Aug. 12, 1969 U. FINSTERWALDER ET AL 3,460,446

BRIDGE TYPE HIGHWAY OF REINFORCED OR PRESTRESSED CONCRETE

Filed Oct. 18, 1967 3 Sheets-Sheet 1

Fig. 1

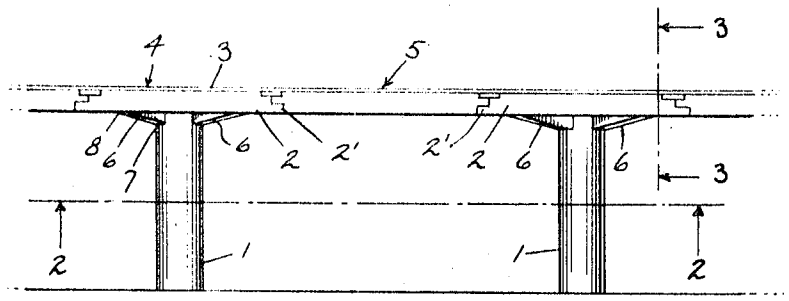


Fig. 2

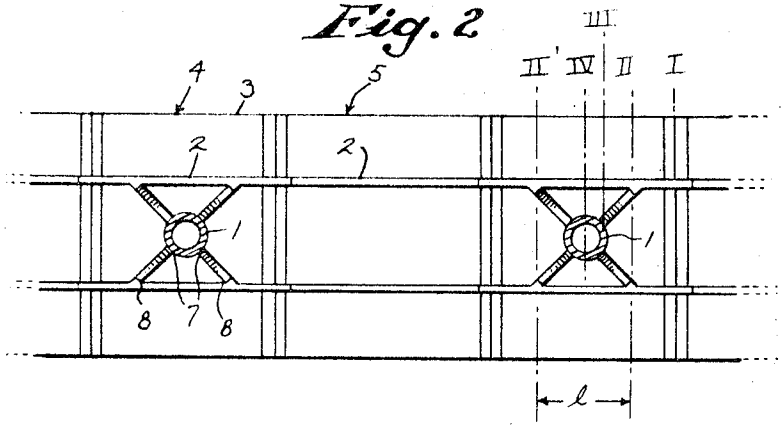
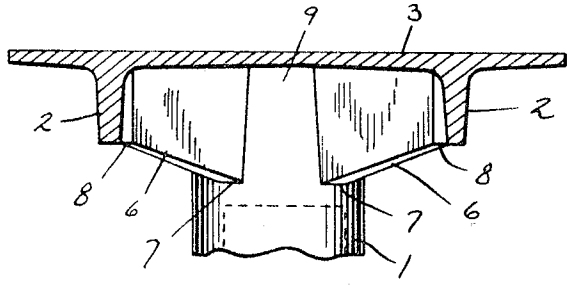


Fig. 3



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Fig. 4

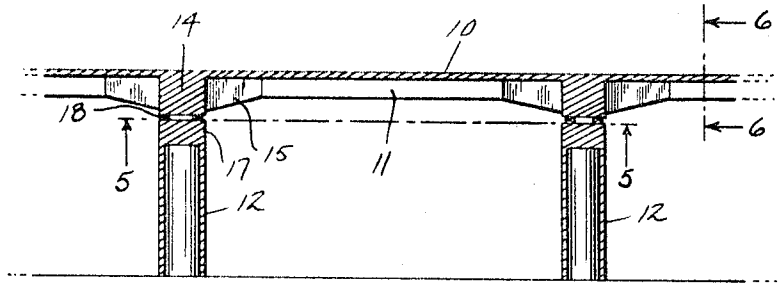


Fig. 5

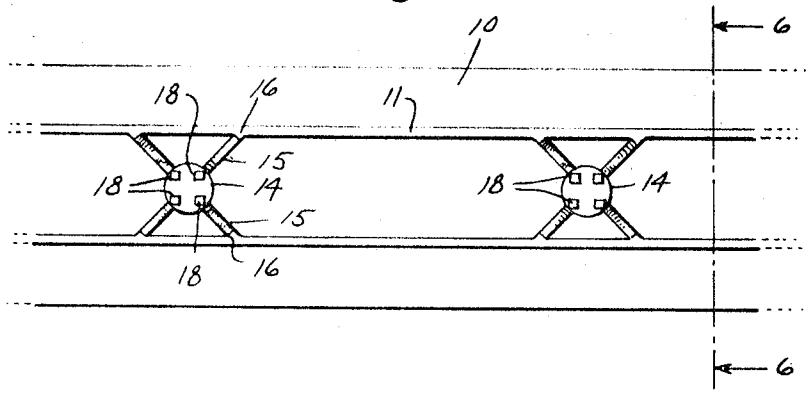
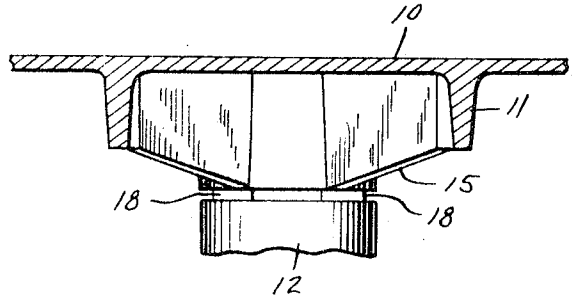


Fig. 6



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Fig. 7

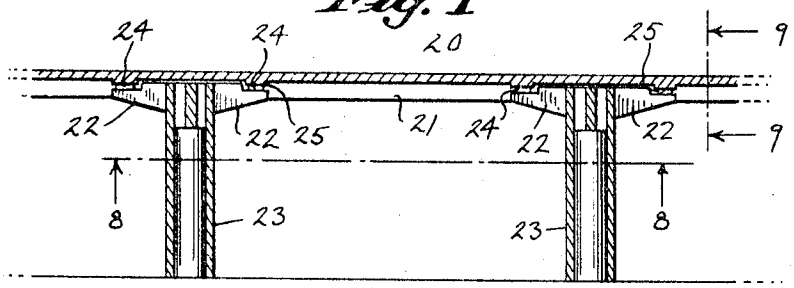


Fig. 8

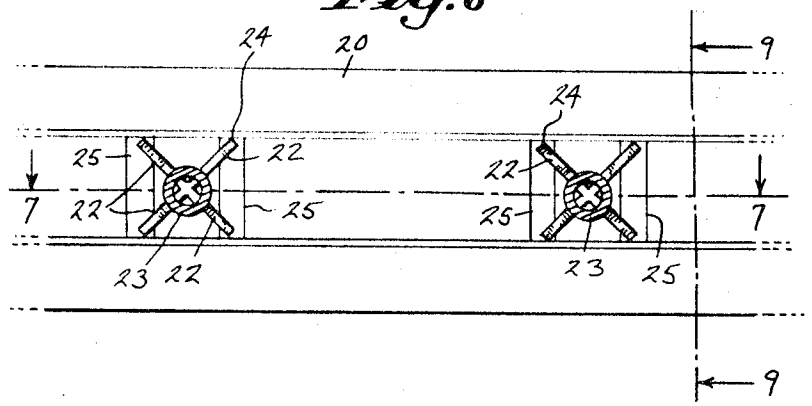


Fig. 9

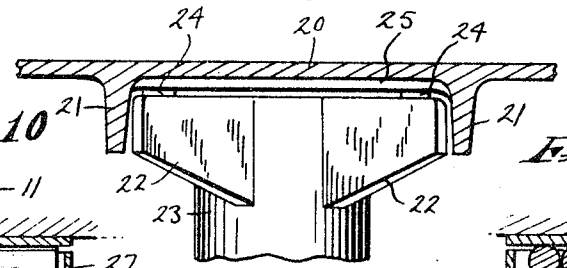


Fig. 10

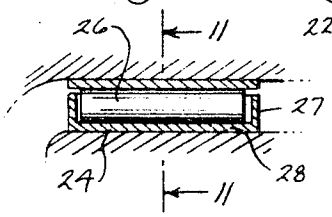
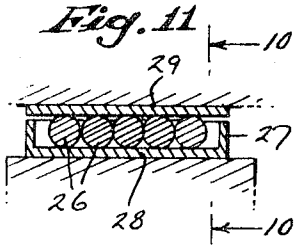


Fig. 11



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United States Patent Office 3,460,446 Patented Aug. 12, 1969

3,460,446

BRIDGE TYPE HIGHWAY OF REINFORCED OR PRESTRESSED CONCRETE

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Int. Cl. E01c 1/00; E04b 1/00
U.S. Cl. 94—1 4 Claims

ABSTRACT OF THE DISCLOSURE

Elevated highway structure or bridge where columns support diagnoally extending beams which decrease in thickness outwardly from the columns and that support parallel girders carrying the runway.

BACKGROUND OF THE INVENTION

The present invention relates to concrete highways. More in particular, the invention relates to an elevated highway constructed in the manner of a bridge of reinforced or prestressed concrete having support structures such as columns disposed along the longitudinal axis of the bridge and a superstructure in the form of a runway which is carried by two longitudinal girders disposed laterally of the columns at a distance therefrom.

DESCRIPTION OF THE PRIOR ART

An elevated highway is known from U.S. Patent No. 2,225,186 where transverse beams extend from the individual columns disposed in the direction of the longitudinal axis of the bridge which merge with the longitudinal girders that are disposed at a distance laterally of the columns. A reinforced concrete plate spans this supporting structure. This highway is so constructed with respect to its static concepts that the superstructure of a section is connected with the supports that limit this section and projects beyond these supports into the adjacent areas, where the points of the cantilever arms constitute supporting locations for a suspended carrier arranged centrally of the adjacent sections.

In its cross section this known highway is designed in accordance with the principle of the plate girder or beam. The plate girder is a very advantageous form of construction in reinforced and prestressed concrete building art and is therefore widely used. Its greatest advantages are inherent in bending components which are subjected to positive moments. In this connection the upper plate constitutes the pressure zone, while the tension members can be arranged to be concentrated at the lower end of the supporting span. These advantages, however, fail as soon as continuous bridge or highway structures are to be constructed with plate beams. Considerable negative moments arise there at the supports or columns which cause tensile stresses at the upper side or top and pressure stresses at the bottom or lower side. These presure stresses, however, cannot be absorbed by the very small carrier or supporting span. It is therefore necessary to either abandon the principle of the plate beam in the area of the supports or columns and provide a lower pressure plate which approaches the form of construction of a hollow casing or to reinforce the plate beam in such a manner that it is capable to absorb the pressure stresses that result from the negative moments. This can be done by means of vaulted or arched configurations either vertically in the sense of an increase in the structural height or horizontally in the sense of a broadening or widening of the supporting bridges.

All of these measures which have to be undertaken in connection with plate beams in order to absorb the negative moments arising in the supporting area of the continuous girders require not only a considerable expenditure as regards forms or casings, but they interfere with the supporting characteristics and affect the aesthetic appearance of the bridge.

SUMMARY OF THE INVENTION

The invention is based on the problem of finding a possibility in connection with a bridge-type highway that is built in accordance with the principle of the plate beam to transfer the supporting moments in a statically improved and economically more favorable manner than has been possible heretofore with known forms of construction.

In accordance with the invention, this problem is solved in a bridge-type highway of reinforced concrete or prestressed concrete where the supporting columns are arranged along the central longitudinal axis of the bridge and a super or top structure in the form of a roadway plate which is supported by longitudinal girders disposed at a distance laterally from the supports or columns in that the runway plate is thickened in the area of the supporting means to form a substantially massive block from which extend four diagonal supporting beams which merge into the longitudinal girders. These beams suitably increase in structural height from the abutment joints or intersections at the longitudinal girders to the abutment joints or intersections with the block.

The primary advantage of the bridge or elevated highway construction in accordance with the invention resides in that the essential maximum negative moment for computing the longitudinal girders constructed as plate supporting beams is not attained first in the cross section of the support but already in that cross section where the beams that extend diagonally from the support join or merge with the longitudinal girders. In the actual support region between the sections determined by these joints on both sides of the supports the supporting moment remains constant. In this manner it is made possible that the relatively narrow longitudinal girders where they pass through the support section can be of the same height and width as in the area of the normal panel or section. The unattractive vaultings or arch configurations which present considerable technical casing or form problems are avoided. The moment of support rather is again restored in the beam from the joint of the diagonal beam with the longitudinal girder to the joint at the support or column. In these short beams which can without difficulty also be arched, this moment of support can be more readily absorbed and passed on to the support or column.

The development of a bridge-like highway, not considering the construction of the superstructure, with two main girders running in the direction of the longitudinal end of the bridge and individual supports arranged at the axis of the bridge, is not restricted to any specific static system. Thus, the superstructure may be as a continuous girder that is supported to be horizontally movable on the individual pillar-like columns in a manner that bearing support is obtained for a live load. The superstructure may also be constituted in a known manner by individual roadway sections which cantilever out from column supports and are separated from one another by expansion gaps. Furthermore it is possible in a known manner to provide roadway sections that are in the form of suspended girders between the roadway sections cantilevering out from the columns. With all these forms

of construction the expansion gaps may be constructed in accordance with proven methods.

BRIEF DESCRIPTION OF DRAWINGS

Further objects and advantages of the invention will become apparent from the following description with reference to the accompanying drawings illustrating several embodiments of the invention, and in which:

FIG. 1 is a side view of a bridge-type highway with roadway sections supported by central columns between which bridge sections are arranged in the manner of suspended girders;

FIG. 2 is a bottom view of the highway illustrated in FIG. 1;

FIG. 3 is a section taken along the line 3—3 in FIG. 1;

FIG. 4 shows a different embodiment of a bridge supporting structure having a superstructure in the form of a continuous suspension girder;

FIG. 5 is a bottom view of the structure in accordance with FIG. 4 with the section taken along line 5—5 in FIG. 4;

FIG. 6 is a sectional view of the structure taken along line 6—6 in FIG. 4;

FIG. 7 shows another embodiment of the invention with a continuous suspension girder that is supported on the cantilever beams of the columns with bearing rollers therebetween;

FIG. 8 is a bottom view of FIG. 7 taken generally along line 8—8;

FIG. 9 is a sectional view of the superstructure as supported on the columns, taken along line 9—9 in FIG. 7; and

FIGS. 10 and 11 illustrate the bearing rollers on which the continuous suspension girder constituting the superstructure is supported as shown in FIGS. 7–9.

DESCRIPTION OF THE INVENTION

In the embodiment illustrated in FIGS. 1–3 the bridge-type highway in accordance with the invention consists of columns **1** disposed at such a distance from one another as corresponds to the span to be bridged, and of the superstructure extending over it. The superstructure is composed of two longitudinal girders **2** disposed at a distance from each other laterally of the columns **1** and a top runway plate **3**. The longitudinal girders of the highway sections **4** which cantilever out from the columns present ledges at the ends on which the suspended girders defining the highway sections **5** are supported by means of corresponding projecting ledges.

Short beams **6** cantilever out from the columns **1**, which at the joint **7** in the column may be of greater height than at the joint **8** where they merge with the longitudinal girders **2**. The column head or the area below the roadway plate **3** is suitably of massive construction in order to insure of a satisfactory support for the moments that are conducted by the cantilever beams or arms **6** to the column. The same effect may also be obtained if the cross-section is distributed or spread out over a larger area.

In the static system of a cantilevering mushroom illustrated in the embodiment at the opposite borders of which suspended supports are disposed, the magnitude of the supporting moments is limited by the choice of the joint locations. The bending moments here begin at the ends of the cantilever arms or beams of the mushroom construction with zero and increase in the direction of the column. The cantilever moments reach their highest value at the cross-section that is defined by the mergings of the cantilever beams **6** with the longitudinal girders **2**. In the area of the stretch L of the longitudinal girders **2** that is disposed between these two sections the negative supporting moment remains constant. In fact, it restores itself again in the supporting arms or beams **6** in the direction of the column. In order to construct the absorption of the bending moment in these cantilever beams **6** more economically, they can be constructed in a manner that the height increases in the direction of the column.

The explanation of the highway construction in accordance with the invention with reference to the embodiment described above is only one of many possible embodiments. The superstructure may also be in the form of an uninterrupted supporting girder, if a horizontal section is passed through the columns below the superstructure and the superstructure is supported in a horizontally displaceable manner by means of a substantially massive block **9** on the supporting column. This may be accomplished with a four-point bearing support known per se, by means of which bending moments are absorbed as long as the resultant of the dead weight of the live load of the traffic still remains within the core.

Such an embodiment is illustrated in FIGS. 4 to 6 where a bridge supporting structure has a superstructure with a continuous suspension girder. Also here the superstructure comprises a roadway plate **10** which is supported on or carried by continuous longitudinal girder **11**. In the region of the columns **12** the roadway structure is thickened to define a block **14** which corresponds in form and dimensions to the columns, and from which cantilever diagonal short cantilever beams which at **16** merge with or join the longitudinal girders **11**. Between the block **14** and the head of the column **12** which is also thickened to form a massive block **17** bearing components **18** are located.

These bearing components which are also used in the embodiment of the structure in accordance with FIGS. 7 to 9 are shown to an enlarged scale in FIGS. 10 and 11. This type of support structure is known per se. Four multi-roller bearings are built in at each supporting column head which permit a horizontal movement. By virtue of their planar construction and their arrangement in a plane it is nevertheless possible to a certain degree to transmit encastre moments or moments at points of fixation. To be sure, moments can be transmitted as long as the eccentric loads on the bridge do not become so great that lifting from one pair of bearings and whence tilting of the bridge structure occur. While this type of support is known, the manner of building the superstructure in the region of the column head with the cantilever beams **15** in accordance with the present disclosure is new.

FIGS. 7 to 9 illustrate a further embodiment of the invention. Also here the roadway plate 20 extends with its longitudinal girders **21** through several spans. However, in contrast to the construction in accordance with FIGS. 4 to 6 the cantilever arms or beams **22** are connected to the columns **23** in a manner to resist bending, thus realizing in the head of the column a type of construction referred to as loose or distributed. The head of the column is not massive or solid, but the cantilever beams intersect centrally of the column.

The bearing supports of components **24** are here disposed at the ends of the cantilever beams **22**. They are constructed in the same manner as shown in FIGS. 10 and 11. The runway plate **20** is provided with thickening or strengthening ribs **25** in the areas of the supports in order to improve the bearing conditions. This form of construction affords the advantage of greatly enlarging the width of the support as compared to the embodiment of FIGS. 4 to 7 and that means that the safety against tilting and therefore the ability to transmit encastre moments are improved.

The bearings in accordance with FIGS. 10 and 11 include a number of relatively small rollers **26** which can run in an encompassing frame **27**. Bearing plates **28** and **29** are provided to distribute the pressure. The arrangement of these rollers ascertains that displacement longitudinally of the axis of the structure can occur, while transverse sliding is impossible. Due to their very small structural height the bearings are not noticeable from the outside. This type of bearing arrangement is comparable

to an elastic setting of the structural carrying elements in the columns.

Having now described our invention with reference to the embodiments illustrated in the drawings, what we desire to protect by Letters Patent of the United States is set forth in the appended claims.

We claim:

1. Elevated highway structure of reinforced or prestressed concrete, comprising supports such as columns arranged longitudinally of the axis of the structure and a superstructure defining a roadway plate disposed on said supports, a pair of girders extending laterally of and at a distance from said supports, one on each side thereof, said superstructure being thickened in the area of said supports to define a massive block at the upper portion of each support, and four diagonal beams extending from each said block, two to each of said girders, said girders, said block and said beams proximate each support defining an integral structure with said plate.

2. Elevated highway structure in accordance with claim 1, where said beams increase in structural height from the abutments with said girders to the abutments with said block.

3. Elevated highway structure in accordance with claim 2, where bearings are disposed intermediate said

supports and said blocks and said superstructure together with said girders defines a continuous girder supported by said bearings in horizontally movable fashion on individual said columns.

4. Elevated highway structure in accordance with claim 2, where said superstructure is defined by said integral structures cantilevering out from said supporting columns and present at opposite ends thereof supporting ledges for roadway plate sections.

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JACOB L. NACKENOFF, Primary Examiner

U.S. Cl. X.R.

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