wherein a trench 21 is formed, the side portions 22 and bottom 23 of the lining within said trench being desirably composed of mastic or fibre saturated with asphalt, this material being adapted to act as a cushion to allow for slight bending movements without in-

jury to the adjacent structures. The bottom lining **23** is shown as shaped in a serrate or zigzag manner as indicated in dotted lines in Fig. 3, in order to aid in preventing longitudinal displacements of the building structure thereabove, the trench bottom being correspondingly shaped.

An upwardly and downwardly extending anchor rod **27** is shown imbedded in the foot portion **24** of the arcuate wall, said rod extending down below the bottom of the trench **21** and terminating in a hook portion **28** to anchor it more securely in the cement body **20**. The portion of said rod which passes through the trench **21** and also a portion of the rod below the bottom of said trench is surrounded by a thick sleeve **29**, the structural details of which are illustrated in Fig. 8, said sleeve functioning to distribute the strain upon a portion of the rod which it surrounds. Said sleeve **29** is made of a cellular fiber and is impregnated with asphalt, or some other material of a similar consistency, if desired.

The reinforcing structure for the fragment of the arched wall **14** shown in Fig. 7 includes the spaced, substantially parallel reinforcing metal slats **31** shown in the upper portion of the structure as being embedded at about the middle of the thickness of the wall and as extending lengthwise of the arch, that is to say, parallel to the axis of the space underlying said arch. At lower points in the wall are shown the reinforcing rods or wires **32** which also extend lengthwise of the arch and are in spaced, parallel relations to each other. Among said rods **32** and slats **31**, in a contacting relation to them is arranged in a zigzag or sinuous manner webs or tie strips or rods **33**, a part of one of these being shown in Fig. 7. The edges of the slats **31** contact with and are welded to rods **16** and **17**.

The reinforcing tension rods **16** and **17** are paired as shown in Fig. 7 and are arranged in an embedded, radially spaced relation to each other in the wall structure, and said reinforcing members **31**, **32** and **33** are shown occupying the space between these paired tension rods.

Between their angles the zigzag tie strips **33** have substantially straight runs, as shown in Fig. 7, the end portions of these straight runs being welded to the spaced apart reinforcing rods **16** and **17**. All these parts **16**, **17** and **33** are embedded in the cementitious material of the wall.

In order to facilitate construction of the wall and to maintain the strength of the wall without using inconveniently long tension rods, said tension rods are formed in sections, their lower sections **16***x* and **17***x* being shown in Fig. 7 with their upper end portions in a nearly abutting relation to the upper rod sections **16** and **17**. Splice sleeves **35** are shown at these points, each of said sleeves being welded to the rods which it encloses both above and below the slight gap between their ends, thus making said reinforcing rods continuous. Wherever any two of said metallic reinforcing members contact with each other they are welded together.

In Fig. 6 an expansion joint located at the juncture of the arch and the top of the upstanding wall **40** is shown on an enlarged scale, said joint comprises an upstanding concrete tongue portion **41** which projects into a downwardly directed groove or wall slot **42**, it being understood that both said tongue and groove extend lengthwise of the arch any desired distance. This joint is lined with fibrous material impregnated with asphaltum if desired. The shoulder portions of this layer are designated **43** and the portion of the material located between the top of the tongue and the bottom of aforesaid groove is designated **44**. Desirably, at least a single sheet **45** of the same material is located at each side of the tongue to allow a slight movement between the adjacent concrete surfaces when expansion and contraction occur. **46** designates a series of short upstanding reinforcing rods within the joint structure which has been described.

Another expansion joint is shown in Fig. 4, said joint including a layer **50** of sheet material impregnated with asphalt extending across the thickness of the wall at the point where the stay rod **15** is located, to afford a restricted hinge movement in the wall structure at this place. Other cushion means may be used at this point, if desired.

I claim:

1. A cementitious, upstanding arcuate structure having an embedded horizontally extending stay rod in its top portion, and upwardly and downwardly extending embedded tie rods in opposite side portions of the arch formed by said structure, the upper end portions of said tie rods being looped around said stay rod, there being a layer of sheet material impregnated with asphalt extending across the thickness of the wall at the point where said stay rod is located to afford a restricted hinge movement in the wall structure where said layer is located.

2. In combination, a foundation footing of cementitious material having a groove or trench therein, said trench being lined with expansion joint sheet material, an upstanding structure having a wall of cementitious material, the lower portion of said wall being located in said trench, an anchor rod which extends upwardly into said wall from said footing, and a sleeve of strain-distributing material surrounding a portion of the length of said anchor rod where the latter passes through the bottom portion of said trench, a restricted hinge action thus being provided for in the portion of said wall within said trench.

3. In a construction of the kind described, a wall structure having main reinforcing rods embedded therein in a generally approximately parallel spaced relation to each other, said rods being spaced apart in the direction of the thickness of the wall, a series of auxiliary rods passing through the space between said main rods, and a tie rod tying said auxiliary rods to each other, said tie rod extending in a zigzag direction through the cementitious material and consisting of straight runs the joined end portions of which are secured to said auxiliary rods.

4. A cementitious upstanding structure having a horizontally extending stay rod embedded in its upper portion, and upwardly and downwardly extending tension rods extending to said stay rod from opposite sides thereof and being secured to said stay rod, there being in said cementitious structure adjacent to said stay rod a body of material of a somewhat more yielding nature than said cementitious structure to permit a slight hinge action in the structure about the pivotal axis formed by said stay rod.

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