

March 22, 1932.

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1,850,507

METHOD OF ERECTING BRIDGES

Filed Sept. 15, 1928

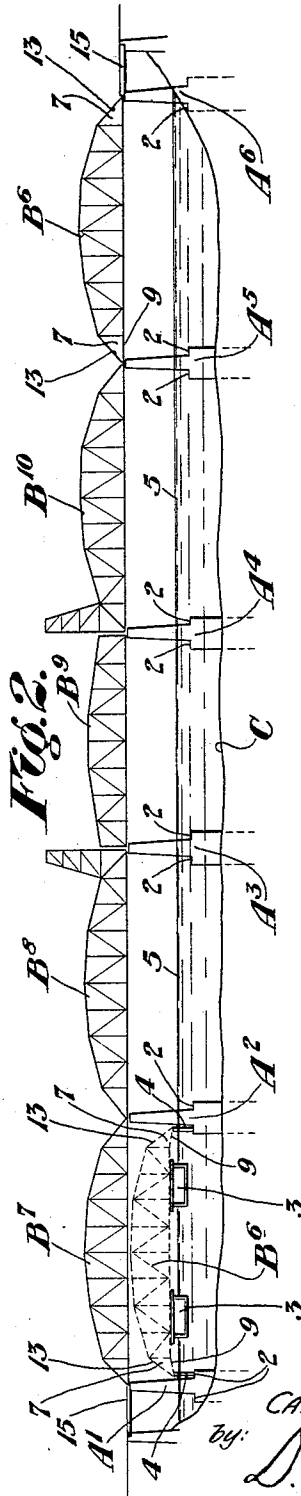
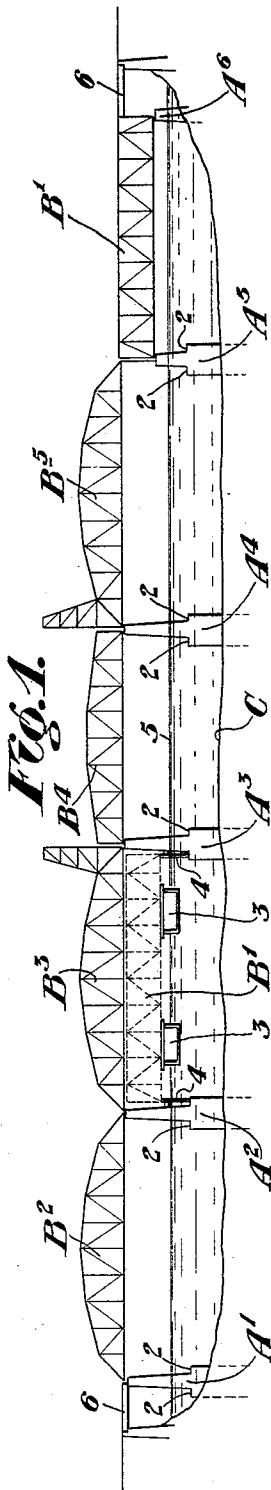


Fig. 4.

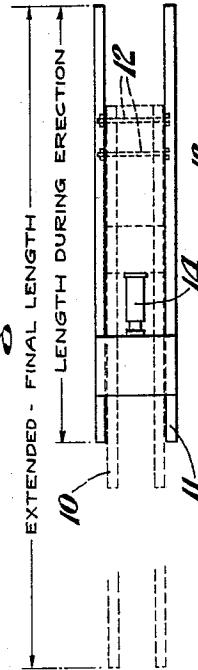
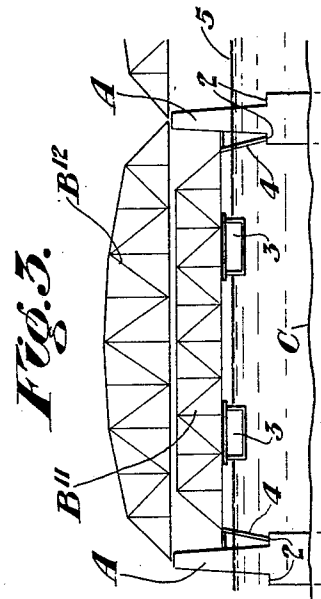
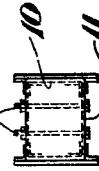


Fig. 5.



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UNITED STATES PATENT OFFICE

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METHOD OF ERECTING BRIDGES

Application filed September 15, 1928. Serial No. 306,130.

This invention relates to the building of bridges across wide waterways and more particularly to bridges having a series of long, heavy spans, such as bridges for spanning rivers of great width.

When a wide waterway is to be crossed by a bridge, it usually is economical to build the bridge in several spans, with intermediate piers. When the water is deep the bridge must be built high above the water to take care of navigation requirements. That is to say, if the ordinary false-work is used, a large amount of timber is required, and it is very difficult to brace the bents under water.

The use of a floating scheme involves a large risk on account of wind forces that may occur while the spans are being floated. By the use of my improved method these difficulties are overcome.

One object of my invention is to provide a novel method of assembling and erecting the series of separate spans forming such bridges, wherein the use of false-work in erecting the bridges is avoided or greatly lessened, the difficulties ordinarily met with in erecting bridge spans over waterways of great depth are avoided and overcome, and whereby the cost of erection is very materially decreased.

Other objects of the invention will be made apparent hereinafter in the detailed description, and be particularly pointed out in the appended claims.

Referring now to the drawings forming part of this specification, Figure 1 is a diagrammatic side elevation of a bridge, illustrating novel features in the method forming my invention.

Figure 2 is a similar side elevation, showing other features of my improved method.

Figure 3 is a side elevation of a portion of a bridge showing further features of the novel method forming my invention.

Figure 4 is a plan showing details in the construction of one form of telescopic bottom chord adapted for use in carrying out my invention.

Figure 5 is an end elevation of the telescopic bottom chord of Figure 4.

In the accompanying drawings, the letter A

denotes, in a general way, the bridge piers which are shown built up on the bed of a river or wide stream, and B, in a general way, the series of bridge spans of which the bridge structure is formed.

The bridge piers A will be supported on suitable foundations and when the nature of the river bed C requires, the foundations for the piers will be built upon previously driven piles, or in any other approved manner. The piers A have an offset or step 2 in each side, at an intermediate point in the height thereof, for a purpose later described.

In building bridges like that shown in Figure 1 by my improved method, the false-work necessary to support one of the spans will be built alongshore, where the river is comparatively shallow, at or near the bridge site. As various ways of building such false-work, usually of wood, are old and well known, it is not shown and will not be further described.

In designing the bridge of Figure 1, one of the spans, generally one of the two shore spans and in this case the deck span B¹, will be made somewhat shorter than the others and of a length which permits it to be securely mounted on the offsets 2 of any two adjoining piers A, except the pair on which it is eventually mounted in completing the bridge. The other spans will be of uniform, or substantially uniform, length.

This short deck span will first be erected on the false-work previously built off shore in the usual well known manner and after being assembled, will be transferred to pontoons or barges 3, 3 or similar floating craft. In building the false-work provision will be made for positioning the pontoons to receive the spans B. The span laden pontoons will then be floated or towed into position to bring the short span B¹ lengthwise opposite the gap or opening between the piers A² and A³. When not high enough, the span will be blocked up on the pontoons to permit of its being moved between the pair of piers A², A³. It will then be lowered until its ends rest on the offsets 2 of these piers, or on the bents 4 when the offsets 2 are under water, as shown in Figure 1.

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The pontoons may then be removed or may remain in place until needed in removing the span B^1 .

Generally, the offsets 2 in the sides of the piers are below the level 5 of the water in the river over which the bridge is to extend and, when necessary the height of the offsets relative to the tops of the piers will be carefully determined in order to locate the top of the span B^1 at the elevation required for the use to which it is put when mounted on the offsets or steps 2 in the pier sides.

To bring the top of the span B^1 to the desired height when supported on the offsets 2, the bents 4 will be placed between the ends of the spans B^1 and top of the offsets 2, as is shown dotted in Figure 1.

After the short span has been positioned temporarily, as shown dotted in Figure 1, the span B^3 is erected above the span B^1 and, in assembling the span B^3 , the span B^1 is used instead of the customary false-work to support the span B^3 while it is in the course of erection on top of the piers A^2 , A^3 .

After the span B^3 is erected, the span B^1 is transferred to the pontoons 3, 3 and, after being moved by means of the pontoons into position between the piers A^1 and A^2 , is mounted on the offsets 2, 2 of these piers in the same way as has been described. The span B^1 is then again used in lieu of the usual false-work to support the span B^5 while it is being erected in place on the piers A^4 , A^5 .

The deck span B^1 also will be used in erecting the lifting span B^4 of the bridge of Figure 1 when considered necessary or desirable, in the same way as has been described.

The deck span B^1 is then transferred from the offsets of the piers to the pontoons 3, 3 and is carried by the pontoons into position on its piers A^5 , A^6 where it remains permanently.

On account of its being longer than the distance face to face of the piers A^5 , A^6 , it will be necessary to raise the span B^1 on the pontoons high enough for it to be moved into position above the piers on which it is then placed to complete the erection of the new river spans of the bridge. The approaches 6, 6 will then be erected in the usual manner, in completing the bridge of Figure 1.

Frequently it is found necessary or expedient in designing such bridges to make all of the spans of the same length or of so nearly uniform length that no one of them will be short enough to be positioned on the offsets or steps of the piers for use in erecting the other spans, as shown for example in Figure 2.

In such case, the end panels 7, 7 of one span B^6 will be distorted when erecting it on the false-work so as to shorten the overall length of this span enough for it to be used in the same way and for the same purpose as the short span B^1 is used in erecting the bridge shown in Figure 1.

In distorting the end members of the span B^6 to temporarily shorten its overall length enough for it to be mounted on the offsets of adjoining piers the end members of the bottom chords 9 of the trusses forming the span B^6 will be made to telescope in the manner shown in Figures 4 and 5, and when assembling this span on the false-work on which it is erected, the telescopic members 10, 11 will be secured in telescoped or shortened position by bolts 12 which extend through registering holes in the telescoping members 10 and 11. (See Figure 4.) The end members 13 of the top chords of the trusses forming this span being pin connected their outer ends will be swung downwardly out of normal position and will be connected by pins in the outer ends of the shortened members 10 of the bottom chords so as to form the ends of the span as shown dotted in Figure 2.

After the shortened span B^6 has been erected on the false-work it is transferred to the pontoons 3, 3 and is carried by the pontoons into position to be mounted on the offsets 2 of the piers A^1 and A^2 of Figure 2, in the way described in connection with the bridge of Figure 1.

The span B^7 of the bridge of Figure 2 is then erected on top of the piers A^1 and A^2 , and is supported on the distorted or shortened span B^6 during its erection. On account of the curved top chords of the span B^6 , a small amount of false-work will be built on top of the span B^6 , this being done while the span is on the false-work on which it is erected or after being placed in position between the piers A^1 , A^2 , as is found most expedient. After once being built, it will remain on top of the span B^6 until the other spans of the bridge have been erected.

After the span B^7 has been erected on the piers A^1 , A^2 , the shortened span is then successively moved, by means of the pontoons, into position and transferred to the offsets on the piers A^2 and A^3 , A^3 and A^4 , A^4 and A^5 , in erecting the spans B^8 , B^9 and B^{10} by the method previously described.

After the other spans have been erected in place with the aid of the distorted or shortened span B^6 , it is transferred by the pontoons into position to be put on top of its piers A^5 , A^6 .

The false-work on its top chords having now been removed, the span B^6 is raised on the pontoons until its shortened ends will swing clear of the tops of the piers on which it is to rest, in the manner shown in Figure 2, and the span is then lengthened.

The bolts 12 are then removed from the telescoped end members 10, 11 of the bottom chords 9 and the outer panels are successively extended by means of a hydraulic or other jack 14 (shown diagrammatically in Figure 4) until the span B^6 is restored to its full length.

The bolts 12 are then replaced in registering holes in the members 10 and 11 of the bottom chords 9 and the span B^o is lowered until its ends rest on top of the piers A^s, A^e. The approaches 15 will then be built and the bridge will be placed in position in completing the bridge.

It also is found necessary at times to make the series of spans of a bridge of such lengths that no one of them is adapted for use to support in the offsets of the piers the other spans while they are being erected on their piers, the spans being either too long or too short. When this necessity arises the lengths of the various spans will be proportioned so that one of them, while too short to reach from the offset in one pier to that of the opposite pier, is long enough to nearly reach from one offset to that of the opposite pier. When this condition arises a short span B¹¹ can be used as a support for the other spans B¹² while they are being erected by canting the bents 4, 4 outwardly and anchoring them to the piers, in the way shown in Figure 3.

The steps of the method used in erecting the bridge of Figure 3 with the short span B¹¹ will be the same as has been described in connection with the bridge of Figure 1, other than canting the bents 4, as shown in Figure 3. The supporting bents 4 may be used with the distorted trusses as well as with the normal trusses.

In other cases an extension will be built on each end of the span B¹¹ to make it of the desired temporary length while it is being used to erect the other spans B¹² of the bridge of Figure 3.

The advantages of my invention will be readily appreciated by those skilled in the art. By the use of my improved method the necessity of building false-work between each pair of piers to support each span is avoided. The enormous cost of erecting false-work in very deep water or in swiftly flowing water is made unnecessary. The danger of the false-work being carried away by floods or by ice during the erection of the bridge is removed and the cost of erection of the bridge is materially decreased.

Modifications in the steps of my improved method may be made without departure from the invention, as defined in the appended claims.

I claim—

1. In the erection of bridges, the steps of erecting a span of the bridge on false-work, moving the erected span into position between opposite piers of the bridge, supporting the span temporarily from said piers below the top supporting faces thereof and employing the temporarily positioned span to support a second span during the erection thereof on said piers, and then transferring the temporarily positioned span into posi-

tion on other piers to form a component of the completed bridge.

2. In the erection of bridges, the steps of erecting a span of the bridge on false-work, moving the erected span into position between opposite piers of the bridge, supporting the span temporarily from said piers below the top supporting faces thereof and employing the temporarily positioned span to support a second span during the erection thereof on said piers, then transferring the temporarily positioned span into position between another pair of piers, and again employing the transferred span to support another span in the erection thereof on its piers, and finally positioning the temporarily positioned span on other piers to form a component of the completed bridge.

3. In the erection of bridges, the steps of assembling a span on false-work, transferring the span to offsets on opposite piers of the bridge below the top supporting faces thereof and employing said span to support a second span during the erection thereof on said piers between which the first span extends, and finally transferring said first span in place on other piers to form a component of the completed bridge.

4. In the erection of bridges, the steps of erecting a span on false-work, transferring the assembled span to offsets on opposite piers of the bridge below the top supporting surface thereof, interposing supports between said offsets and span to bring the span to the desired elevation, and employing said span to support another span during the erection thereof on said piers between which the first span extends, and then removing said span and positioning it on other piers to form a component of the bridge.

5. In the erection of bridges, the steps of assembling one span of the bridge on false-work, distorting the ends of the span to change its finished length, floating the distorted span between opposite piers of the bridge, transferring the distorted span to offsets on said piers below the top supporting faces thereof, then erecting a second span above said distorted span and employing the distorted span to carry the weight of said second span during the erection thereof on the piers, removing said distorted span and then removing the distortion and positioning the span on piers to form a component of the completed bridge.

6. In the erection of bridges, the steps of assembling one span of the bridge on false-work, distorting the ends of the span to reduce the finished length thereof, floating the span between opposite piers of the bridge, transferring the distorted span to offsets on said piers below the top supporting faces thereof, erecting a second span above said distorted span and employing the distorted span to carry the weight of said second span

in the erection thereof on the piers, and then alternately removing said distorted span to a location between other piers of the bridge and employing it in erecting other spans of the bridge, and finally lifting the distorted span into position above and between opposite piers, increasing the length of the span by re-forming its distorted ends and then lowering the lengthened span upon piers to form a component of the completed bridge.

7. In the erection of a bridge, the steps of building a trussed span, locating it temporarily between two piers in position to serve as a false-work for a permanent span between said piers, supporting it from said piers in said location, building the permanent span thereon and withdrawing the temporary span, and positioning it on other piers to form part of the complete bridge.

8. In the erection of multiple span bridges, the steps of assembling one span of the bridge in such a position that it may be readily floated, floating the assembled span between opposite piers of the bridge, supporting said assembled span on the piers between which it is floated, then erecting a second span above said first named span and employing said first named span to carry the weight of said second named span during the erection thereof on the piers, removing said first named span and repeating said operations for successive spans of the bridge until said first named span only remains to be placed in position on the piers, then floating said first named span into position between the piers on which it is to rest, and then finally lifting said first named span above the piers on which it is to be mounted and mounting said span.

9. In the erection of multiple span bridges, the steps of assembling one span of the bridge in such a position that it may be readily floated, distorting the ends of the span to reduce the finished length thereof, floating the span between opposite piers of the bridge, supporting said distorted span on the piers between which it is floated, then erecting a second span above said distorted span and employing said distorted span to carry the weight of said second named span in the erection thereof on the piers, removing the distorted span and repeating said operation for successive spans of the bridge until said distorted span only remains to be placed in position on its piers, then floating said distorted span into position between its piers, and finally lifting said distorted span into position above and between its opposite piers, increasing the length of said distorted span, and then lowering the lengthened span upon its piers to form a component of the completed bridge.

10. In the erection of a bridge, the steps of providing a span, placing said span temporarily between and supporting the same on

adjacent piers, utilizing said temporarily positioned span in lieu of false-work for the erection of a permanent span on and between said piers, and then withdrawing the temporarily positioned span and moving it to another position and including it in the bridge structure as a permanent part thereof.

In testimony whereof, I have hereunto set my hand.

CARL GUSTAF EMIL LARSSON. 75

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