United States Patent

Younker

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[54] CONCRETE STRUCTURAL MEMBER

[72] Inventor: **George C. Younker,** 301 Nittany Drive, Monroeville, Pa. 15146

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[51] **Int. Cl.** **E01c 23/16**

[58] **Field of Search** 94/1.5, 31, 4, 1

[56] **References Cited**

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Primary Examiner—Jacob L. Nackenoff
Attorney—Parmelee, Utzler & Welsh

[57] **ABSTRACT**

A concrete structural member and method of forming same is disclosed. The member, which may be used in forming roadway and bridge guard rails, median barriers and the like, includes a pair of identically shaped, pre-cast, outer face members or shells spaced from each other with their inner faces confronting each other. The outer surface of each shell has a contour which, when the members are together, defines the desired structural shape. A core of solid material, such as concrete, is bast between the shells to thereby form a composite integral structure with the shells.

16 Claims, 5 Drawing Figures

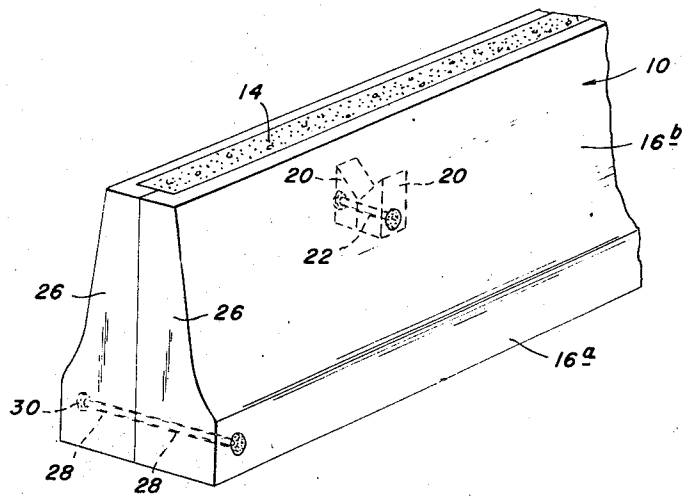

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FIG. 1

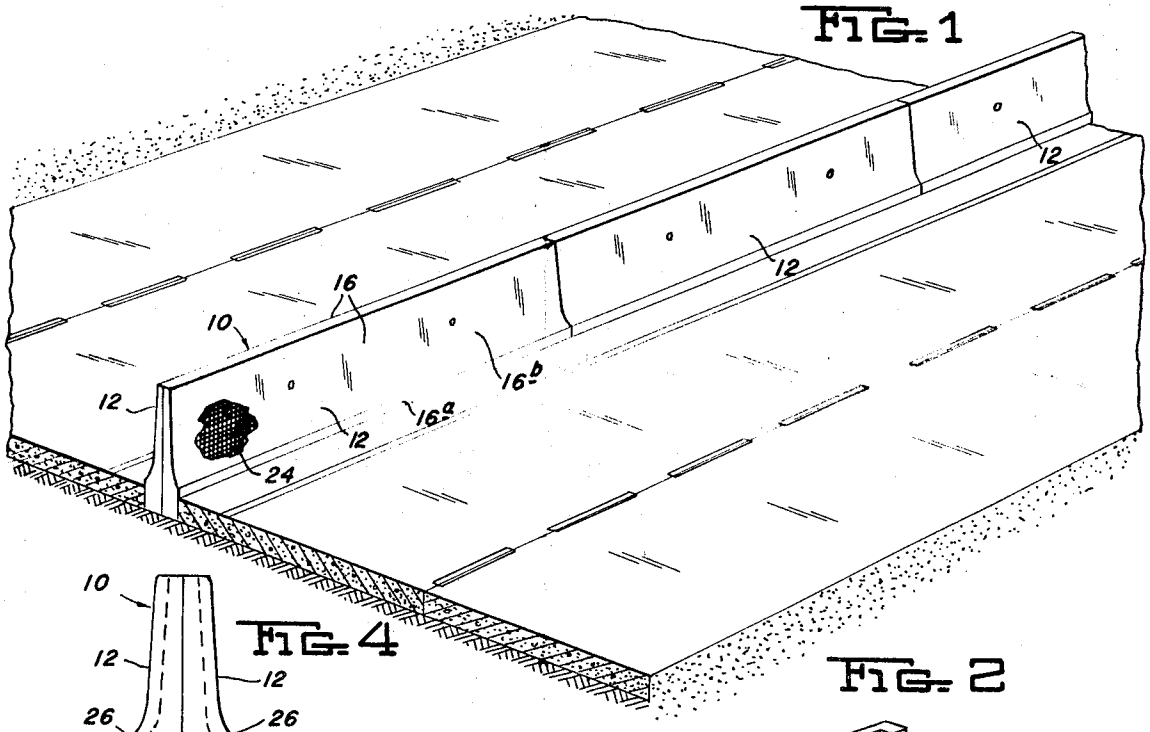


FIG. 4

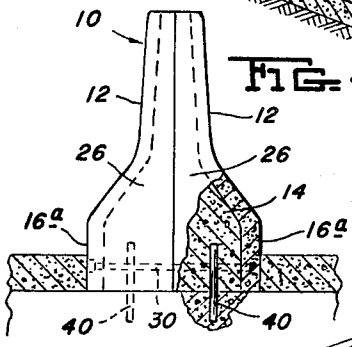


FIG. 2

FIG. 3

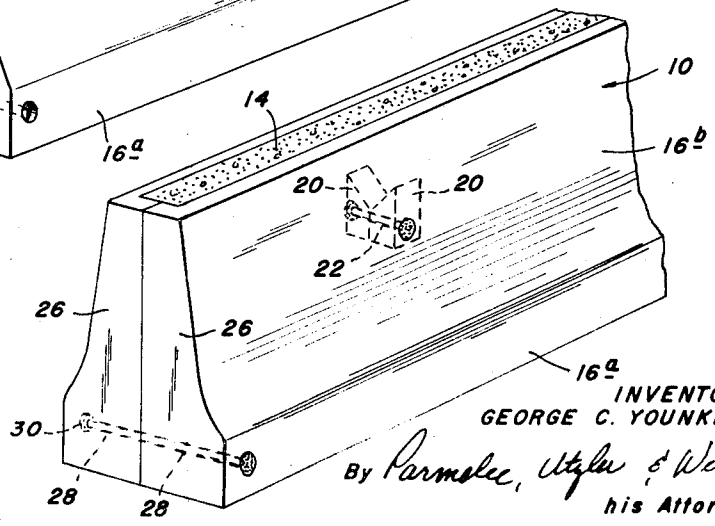
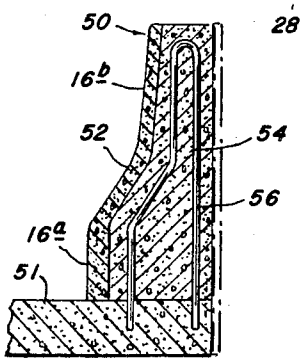


FIG. 5



INVENTOR
GEORGE C. YOUNKER
By Parmelee, Utley & Welsh.
his Attorneys

CONCRETE STRUCTURAL MEMBER

This invention relates to a structural member and method for forming same, and particularly to a concrete structural member as would be used in forming roadway and bridge guard rails, median barriers, and the like.

Roadways and bridges are frequently provided with side guard rails and median barriers for the safety and protection of automobiles traveling over them. Such rails and median barriers may be formed of preformed steel bars, wire cables, link fences, and the like, supported on spaced posts or pedestals, or entirely of concrete. The tendency, however, is more towards the all steel bar and post type rails and barriers, mainly because the concrete rails and barriers have become considerably more expensive than the steel. One place where concrete structures could conceivably compete in price with the steel structures would be where expensive box-type steel median barriers are required by state law, as, for example, where the median width between roadways is narrow (e.g. 16 feet or less). The same would hold true with regard to the side rails or parapets used on bridge decks, where combination pre-cast and cast-in-place concrete structures could, if properly constructed, effect more economical construction practices.

Various concrete structures and methods of forming those structures are being used or have been proposed, but none of them so far have been able to be priced competitively with any of the existing type of steel rails and barriers. One method currently used is to form the structures in place by setting up forms and pouring the concrete at the construction site. The labor cost for casting-in-place is very high, as is the material cost especially where it is required that white concrete be used for the median barriers and rails. Additionally, some states require that the mixers for pouring the concrete on road construction jobs be used exclusively for that job. In other words, a mixer truck on a road job may only be used for that job even if the job might be stalled for a time period. Such exclusive use of the mixers is costly and increases the guard rail and median costs. Casting-in-place is also very slow, requiring careful and time consuming set-up and placement of the forms in order to achieve a smooth face on the oddly shaped structures. Daily production of the cast-in-place structures is also restricted due to the set-up time involved, which often discourages the use of concrete barriers when a job is rushed.

Pre-casting of solid concrete barriers has been proposed, but, as with cast-in-place, also is expensive and is not competitive in price with steel structures. The weight of a pre-cast barrier section would be extremely high and thus would not allow shipping of any appreciable quantity of sections. The shipping charges would considerably increase the per unit cost of each section. In addition, the weight of the solid sections would require large handling equipment, not ordinarily available at a road job site. Also, the difficulty in handling the heavy sections would make alignment rather time consuming. Although a pre-cast solid section could conceivably use a white concrete outer skin with a less expensive gray concrete core, this would require two concrete mixtures and extra operations in the casting procedures. The cost saving of a white concrete outer skin and gray concrete core structure would probably be outweighed by the labor costs in the casting. Finally, pre-cast solid structures would be very difficult or even impossible to use in reconstruction of existing road pavements where dowels would be required for anchoring the structures.

It would be conceivable to use a continuous slip-form method for constructing solid concrete barriers and guard rails. With such an approach, a machine would move along while concrete was poured into a form carried by the machine. However, no such machine is available, and the cost to develop one would be excessive. Even if a slip-form machine were available, extensive preparation work would be required to result in satisfactory alignment of the structure being cast. Also, the placement of transverse joints, especially with expansion material, would be very difficult. With median barriers, the peculiar shape does not readily lend itself to economical sawing of joints, while scoring the joints in the fresh concrete would be extremely difficult while maintaining high quality workmanship. Finally, the structures would not economically lend themselves to being slip-formed with a gray concrete core where white concrete faces are required since that would necessitate two slip-form machines.

I overcome the above mentioned problems with regard to concrete median barriers and guard rails by providing a structure, and a method for forming that structure, which is competitive in price with certain type steel structures. More particularly, I provide a structural member for use in forming roadway and bridge guard rails, median barriers, and the like, which comprises, preferably, a pair of identically shaped outer face members spaced from each other with their inner faces confronting each other, and with the outer surface of each having a contoured shape such that together the pair of outer members define the desired structural shape; and an inner core of solid castable material adhered to the inner faces of both of the outer face members, thereby forming a composite integral structure with the outer face members. Thus, the outer shell of my structure could be pre-cast with white concrete, for example, using a single mixer, whereby the forms could be placed in a horizontal position making casting of the structure simple and their quality easy to ensure. Production of the shells could be at a rate considerably higher than a solid structure, and the lighter weight of the shells would permit shipping of much larger loads than would be permitted with the solid concrete pre-cast structure. The light weight shells could be easily handled at the job site without the need for special handling equipment. Positioning of the shells would be relatively easy because of their light weight, and expansion material when required could be simply placed. The shells would be positioned, and gray concrete, for example, poured in between them to form the cores, and for all practical purposes the job would be completed except for troweling and field curing a small exposed top surface area. Thus, much longer lengths of work could be completed in a single day as compared with pre-cast and cast-in-place structures. A minimum amount of site work is required in forming the structure of my invention, which becomes especially significant where a project is under traffic. Also, my structure is particularly adaptable to reconstruction work on existing road pavements where doweling is required since the dowels would be placed in holes formed in the existing pavement and positioned within the confines of the shells and secured by the core after it is cast.

All of the above factors regarding the structure of my present invention diminish its price and render it competitive with certain steel structures being used. The ease of handling and capability of being used on reconstruction jobs also makes its use attractive.

Other details and advantages will become apparent upon the reading of the following description taken together with the accompanying drawings in which:

FIG. **1** is a perspective view showing a general arrangement of one form of the invention as used for a median barrier on a dual highway;

FIG. **2** is an exploded perspective view of the outer face members of shells of the median barrier of FIG. **1**, and forming part of the invention, with the shells being separated to show details of construction;

FIG. **3** is a perspective view of a fragmentary section of the median barrier of FIG. **1**, to show details of construction;

FIG. **4** is an end elevational view, partly in section, through a median barrier embodying the invention, showing the composite structure together with dowel pins in elevation as would be used when the median barrier is used on an existing road; and

FIG. **5** is a sectional view taken through a guard rail or a parapet embodying the invention as used on a bridge deck, showing a reinforcing member in elevation and the composite structure of the parapet.

Referring now to the drawings, and particularly to FIGS. 1–3, the concrete structural member of my invention is shown as a median barrier generally designated by the numeral **10**, as would be used for separating lanes of traffic moving in opposite directions. The median barriers **10** are shown in FIG. **1** as they would be positioned during construction of new road, that is, with the base of the barrier resting on the sub-surface with the road pavement extending to and contacting the opposite lower sides of the barrier. Each section of median barrier **10** includes a pair of identically shaped concrete outer face members or shells **12** and a core **14** of solid castable material such as concrete adhered to the inner faces of both of the shells to thereby form a composite integral median barrier structure with the shells. Each shell **12** is separately formed by casting with concrete, and has a relatively thin side wall as compared with the overall thickness of the composite median barrier. Each shell **12** has a smooth outer surface **16** with a generally straight lower section **16*a*** and a smoothly curved upper section **16*b***. The inner surface **18** of each shell **12** has essentially the same contour as the outer surface **16** but is finished with a rough texture and includes a pair of longitudinally spaced bosses **20** having bolt holes therethrough for receiving the bolts **22** which secure the pair of shells **12** together prior to casting the core **14**. The shell **12** is also provided with welded mesh wire fabric **24** for giving reinforcement thereto. Each shell **12** is formed with transversely extending end pieces **26** so that when a pair of shells is mated solid ends are formed. A bolt hole **28** is formed through a lower portion of each of the end pieces **26** for receiving a tie bolt **30** which together with tie bolts **22** secure the shell **12** halves together.

Shells **12** are pre-cast and may be formed of white concrete which would be the case when installing median barriers in states which require white concrete barriers for visibility reasons. The shells **12** may be cast away from the job site and easily shipped in, since their weight is relatively light, as compared with a solid pre-cast barrier. At the job site the shells **12** would be positioned on a firm base and the tie bolts **22** and **30** extended through the shells to secure them together. The heads of the tie bolts **22** and **26** and the nuts would be disposed in countersunk openings which would be closed with white grout or white plastic inserts. When the shells **12** are finally positioned, the cavity therebetween is filled with castable material, such as gray concrete, to form the core **14**. The gray concrete is poured to the top of the section. After sufficient hardening of the concrete forming the core **14**, the top surface is troweled and properly cured. The tie bolts **22** extending through the formed core **14** remain in place to serve as reinforcement for the structure.

The outer shape of the median barrier **10** as defined by the outer surfaces of the shells **12** is a shape commonly used. Any other shape could be provided where desired or required by state law. The median barrier **10** would have an over-all height of about 41 inches with about 32 inches being above the road surface. The width of the barrier at the base would be about 24 inches and about 7 inches at the top. The thickness of each shell **12** would be determined on the basis of convenience of handling the shells. In other words, the shell **12** should be thick enough so that it could be handled without cracking. Thus, a shell **12** having a thickness of around 2 ½ inches at the base tapering to a thickness of around 1 ½ inches at the top should be sufficient for normal handling. The length of each shell **12** would be determined by the required section length. Each section of shell **12** could be anywhere from 10 to 30 feet long.

Multiple sections of shell **12** pairs could be positioned and secured together before the cores are cast. In the event that expansion material is required between the sections, placement would simply be made between end pieces **26** of successive sections of the median barrier.

FIG. **4** shows a transverse section of a median barrier **10** as it would be emplaced on an existing road pavement, as when the road is re-paved. In such a case, holes would be drilled in the existing pavement and dowels **40** placed in the holes. Shells **12** would be secured by tie-bolts **22** on the existing pavement and concrete poured inside the shells to form a core **14**. The core **14** would cure around the dowel **40** and be thus firmly secured to the pavement. The re-paved road surface would be layed up to the lower section **16*a*** of the outer surface of each shell **12**. The overall height of the median barrier as used with existing roads would be less than those used on new road construction. The height above the re-paved road surface would, however, be the same as with a new road construction.

FIG. **5** shows my invention as it could be used as a bridge deck parapet. The parapet **50** would be formed in section on the bridge **51**, much the same as the median barriers, with each section having a single shell **52** with an outer face (i.e. the face looking toward the center of the bridge deck) shaped to a desired configuration. A core **54** would be formed around a reinforcement bar **56** anchored to the bridge deck **51**, by positioning the shell **52**, in its desired final position and positioning a removable form along the outer side edge of the deck. Gray concrete or any other suitable material, would then be poured to form the core **54**.

As mentioned earlier, the structure of my invention is considerably lower in price as compared with a solid pre-cast or cast-in-place like structure. My structure is thus competitive in price with steel structures; similarly used. In addition, my structure provides additional cost savings in maintanence over steel median barriers and guide rails, in that dirt and debris cannot collect under my structure as it can under steel barriers and rails. Another cost consideration in using concrete median barriers is the savings in pavement material which would be realized as compared to when steel barriers are used. For example, the roadway is completely paved and then the parts for supporting the steel rail are driven through the pavement material. When using concrete median barriers, no pavement material is wasted since the barrier is first positioned and then the pavement is layed up to the side of the barrier.

Although the above descriptions have been made in reference to median barriers, guard rails and parapets, it is to be clearly understood that this invention is not limited to those structures. For example, my invention is equally applicable to use in planters, safety barriers for appurtenant structures along roadways, or, for example, bridge piers, bridge abutments, sign posts and the like, as well as for other constructions which those skilled in the art will readily recognize.

While I have shown and described a present preferred embodiment of this invention and have illustrated a certain present preferred method of practicing the same, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

I claim:

1. A structural guard member comprising:

a. at least one elongated, relatively thin outer shell member preformed of reinforced concrete and having an outer surface defining an outer peripheral shape of a desired structure, said shell member having end flanges of a height substantially the same as the side thereof with the flanges being adapted to abut with another form member to form a space for receiving a filler of castable material;

b. an inner core of solid castable material adhered to the inner face of and forming a continuation of said shell member;

c. said shell member having an average thickness considerably less than the average thickness of the overall composite structure of said shell member and said inner core such that said shell member would not, standing alone, be of sufficient strength to withstand impacts from moving motor vehicles.

2. The concrete structural member as set forth in claim **1** including a reinforcing means within said core.

3. The concrete structural member as set forth in claim **1** including a pair of elongated outer shell members spaced from

each other with their inner faces confronting each other, with the outer surface of each shell member shaped to define a desired structure; each of said shell members having end flanges of a height substantially the same as the sides thereof with the flanges adapted to abut each other such that a space for receiving a filler of castable material is defined between said shell members; and wherein said core is adhered to each inner face of both of said shell members.

4. The concrete structural member as set forth in claim 3 including rod means extending between both of said shell members and through said core for holding said shell members together prior to casting of said core and for reinforcing said core.

5. The concrete structural member as set forth in claim 1 wherein said core is formed from concrete.

6. In combination with a bridge deck, a parapet structure comprising:

a. an elongated relatively thin outer shell member preformed of reinforced concrete and having an outer surface defining the desired shape of the inner face of the parapet and disposed inwardly adjacent the bridge deck; said shell member having end flanges of a height substantially the same as the side thereof with the flanges adapted to abut with another form member to form a space for receiving a filler of castable material;

b. a core of solid castable material adhered to the inner face of and forming a continuation of said shell member and extending substantially to the side of the bridge deck;

c. reinforcing means secured at one end to the bridge deck and extending upwardly into said core; and

said shell member having an average thickness considerably less than the average thickness of the overall composite structure of said shell member and said inner core such that said shell member would not, standing alone, be of sufficient strength to withstand impacts from moving vehicles.

7. The combination as set forth in claim 6 wherein said core has the side thereof opposite said shell member lying in a vertical plane including the side of the bridge deck.

8. The combination as set forth in claim 6 wherein said core is formed of concrete.

9. A median barrier along the center of a road constructions comprising:

a. a pair of identically shaped relatively thin outer shell members preformed of reinforced concrete and spaced from each other with their inner faces confronting each other, and with the outer surface of each outer face member having a contoured shape such that together the pair of shell members define the desired median barrier shape; said shell members having end flanges of a height substantially the same as the sides thereof with the flanges of both shell members being adapted so abut each other whereby a space is formed between the shell member for receiving a filler of concrete;

b. an inner core of solid concrete adhered to the inner faces of both of said shell members, thereby forming a composite integral structure with said shell members;

c. each of said shell members having an average thickness considerably less than the average thickness of said composite integral structure such that said shell members either standing alone or together would not be of sufficient strength to withstand impacts from moving vehicles.

10. The median barrier structure as set forth in claim 9 including reinforcing means extending upwardly into said core from beneath said core to a point at least intermediate the lower and upper ends of said core.

11. The median barrier structure set forth in claim 9 including rod means extending between both of said shell members and through said core for holding said shell members together before said core is cast and for reinforcing said core.

12. The method for forming a structural guard member comprising:

a. supporting at least one elongated relatively thin, reinforced concrete outer shell member having an outer surface and end flanges of equal height, said outer surface being shaped to define an outer peripheral shape of a desired structure on a surface with which the structural member will become part of;

b. positioning another form member opposite to the outer shell member and abutting said flanges to define a hollow area for receiving a castable material therebetween;

c. casting a material into the hollow area between the outer shell member and the other form member to form a core integral with at least the outer shell member; and at least said outer shell member having an average thickness considerably less than the average thickness of the overall composite structure of said outer shell member and said other form member such that said outer shell member would not, standing alone, be of sufficient strength to withstand impacts from moving vehicles.

13. The method as set forth in claim 12 wherein said positioning is of another identically shaped outer shell member.

14. The method as set forth in claim 13 including the step of securing with rod means the oppositely arranged outer shell members.

15. The method as set forth in claim 12 including the step of removing the form member after the core has at least set.

16. The method as set forth in claim 12 wherein said casting of the core is preformed with concrete.

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