July 26, 1932. J. L. DE VOU 1,868,630

METHOD OF ERECTING BRIDGES

Filed Nov. 6, 1929 4 Sheets-Sheet 1

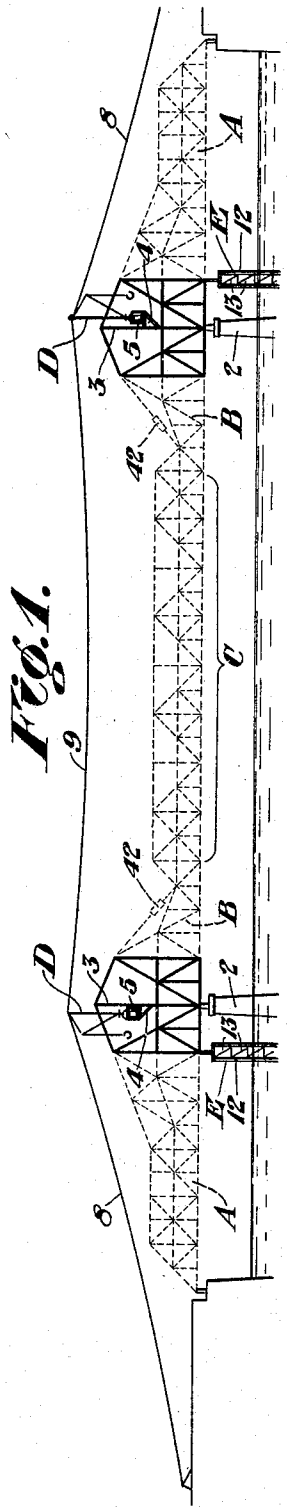


Fig. 1.

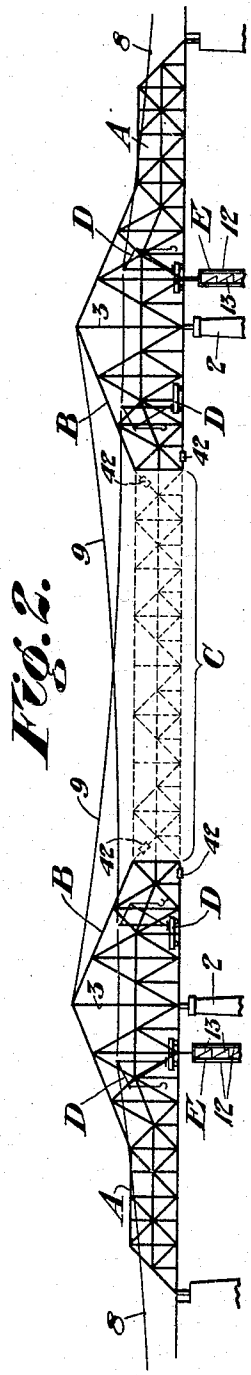


Fig. 2.

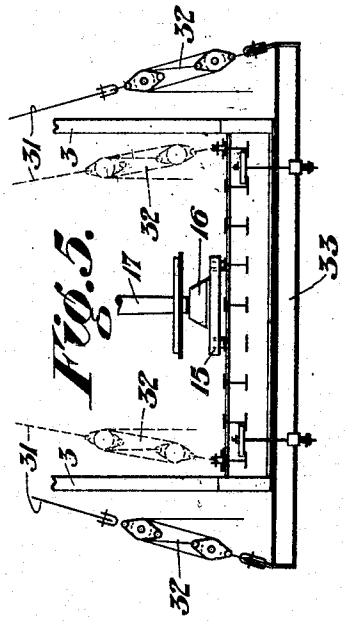


Fig. 5.

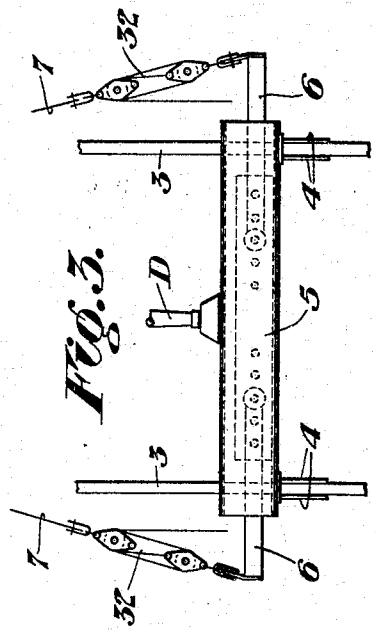


Fig. 3.

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METHOD OF ERECTING BRIDGES

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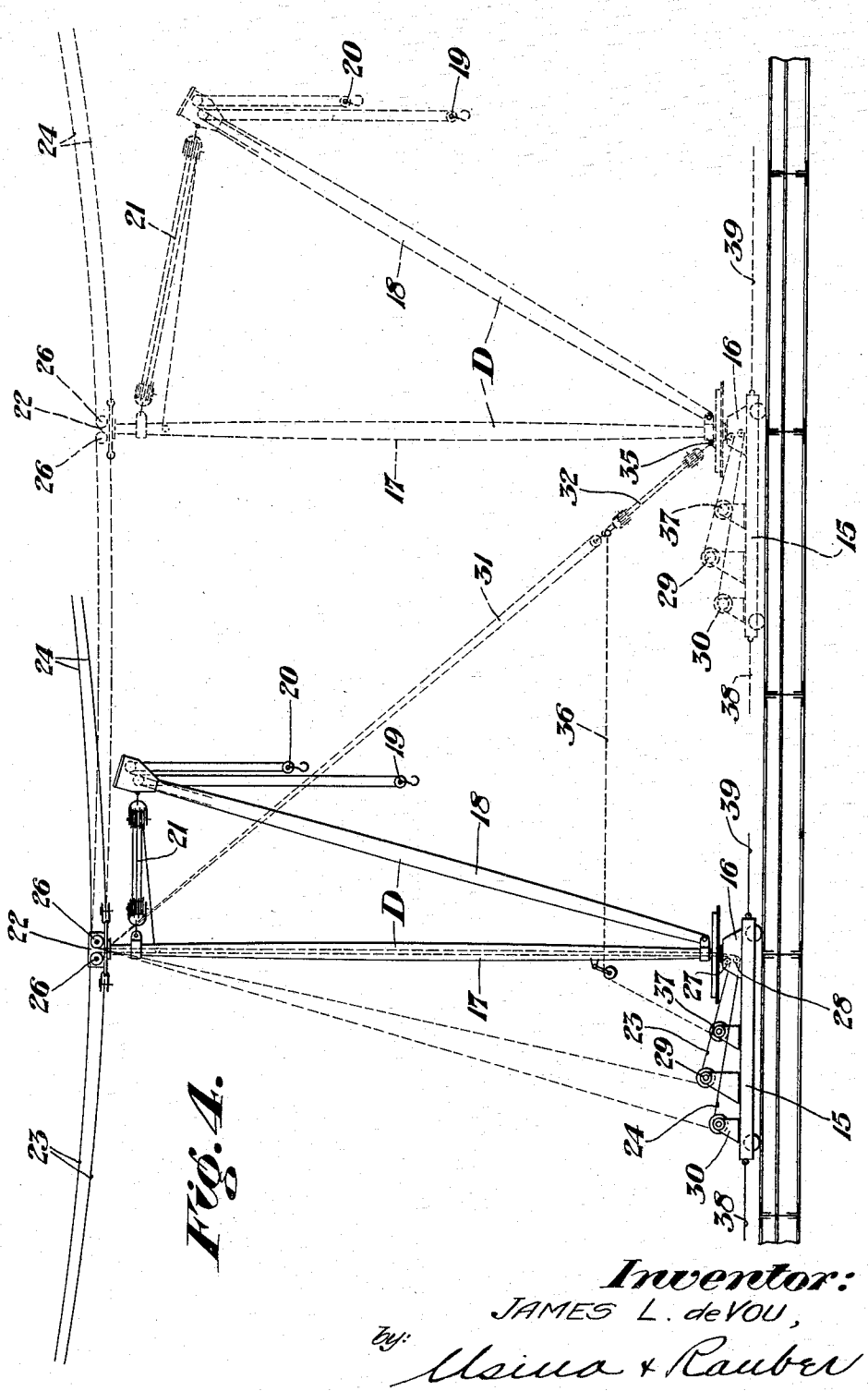


Fig. 4.

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METHOD OF ERECTING BRIDGES

Filed Nov. 6, 1929 4 Sheets-Sheet 3

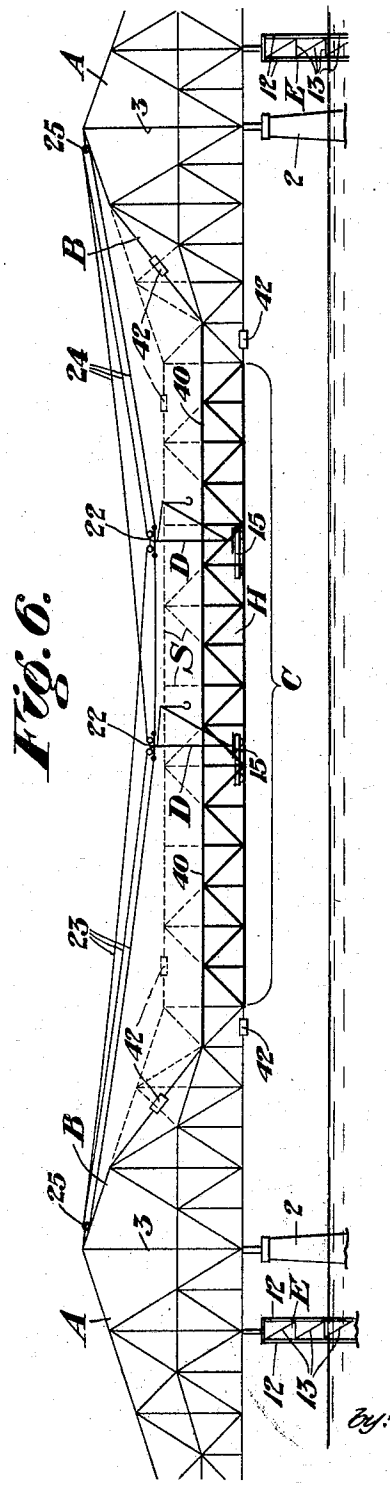


Fig. 6.

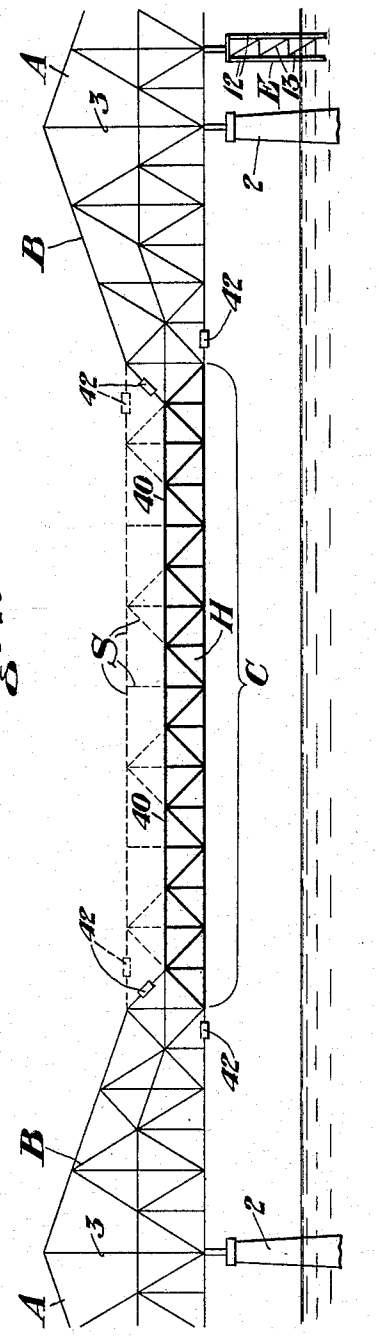


Fig. 7.

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METHOD OF ERECTING BRIDGES

Filed Nov. 6, 1929 4 Sheets-Sheet 4

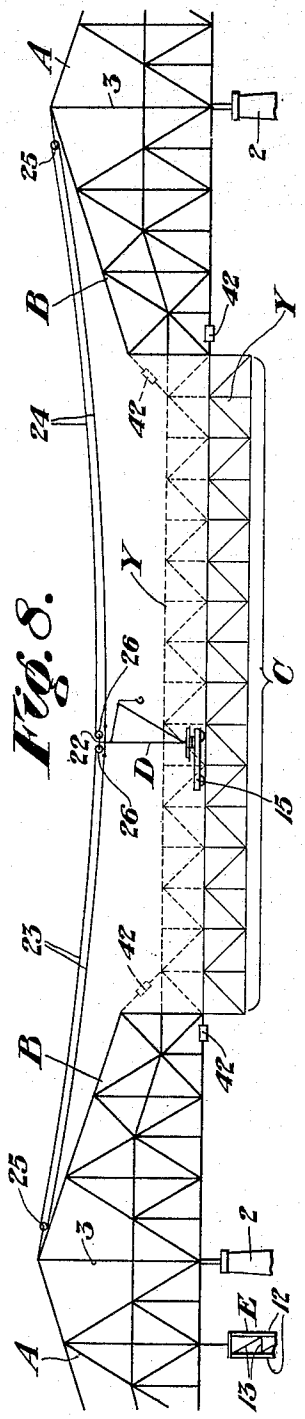


Fig. 8.

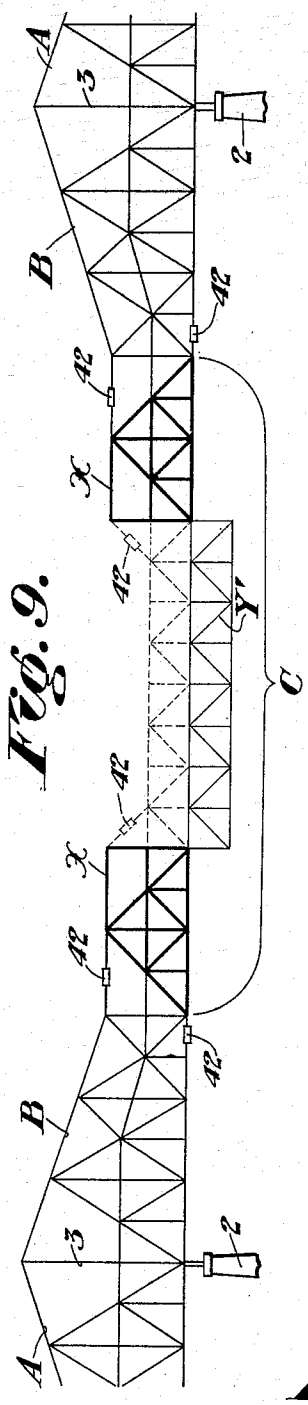


Fig. 9.

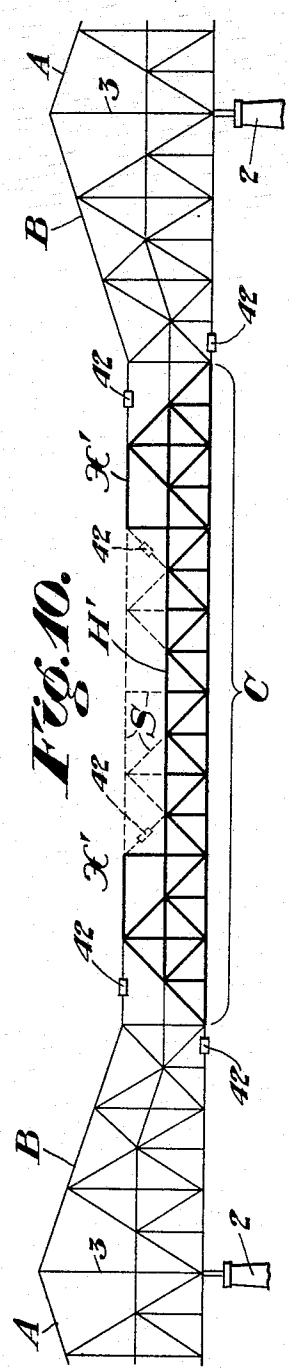


Fig. 10.

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Patented July 26, 1932

1,868,630

UNITED STATES PATENT OFFICE

JAMES L. DE VOU, OF PITTSBURGH, PENNSYLVANIA

METHOD OF ERECTING BRIDGES

Application filed November 6, 1929. Serial No. 405,196.

This invention relates to a method of erecting bridges and has for its object the provision of a novel method whereby the expensive false work heretofore necessary to support bridges during erection is dispensed with, thus providing an enormous saving in labor, expense and time.

Another object is to provide a novel method whereby the use of heavy traveler cranes is entirely dispensed with, thereby eliminating the necessity of reenforcing the bridge structure to carry said cranes during construction.

Another object is to provide a novel method whereby the entire bridge structure is erected in place, thus eliminating the necessity for erecting certain spans on barges and floating them into place and then raising said spans into place as has heretofore been the practice.

In the drawings:

Figure 1 is a side elevation showing a bridge being constructed by the method of this invention.

Figure 2 is a similar view showing the same bridge after the erection has progressed to the center span.

Figure 3 is a fragmentary elevation showing the derrick supporting beam used to support the derrick on the bridge columns.

Figure 4 is a detail side elevation showing the derrick mounted on a wheel base for erecting the bridge structure after the limit of erection from the columns has been reached.

Figure 5 is a fragmentary detail showing the method of supporting the side guys from the derrick when mounted on the wheeled base.

Figures 6 to 10 are side elevations of bridge structures showing modified systems of erection carried out by the method of this invention.

Referring more particularly to the drawings, the letter A designates the anchor-arms or spans of a bridge, the letter B designates the cantilever arms or spans, and the letter C designates the center suspended span.

In carrying out the method of this invention the bridge piers 2 are first constructed to the desired height in any desired manner and from any desired material. The pier columns 3 are then mounted on the piers and secured in place. After the pier columns 3 are erected suitable temporary brackets 4 are secured on the columns to form supports on which a suitable guy derrick D is mounted.

The guy derrick, when mounted on the columns 3, is supported on a transverse girder member 5 which has telescopic end members 6 adapted to be extended to form anchors for side guys 7 of the derrick mast. The front and back guys 8 and 9, respectively, are anchored to the shore or abutment and to the opposite pier or pier columns.

The derricks D on the pier columns are used to first erect or construct suitable steel bents E which are formed by driving suitable steel piles 12 into the river bed and then securing suitable structural members thereto forming bracing 13.

After the bents E are constructed the derricks D will be used to erect the portions of the anchor-arms A extending between the steel bents E and the bridge piers 2. The derricks D will then be swung around and used to erect the portions of the cantilever arms B adjacent the piers 2, said cantilever arms being erected for a distance sufficient to substantially counter-balance the portion of the anchor-arms A previously erected.

After the erection of the parts of the anchor and cantilever spans, as above described, the derricks D are removed from the pier columns 3 and mounted on wheeled bases 15 as shown in Figure 4. Two other derricks D are then assembled on wheeled bases and one of said derricks is positioned on each cantilever arm or span B and one on each anchor-arm or span A as indicated in Figure 2.

The derricks D when mounted on the wheeled bases are adapted to be moved along the span floors or beams as the erection progresses. The derricks D as thus assembled comprise the wheeled bases 15 on which a foot-block 16 is mounted. The derrick proper comprises the usual mast 17, boom 18, main and auxiliary load falls 19 and 20 and topping lift 21.

The guying of this class of derrick so as

to permit its ready movement as the erection progresses is novel and will be described. A suitable spider 22 is pivotally mounted on the upper end of the mast 17, and longitudinal guy cables 23 and 24 are anchored to the spider 22 and then pass around sheaves 25 which are anchored to the bridge structure at a remote point such as at the upper ends of the pier columns. The cables 23 and 24 are then trained back over sheaves 26 in the spider 22 and then down through the hollow mast and around sheaves 27 and 28, respectively, mounted in the foot-block 16. From the sheaves 27 and 28 the cables 23 and 24 extend to crabs 29 and 30 on the wheeled base 15.

The side guys 7 have one end secured or anchored to the spider 22 while their ends carry take-ups 32. When the derricks D are mounted on the bases 15 and are ready for erection operations, the side guys 7 are anchored to a guy anchor-beam 33 extending transversely under the bridge girders and secured to such cross beams of the bridge.

As the bridge erection progresses in each direction from the piers and the derricks D are moved to new locations the guys 23 and 24 and side guys 31 will be operated as follows.

The longitudinal guy cable in the direction of travel of the derrick will be shortened while the other longitudinal guy cable will be lengthened by operation of the crabs 29 and 30. Preparatory to moving the derricks D forward the lower ends of the side guys 31 will be carried forward and anchored to hitches 35 as indicated in dotted lines in Figure 4. The lead lines 36 from the take-ups 32 of the side guys are secured to crabs 37 on the wheeled bases 15 and are adapted to be taken up as the derricks progress in their forward movement.

The crabs 29, 30 and 37 will all be operated at the same time and at a speed sufficient to keep the guys taut as the derricks move forward. The derricks will be moved along the bridge structure by the use of ordinary hauling lines 38 and 39.

After the derricks D are positioned on the bases 15 and in readiness to continue the bridge erection the anchor-arms A and cantilever arms B will be progressively and simultaneously erected so as to remain substantially counter-balanced.

The cantilever arms or spans B may be either built completely before starting to erect the suspended span C as shown in Figure 7, or the upper part of two or more panels next to the suspended span C may be omitted until the lower part of the suspended span is joined as indicated in Figure 6.

After the cantilever arms or spans B are erected the suspended span C will be erected as cantilever arms from each end, the erection serving to counter-balance the anchor-spans until said anchor-spans are finished.

The suspended span C may be erected in various ways depending upon the length and weight of said span.

In Figures 6 and 7 the suspended span is shown as erected in two parts. In this method the lower half H of the span C is erected in the form of cantilever arms, each of which is provided with a top chord 40 to form trusses. The derricks D are progressively moved outwardly along these light weight, half height cantilever arms as the erection progresses. The two cantilever arms forming the suspended span are thus simultaneously erected toward each other and finally joined to form a simple suspended span which is of only a fraction of the weight and height of the completed suspended span of the bridge.

After the lower sections of the suspended span C are thus completed, the derricks D are then either again started from the cantilever end of the span or from the center to erect the portion S of the span C above that already erected as indicated in dotted lines; the lower part of the span thus serving as an erection span. If desired, at this stage of construction more than two derricks D may be employed and the upper portion of the span C may be constructed simultaneously from several points.

Throughout the drawings jacks 42 are indicated, these jacks being of standard construction and being used for the purpose of flexing the bridge into position to join the parts as is usual in all bridge construction.

In Figure 8 a modification of the method described above is shown. In this modification instead of erecting the lower part of the suspended span C to be used as an erection span a false work span Y is erected in exactly the same manner as described for erecting the lower portion of the span C above described. This false work span Y is first erected in the position shown in dotted lines and is then lowered into the position shown in full lines to serve as an erection span. The derricks D are supported on this false work erection span to erect the complete suspended span C above the false work. After the suspended span is thus completed the false work span Y is dismantled and removed.

In Figure 9 a further modification is shown in which the anchor-spans or arms A and cantilever spans or arms B are erected as described above, then two or more panels of the suspended span C are constructed as continuations of the cantilever arms B. The length of the suspended span which can thus be constructed is limited by the strength of the structure and the counter-balancing effect of the anchor-spans.

After the safe limit of construction of the suspended span extensions has been reached

a false work erection span Y^1 is erected as described above to fill the gap between the ends of the suspended span and this erection span is then used to support the derricks and structure during the completion of the suspended span.

In Figure 10 I have shown a still further modification which is a combination of the preferred method, first described, and the last described modification. In the carrying out of this method parts of the suspended span are constructed as continuations X^1 of the cantilever arms B, as described above, then the erection is continued by erecting the lower part H^1 of the span C from each end as described in the preferred method and joining this lower part to form a single span which is then used as an erection span to erect the upper part S of the span C.

In each of the specific methods described, the use of expensive and heavy false work is entirely eliminated, and the necessity of building the suspended span on barges and floating it to the location, then raising it into position, is eliminated.

The use of cumbersome and heavy cranes is eliminated and the speed of erection is materially increased.

While I have shown and described various specific modifications of my improved method it will be understood that I do not wish to be limited thereto since various modifications may be made without departing from the scope thereof, as defined in the appended claims.

I claim—

1. The method of erecting a bridge having piers, an anchor-arm and a cantilever arm extending in opposite directions from each pier, and a suspended span extending between said cantilever arms, which includes erecting the pier columns, mounting guy derricks on said pier columns, erecting rigid supporting bents spaced from said piers on the anchor side thereof, erecting the portion of said anchor-arms extending between said piers and said bents with the aid of said derricks, then erecting a portion of said cantilever arms with the aid of said derricks of a length sufficient to substantially counterbalance the portion of the anchor-arms previously erected, then placing guy derricks on suitable wheeled bases on said bridge structure previously completed, providing at least two additional guy derricks mounted on wheeled bases adapted to travel on said bridge structure previously completed, positioning one of said derricks adjacent the outer end of each of said anchor and cantilever arms, and then proceeding to progressively and simultaneously erect said anchor and cantilever arms with the aid of said derricks until said anchor-arms are complete, and then proceeding to erect the suspended span at least in part in cantilever form from each cantilever arm toward the middle until the ends of said span meet forming a simple suspended span, and moving said derricks along said bridge structure as the erecting proceeds.

2. The method of erecting a bridge having piers, an anchor-arm and a cantilever arm extending in opposite directions from each pier, and a suspended span extending between said cantilever arms, which includes erecting the pier columns, mounting guy derricks on said pier columns, rigid supporting bents spaced from said piers on the anchor side thereof, erecting the portion of said anchor-arms extending between said piers and said bents with the aid of said derricks, then erecting a portion of said cantilever arms with the aid of said derricks of a length sufficient to substantially counter-balance the portion of the anchor-arms previously erected, then mounting guy derricks on suitable wheeled bases on said bridge structure previously completed, providing at least two additional guy derricks mounted on wheeled bases adapted to travel on said bridge structure previously completed, positioning one of said derricks adjacent the outer end of each of said anchor and cantilever arms, then proceeding to progressively and simultaneously erect said anchor and cantilever arms with the aid of said derricks, then continuing to erect the remainder of said bridge as light weight cantilever spans extending outwardly toward the center of the bridge from each cantilever arm, providing a top chord along the top of said light weight cantilever spans, progressively moving said guy derricks along said light weight cantilever spans as the erecting proceeds, finally joining said light weight cantilever spans to form a continuous simple span to serve as an erection span, then using said derricks to erect the remainder of said bridge above said light weight span.

3. The method of erecting a bridge having piers, an anchor-arm and a cantilever arm extending in opposite directions from each pier, and a suspended span extending between said cantilever arms, which includes erecting the pier columns, mounting guy derricks on said pier columns, erecting rigid supporting bents spaced from said piers on the anchor side thereof, erecting the portion of said anchor arms extending between said piers and said bents with the aid of said derricks, then erecting a portion of said cantilever arms with the aid of said derricks of a length sufficient to substantially counter-balance the portion of the anchor-arms previously erected, then mounting guy derricks on suitable wheeled bases on said bridge structure previously completed, providing at least two additional guy derricks mounted on wheeled bases adapted to travel on said bridge structure previously completed, positioning one of said derricks adjacent the outer end of each of said anchor and cantilever arms, then pro-

ceeding to progressively and simultaneously erect said anchor and cantilever arms with the aid of said derricks, then continuing to erect the remainder of said bridge as light weight cantilever spans extending outwardly toward the center of the bridge from each cantilever arm, providing a top chord along the top of said light weight cantilever spans to form a completed truss, progressively moving said guy derricks along said light weight cantilever spans as the erection proceeds, finally joining said light weight cantilever spans to form a continuous simple suspended span to serve as an erection span, and then using said derricks while supported on said light weight simple suspended span to erect the remainder of the suspended span of the completed bridge.

4. The method of erecting a bridge having piers, an anchor-arm and a cantilever arm extending in opposite directions from each pier, and a suspended span extending between said cantilever arms, which includes erecting the pier columns mounting guy derricks on said pier columns, erecting rigid supporting bents spaced from said piers on the anchor side thereof, erecting the portion of said anchor-arms extending between said piers and said bents with the aid of said derricks, then erecting a portion of said cantilever arms with the aid of said derricks of a length sufficient to substantially counterbalance the portion of the anchor-arms previously erected, providing at least four guy derricks mounted on wheeled bases adapted to travel on said bridge structure previously completed, positioning one of said derricks adjacent the outer end of each of said anchor and cantilever arms, and then proceeding to progressively and simultaneously erect said anchor and cantilever arms with the aid of said derricks until said anchor-arms are complete, and then proceeding to erect the suspended span at least in part in cantilever form from each cantilever arm toward the middle until the ends of said span meet forming a simple suspended span, and moving said derricks along said bridge structure as the erection proceeds.

5. The method of erecting a bridge having piers, an anchor-arm and a cantilever arm extending in opposite directions from each pier, and a suspended span extending between said cantilever arms which includes erecting the pier columns, providing temporary column brackets on said pier columns, mounting guy derricks on said brackets, providing a suitable transverse guy anchor-beam below said derrick, anchoring derrick side guys to said beam, providing other guys to the front and rear of said derrick, erecting rigid supporting bents spaced from said piers on the anchor side thereof, erecting the portion of said anchor-arms extending between said piers and said bents with the aid of said derricks, then erecting a portion of said cantilever arms with the aid of said derricks of a length sufficient to substantially counter-balance the portion of the anchor-arms previously erected, then mounting guy derricks on suitable wheeled bases on said bridge structure previously completed, providing at least two additional guy derricks mounted on wheeled bases adapted to travel on said bridge structure previously completed, positioning one of said derricks adjacent the outer end of each of said anchor and cantilever arms, providing transverse guy anchor-beams extending under the bridge structure and suspended from said wheeled bases, anchoring the side guys of said derricks to said anchor-beams, anchoring front and rear guys to said bridge structure remote from said derricks, then proceeding to progressively and simultaneously erect said anchor and cantilever arms of said bridge with the aid of said derricks, then continuing to erect the suspension span of said bridge in the form of two cantilever arms toward the center of the bridge, and joining said last named cantilever arms to form a simple span, said derricks being moved along said bridge structure as the erection proceeds and said guys being adjusted so as to be continually effective as said derricks are moved.

In testimony whereof, I have hereunto set my hand.

JAMES L. DE VOU.