July 12, 1966 P. PATIN 3,259,932

CABLE-STAYED BRIDGE

Filed March 3, 1964 4 Sheets-Sheet 1

FIG.1

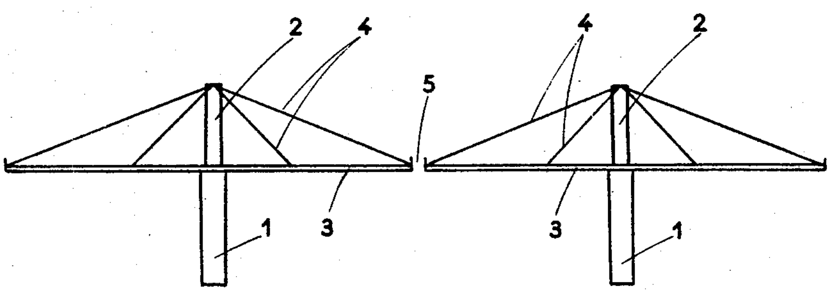


FIG.5

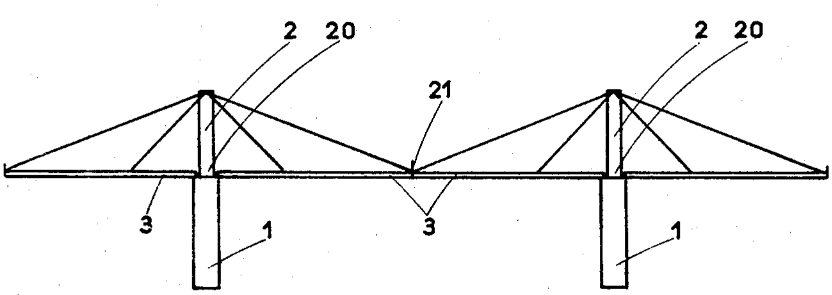


FIG. 2

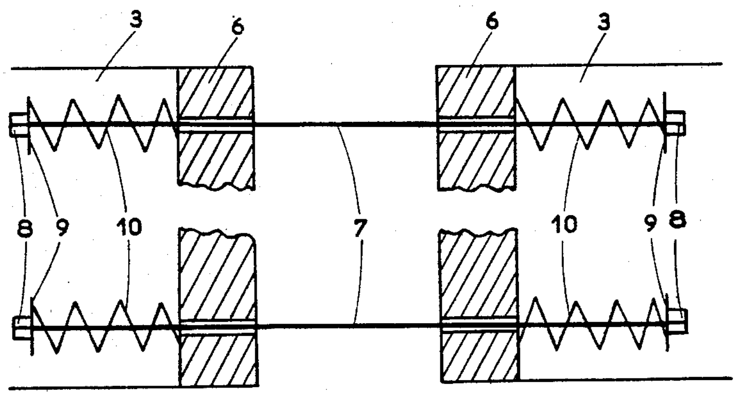


FIG. 3

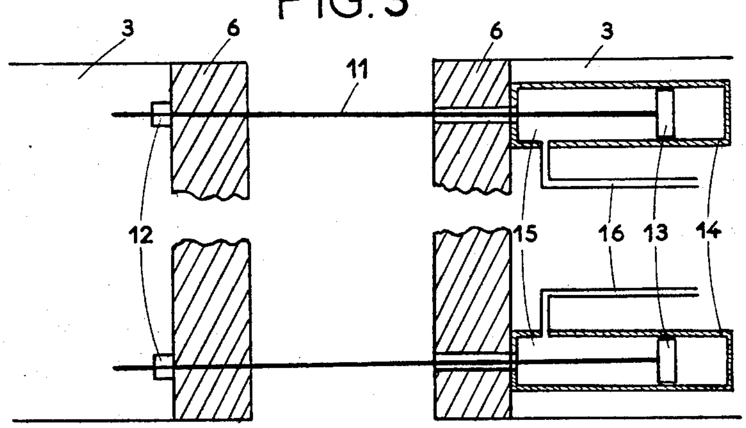


FIG. 4

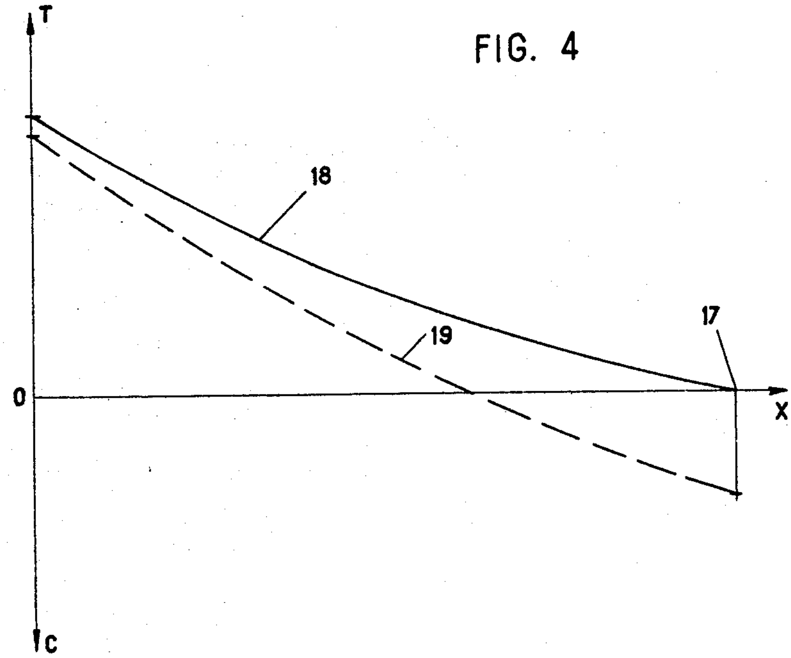


FIG. 8

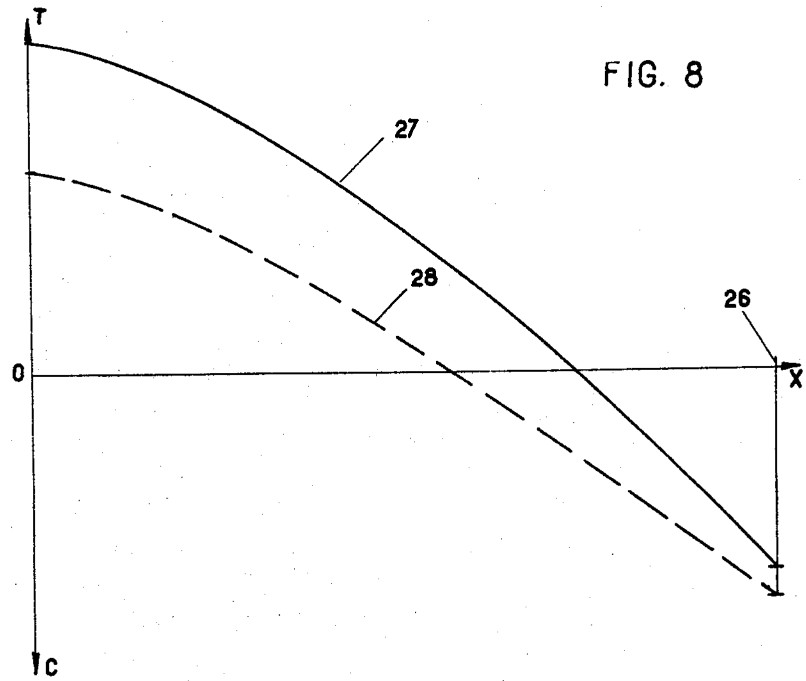


FIG. 6

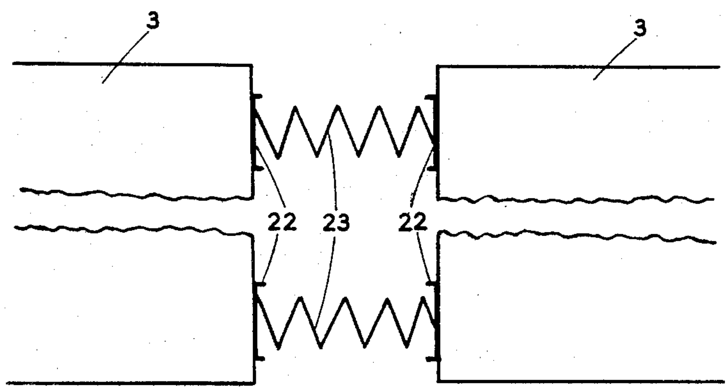
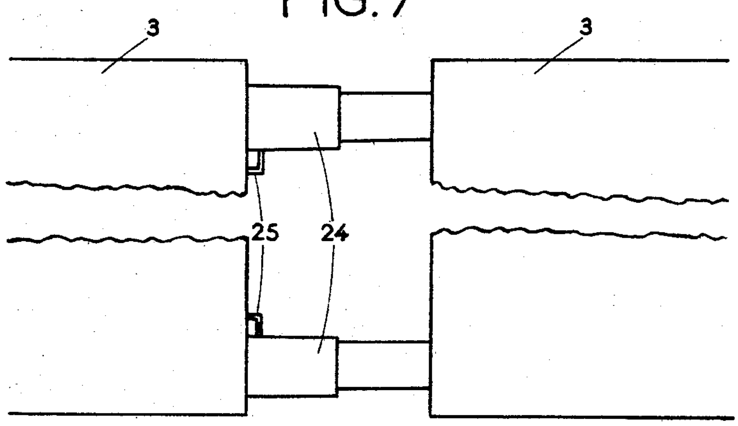


FIG. 7



United States Patent Office

3,259,932

Patented July 12, 1966

3,259,932

CABLE-STAYED BRIDGE

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Filed Mar. 3, 1964, Ser. No. 348,963

Claims priority, application France, Mar. 6, 1963, 927,001

3 Claims. (Cl. 14—18)

The invention has as its subject matter a cable-stayed bridge of the type comprising portals, a decking and cable stays connecting the top of the portals to various places in the decking.

In bridges of the kind specified, various problems arise in dependence upon the forces experienced by the decking, for the same experiences more particularly forces parallel with itself and arising out of the pull by the cable stays. The decking also experiences longitudinal expansion and shrinkage caused by temperature differences, and experiences transverse wind forces.

It is an object of this invention to obviate the various disadvantages arising out of these various forces.

According to the invention, the decking is formed with at least one transverse interruption; and means are disposed, between the two decking portions separated by the interruption, for applying to, such two portions a force operative in the opposite direction to the force produced in the decking and parallel therewith in the vicinity of the interruption by the pull of the cable stays.

The invention will now be described in greater detail, reference being made to exemplary embodiments which are illustrated in the drawings wherein:

FIG. 1 is a diagrammatic elevational view of a cable-stayed bridge in which there is an interruption in the middle of the decking;

FIGS. 2 and 3 are diagrammatic longitudinal sections of the decking in the place near the interruption, in a horizontal plane, two different embodiments being shown of the means for applying a force to the two portions of the decking;

FIG. 4 is a graph in which the longitudinal force experienced by the decking is plotted along the ordinate while the distance of the place where the force is measured from the interruption in the decking is plotted along the abscissae;

FIG. 5 illustrates a variant in which the decking is interrupted at the portal;

FIGS. 6 and 7 are plan views of the two decking portions at the portal with means for applying a force to the two portions, each of these two figures representing an alternative form of such means, and

FIG. 8 is a graph in which the force experienced by a place in the decking used in FIG. 5 is plotted along the ordinate and the distance of such place from the centre of the decking is plotted along the abscissae.

The cable-stayed bridge illustrated in FIG. 1 comprises piles **1** each surmounted by a portal **2**. Cable stays **4** act on decking **3**. In FIG. 1, the decking **3** is formed with an interruption **5** equidistant from the portals **2**. The force applied to the decking **3** by the cable stays **4** parallel with the decking **3** is therefore a compression which is zero at the interruption **5** and at its greatest at the portals.

According to the invention, means for applying tension to the two adjacent portions of the decking are provided in the region of the interruption **5**.

FIG. 2 diagrammatically illustrates the two adjacent portions **3** of the decking; end beams **6** thereof have extending through them rods **7** screwthreaded at their ends to receive nuts **8** in bearing engagement with plates **9**. Compression springs **10** bear at one end against the plates **9** and at the other end against the beams **6** and apply

tension to the rods **7** and therefore to the adjacent portions **3** of the decking.

In the variant illustrated in FIG. 3, tension is produced by rods **11** having on one end a nut **12** bearing against the beams **6**, while the other end of the rod **11** is rigidly secured to a piston **13** of a jack **14** in which a hydraulic pressure is produced by liquid being supplied to a chamber **15** of each jack **14** through ducting **16**. Because of the pull between the two adjacent portions of the decking **3**, the compression applied thereto by the cable stays **4** can be reduced possibly right down to zero.

In the graph shown in FIG. 4, the distance between the interruption **5** and the place where the force experienced by the decking is measured is plotted along the abscissae axis, the point **17** thereof being at the position of the portal **2**. The tensile force T is plotted upwards along the ordinates axis, and the compressive force C is plotted downwards. The solid-line curve **18** represents in diagrammatic form how the forces operative in the decking can be varied by means of the tensile device disposed at the interruption **5** when the bridge span has no load operative on it and is at a very low temperature. In this case, the tensile force can be zero at the place **17**. The chain-line curve **19** diagrammatically represents the variation of the forces when the span is loaded and is at a very high temperature. Most of the decking is still in tension. To produce the curves **18** and **19**, the points representing effects at the level of the connections between the cable stays and the decking were joined together. Since the compressive force is reduced and the length of decking affected by compression is reduced, there is much less risk of the decking buckling. Bridge construction is facilitated by the cable-stay system and by an appropriate choice of the tension.

In the variant illustrated in FIG. 5, the decking is formed with an interruption **20** at the position of a portal. In this case the decking **3** is continuous between two consecutive portals **2**. The decking **3** is therefore in tension, the tension being maximum at the centre **21** of the span and zero at the ends thereof. To reduce this tension in the decking, a compressive force is required at the interruption **20** between the two adjacent portions of the decking **3**, and an embodiment of means for providing such compression is shown in FIG. 6. The means comprise cup-shaped members **22** against which compression springs **23** bear.

In the variant illustrated in FIG. 7, the compression-producing means take the form of jacks **24** to which liquid is supplied through ducting **25**.

Just like the interruption **5** in the decking shown in FIG. 1, the interruption **20** in the decking shown in FIGS. 5–7 means that the decking can be left free to expand or contract to follow temperature variations. The interruption **20** does not impede erection of the bridge; all that has to be done is to temporarily secure the decking portions near the portal during erection.

FIG. 8 is a diagram showing how tensile forces are compensated for in the embodiment illustrated in FIG. 5. Distances from the centre of the decking to the portal are plotted along the abscissae axis, the portal being at the position **26**. The tension T in the decking is plotted upwards along the ordinates axis, and the compression C in the decking is plotted downwards along the ordinates axis. As can be seen from the curve **27** which represents the variation in forces with the span loaded and at minimum temperature, tension is balanced by compression over much of span length. The broken-line curve **28** shows the variation of the forces when the span is unloaded and temperature is at a maximum. These curves were prepared in the same way as the curves in FIG. 4.

The bridge for which alternative forms have just been described has the advantage that the longitudinal forces operative in the decking are reduced; consequently, the bridge can be constructed with very long spans. Also, in the embodiment illustrated in FIG. 1—i.e., when the interruption **5** is at the centre of the span—the distribution of the springs **10** or jacks **14** from one side of the span to the other and over the cross-section of the interruption helps to provide a resilient resistance to horizontal wind forces perpendicular to the span.

Of course the invention is not limited by the details of the embodiments hereinbefore described and modifications can be made without the scope of the invention being exceeded.

What is claimed is:

1. Cable-stayed bridge comprising portals, a decking, cable stays connecting the tops of said portals to said decking, at least one transverse interruption in said decking, decking portions formed by said interruption and means between said decking portions for applying to said portions a force in opposite direction to the force produced in and parallel to said decking adjacent said interruption by said cable stays.

2. Cable-stayed bridge comprising portals, a decking, cable stays connecting the top of said portal to said decking, at least one transverse interruption in said decking, decking portions formed by said interruption and means between said decking portions for applying to said portions a force in opposite direction to the force produced in and parallel to said decking adjacent said interruption by said cable stays, said transverse interruption being at the center of a span of said decking and said means between said two decking portions applying tension thereto.

3. Cable-stayed bridge comprising portals, a decking, cable stays connecting the top of said portals to said decking, at least one transverse interruption in said decking, decking portions formed by said interruption and means between said decking portions for applying to said portions a force in opposite direction to the force produced in and parallel to said decking adjacent said interruption by said cable stays, said transverse interruption being adjacent one of said portals and said means between said two decking portions applying a compression thereto.

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