Feb. 21, 1933. S. KENT 1,898,304

REENFORCED CONCRETE CONSTRUCTION AND METHOD OF BUILDING SAME

Filed June 22, 1928 4 Sheets-Sheet 1

Fig. 1.

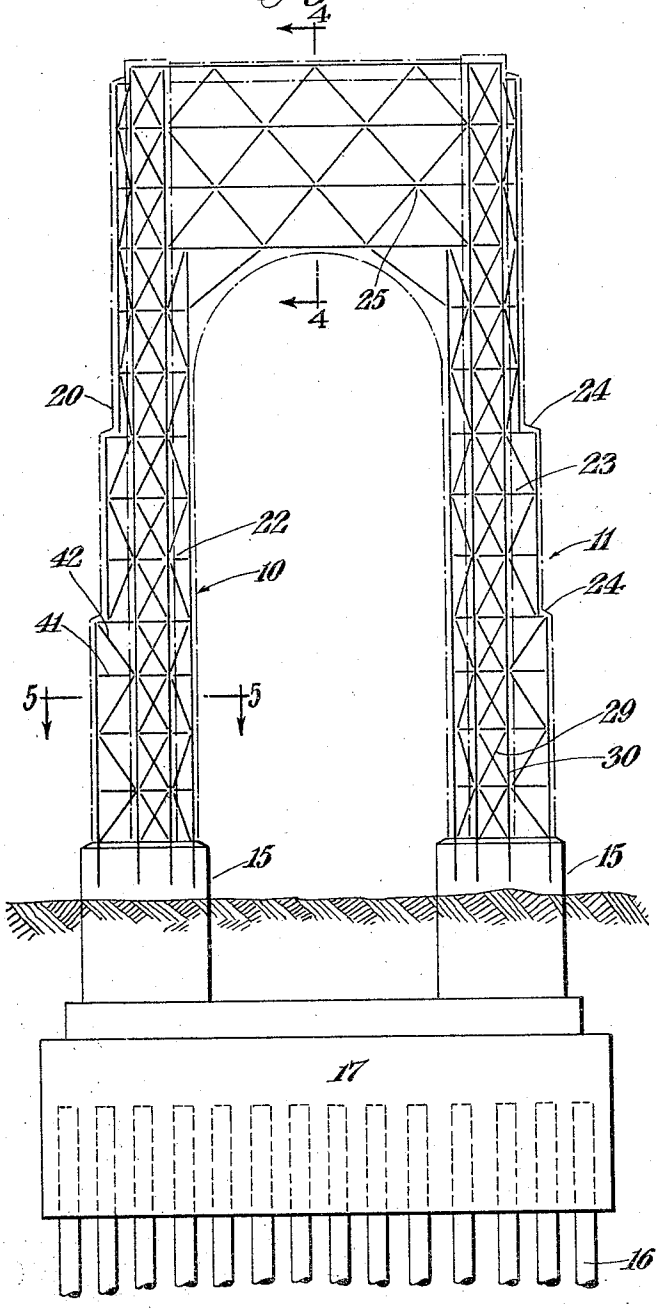

Fig. 2.

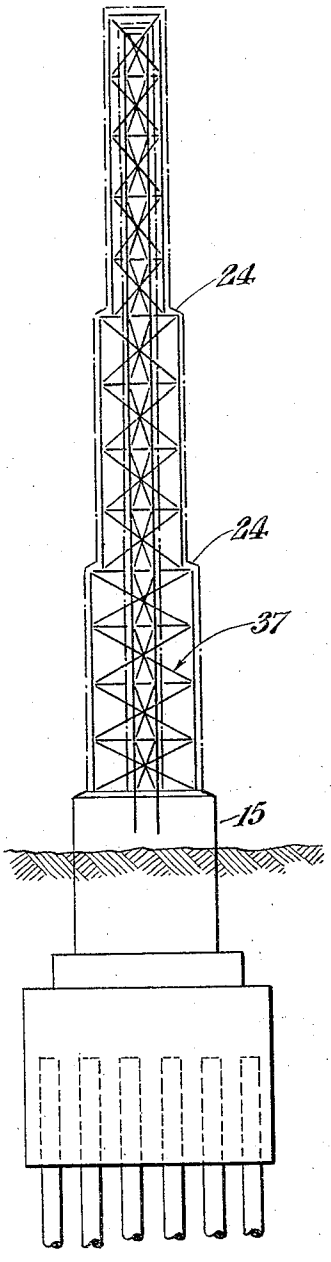

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Fig. 3.

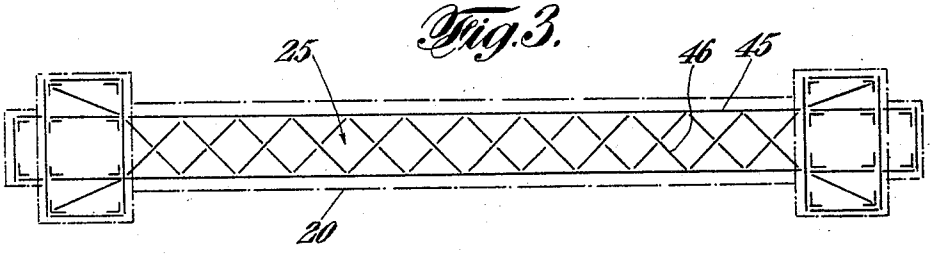

Fig. 4.

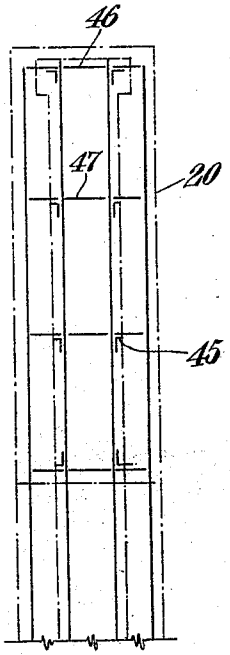

Fig. 5.

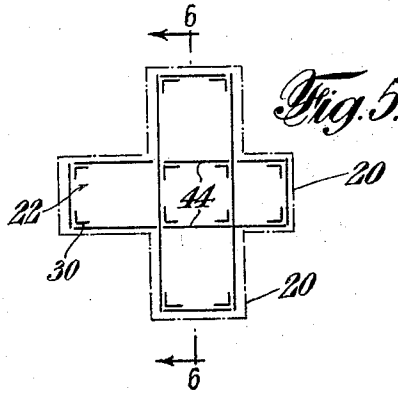

Fig. 6.

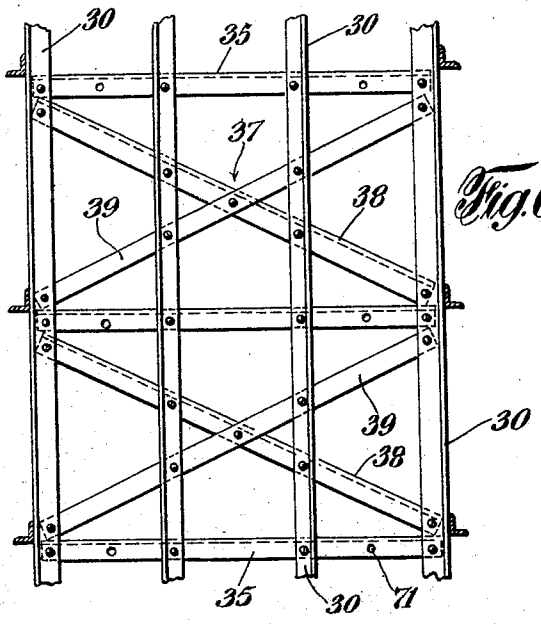

Fig. 7.

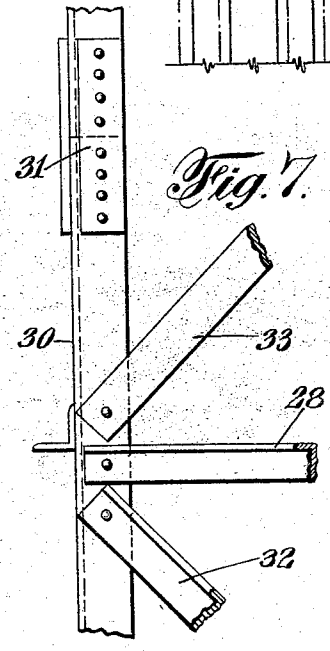

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Fig. 9.

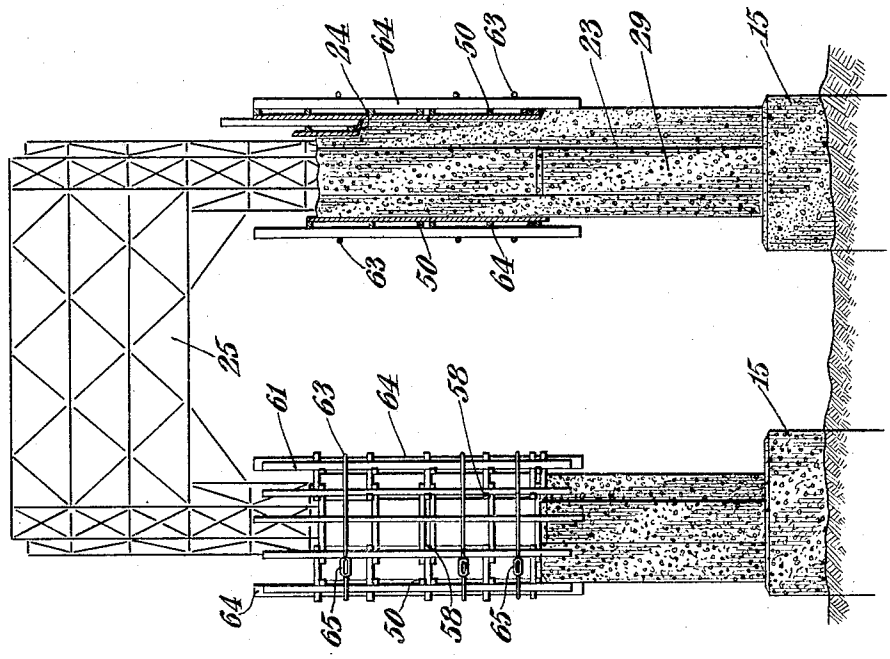
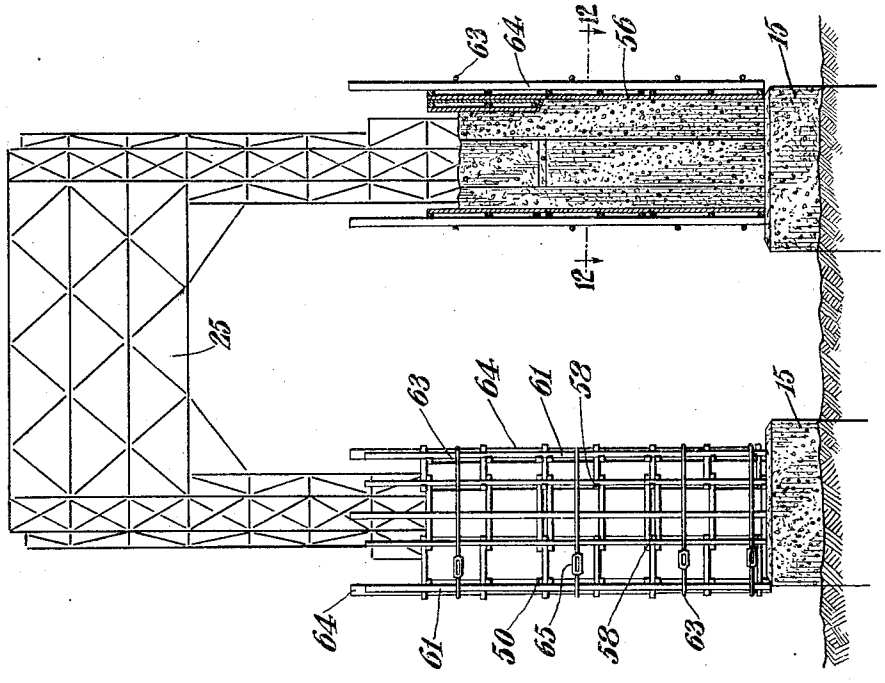


Fig. 8.



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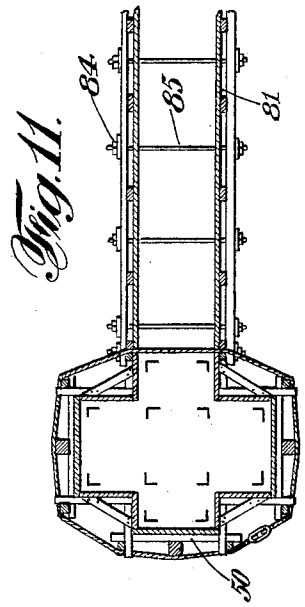

Fig. 11.

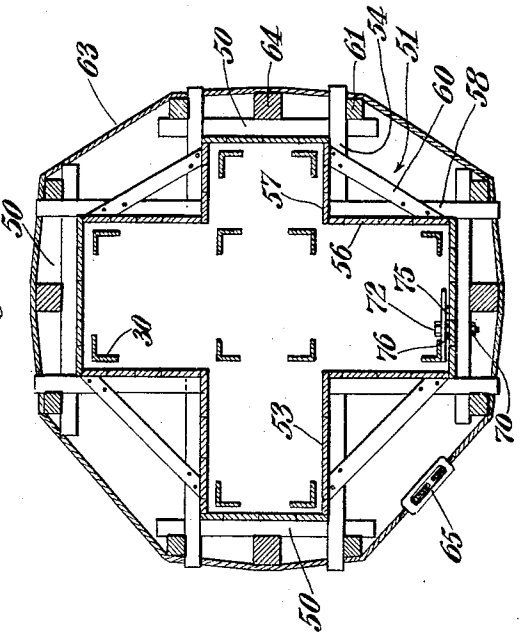

Fig. 12.

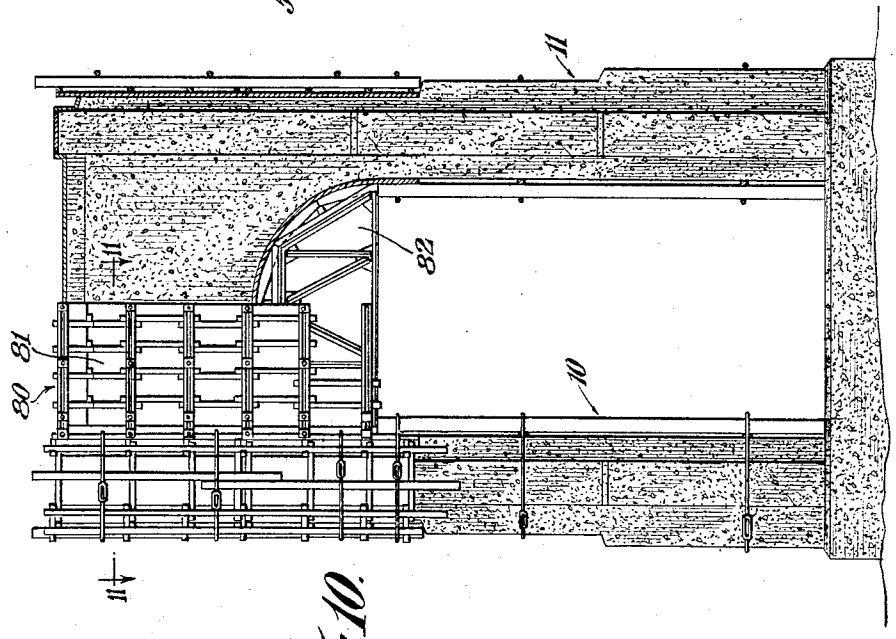

Fig. 10.

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UNITED STATES PATENT OFFICE

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REENFORCED CONCRETE CONSTRUCTION AND METHOD OF BUILDING SAME

Application filed June 22, 1923. Serial No. 287,465.

This invention relates to reenforced concrete structures and particularly to reenforced concrete columns, piers, arches and other tall or elevated structures.

One object of my invention is to provide an improved structure of this character, and a further object is to provide an improved method of building the same.

Tall reenforced concrete structures have heretofore been built in sections from the base up, each section being completed before the next section is started. In forming each section it was necessary to secure vertical reenforcing rods to projecting ends of similar rods of the section below and to these added rods were secured horizontal reenforcing rods or wires. The forms or molds for the concrete were then placed in position around the reenforcing structure thus formed and the molds filled with concrete. The operation of first positioning the reenforcing members and subsequently encasing them in concrete was repeated for each successive section of the structure.

The erection of such structures by the method just described is slow and expensive. The vertical reenforcing rods for each section must be separately spliced to the ends of the rods of the section below and care must be taken that the rods are properly positioned relative to the outer concrete surface of the finished structure. Similarly the horizontal rods or wires must each be secured in proper position. The work of placing the molds accurately in position around the reenforcing structure requires a considerable amount of time and labor. Furthermore, the adding of the successively higher section has always required the erection of an extensive scaffolding around the structure.

In building a structure in accordance with the present invention, I am able to overcome the disadvantages above noted and provide a method which permits the building operations to be carried on more efficiently and economically, wherein apparatus employed in such operations may be more effectively utilized and wherein the time and labor consumed is reduced to a minimum.

In building the structure in accordance with the preferred form of my invention, I first form the base of the structure in the usual manner and I then erect on the base a tower or frame of relatively light construction and formed of metal members rigidly secured together. This tower is of sufficient strength to be self-sustaining and in certain cases may be strong enough to withstand the dead load of the finished structure, but need not be strong enough to support the live load. Starting then from the base or plinth, molds or forms for the concrete are erected around the tower. To position these forms properly the tower is employed as a centering means, the forms being held at the desired distance from the tower by wood or concrete blocks or other spacing devices. These forms are then filled with concrete, thus encasing in concrete the portion of the tower enclosed by the forms. Additional forms are then erected for the next higher section. These forms are in turn filled with concrete and this operation is repeated until the entire structure is complete. Concrete may be poured into the forms to a relatively great depth, thus forming relatively tall sections of concrete at each pouring, the only limitation as to depth being the strength of the forms of molds to withstand hydrostatic pressure at their bottoms.

By building the concrete structure in accordance with the method just described, much time and labor is saved. The reenforcing tower can be easily and quickly constructed from standard metal stock. The molds for the concrete may be quickly and readily placed in position, the interior tower providing a convenient means for centering the forms permitting the accurate placing of templates and anchor bolts, and, in certain cases also, providing a means for supporting the molds. The tower may also be employed as a support for pipes and spouts used in pouring the concrete and, as the tower is an open skeleton construction, it affords a ready means by which workmen may gain access to the interior of the forms to adjust the forms, to secure them in proper position, to tamp the concrete, etc. Furthermore, in building the structure by my improved

method the extensive scaffolding formerly required is no longer needed.

For building the tower I preferably employ steel bars, such as angle bars, which I bolt, rivet or weld together to form a tower structure. When the bars are welded, I preferably employ the arc welding process described in the Schenstrom Patent #1,451,555, April 10, 1923. The tower is composed of upright members or bars connected by cross members. In designing the tower as a reenforcement for a concrete structure which is angular in cross section, the upright members are preferably so positioned that they will be located inside and adjacent to the corners of the finished structure and the cross members will be located adjacent to and extend parallel to the outer surfaces of the finished structure. The tower, as a structure, is not designed to withstand the stresses which the finished structure will subject it to, and for this reason the tower may be of very light construction in comparison with one designed to carry the live load of the finished structure. When the tower is of very light construction it, if desired, can be steadied by guy wires.

A further object of my invention is to provide an improved reenforced concrete structure built in the manner described. Such a structure has advantages over constructions made by older methods in respect to strength and durability, economy of reenforcing material and number of reenforcing parts employed. A further object of my invention is to provide an improved reenforced elevated arch, the particular construction and advantages of which will be more fully described hereafter.

Other objects and advantages of my invention will appear from the following description taken in connection with the accompanying drawings wherein:

Figure 1 is a diagrammatic front elevation of reenforced concrete structure embodying one form of my invention, showing in outline the base of the structure, the metal reenforcing and the outer surface of the concrete;

Figure 2 is an end elevation of the structure shown in Figure 1;

Figure 3 is a top plan view of the structure shown in Figure 1;

Figure 4 is a diagrammatic sectional view taken on the line 4—4 of Figure 1;

Figure 5 is a diagrammatic sectional view taken on the line 5—5 of Figure 1;

Figure 6 is a detail sectional view taken on the line 6—6 of Figure 5 and showing certain of the cross members connected to the uprights of the reenforcing structure;

Figure 7 is an enlarged detail view of the connections between the horizontal and inclined members, and the upright bars as well as the connection between two successive upright bars.

Figure 8 is a diagrammatic view partly in section and partly in elevation of the unfinished structure, showing concrete forms surrounding the lower part of the reenforcing towers;

Figure 9 is a view similar to Figure 8 but showing the structure in a later stage of the building operations;

Figure 10 is a view similar to Figure 8 but showing the structure in a still later stage of the building operations;

Figure 11 is a sectional view taken on the line 11—11 of Figure 10, and

Figure 12 is a sectional view taken on the line 12—12 of Figure 8.

The drawings disclose an elevated arch structure such as may be employed as a bridge pier. The structure comprises two reenforced concrete columns 10 and 11 and a reenforced concrete arch 12 connecting the columns 10 and 11. The columns are supported on reenforced concrete plinths 15 which rest on the base formed by piles 16 capped by concrete 17, as in Figs. 1 and 2.

In Figures 1 to 5 the outer dotted lines 20 represent the outer surface of the concrete, and the full lines between these dotted lines represent the reenforcing structure. The columns 10 and 11 are cruciform in cross section as may be seen, for example, in Figure 5, and the arms of the cross, which in the form of column illustrated are of unequal lengths, are stepped back at successively higher altitudes as shown at 24 in Figures 1 and 2.

The reenforcing structure comprises two towers 22 and 23 connected together at their tops by the overhead metal structure 25. The towers comprise upright members 30 formed of bars which in the form illustrated are joined end to end by tie plates 31 bolted to the bars, as shown in Figure 7, the lowest bar of each upright being similarly joined to a vertical bar which extends down into the concrete of the plinth and forms part of the reenforcing structure of the plinth. Figure 5 shows twelve uprights, each located inside and adjacent to a corner of the finished column, the flanges of the bars forming the uprights being parallel to the sides of the column. Connecting the pairs of uprights at the outer edges of each arm of the cross are a series of horizontal angles 28 and also connecting the uprights of these pairs is a double lacing 29 formed by inclined angles 32 and inclined flat bars 33; see Figure 7. Similarly, uprights at the outer corners of the two opposite equal arms of the cross are connected together by horizontal angles 35 and also connecting these uprights is a double lacing 37 formed of inclined angles and inclined flat bars 39; see Figure 6. Each of the bars 38 and 39 are secured by bolts to a pair of uprights 30 located at inner corners of the cross as shown in Figure 6. Outer and inner uprights at each side of the remaining arms

of the cross are connected together by a series of horizontal angles 41 and by a single lacing 42 and adjacent inner uprights of these arms are connected by horizontal bars indicated diagrammatically by 44 in Figure 5.

It will be seen that the reenforcing tower is composed of bars or members which for the most part lie parallel and close to the sides of the finished structure. This arrangement of the bars forming the tower permits these bars to function most effectively as a reenforcement for the concrete. As the tower is not intended to support a heavy load there is no necessity of employing bars of larger cross section for the lower portions of the tower. The bars may thus be of the same cross sectional size through the height of the tower. I may, if desired, omit the uprights 30 located at the inner corners of the cross, employing only the uprights 30 at the eight outer corners of the cross, the uprights at the two corners of each arm and uprights at corners of opposite arms being joined by the bars and lacings as shown in the drawings. I find that this arrangement of bars gives sufficient strength to the construction and at the same time is extremely economical in the material employed and labor required for erection.

The metal structure 25 which connects the tops of the towers comprises pairs of side members formed of angles 45 secured at their ends to the uprights 30, the two bars 45 of the top and bottom pair being connected together by a lacing 46 and the two bars of each remaining pair being connected by bars 47 which extend at right angles to the side bars 45.

When the reenforcing structure is erected, as above described, it is encased in concrete. For this purpose I employ molds or forms shown in Figures 8 to 12. The forms employed for the towers comprise flat frames 50 located at the outer ends of the cross and cooperating angular frames 51 at the adjacent sides of adjacent arms of the cross to form a mold of cruciform section as shown in Figure 12. The frames 50 and 51 are formed of boards 53 connected together by wooden bars 54, the frames 51 having inner faces or sides 56 and 57 arranged at right angles to one another, these sides being braced by inclined bars 60. Bars 54 cross one another near their outer ends and extending between the outer ends are vertical bars 61. Surrounding the entire mold and holding the frames in position are cables 63 which engage the bars 61 and also engage the spacing bars 64 extending upward along the middle of the frames 50. The cables 63 are provided with turnbuckles 65 for tightening the cables.

With the frames constructed and arranged in the manner described they may be moved toward and away from the center of the column. To provide a means for moving the frames toward the center of the shaft to the desired position I employ bolts 70 which extend through the frames and through openings 71 in the horizontal connecting bars 35, the bolts 70 being provided with nuts 72 at their inner ends. I also provide spacing blocks 75 formed of wood or preferably of concrete, which are interposed between the bars of the reenforcing construction and the inner faces of the forms. When the forms are placed in the position shown in Figure 12 the bolts are turned to move the frames toward the center of the column until they abut against the spacing members 75, the frames being held by these spacing members at the proper distance from the reenforcing structure. In order to permit the ready removal of the bolts 70 after the concrete has been poured I may, if desired, surround the bolts by sleeves 76 formed of thin metal. After the mold is filled with concrete and the concrete has hardened the bolts 70 are removed, the forms taken down and the holes, in the concrete, left by the bolts are filled up.

While I have shown both the cables 63 and the bolts 70 for securing the frames in position, I may, if desired, omit either the bolts or the cables, as either alone will generally be sufficient to hold the frames in proper position. Figure 8 shows the skeleton towers with the lower frames in position, these frames being supported on the plinths 15. Figure 9 shows the next higher frames, these frames being supported on the steps or ledges 24 formed in the concrete below.

The concrete of the arch is formed in molds 80 which comprise flat frames 81 supported on the steel construction 82 employed for supporting the curved bottom of the mold which forms the curved arch. As will be seen from Figure 11, the mold forming the concrete above the arch is continuous with the mold forming the top of the supporting column. The frames 81 are spaced from the internal reenforcing construction 25 by spacing blocks 75 and, for the purpose of moving the frames into contact with the spacing blocks, I employ rods 85 which extend through the mold and are provided with nuts 86 which may be turned to force the frames 81 inwardly.

If desired, all of the steel work of the construction may be completed before the concrete is poured, thus dividing the work of building into steel construction work and concrete construction work. Thus, where the finished structure is a bridge, the skeleton piers will be connected by bars, cables or other metal members so as to complete substantially all of the steel work. In this case the towers will be of sufficient strength to carry the connecting members or dead metal load.

My invention may advantageously be employed in the construction of railway signal towers or similar trackway structures, such structures being built by forming a skeleton tower and subsequently encasing the tower in

concrete. In building a series of such towers the steel constructions may be successively erected by a group of workmen and the concrete work done by a second group following the first.

I claim:

1. The method of building a tall reenforced concrete structure such as a bridge pier, which consists in forming a base for the structure, erecting a tower on the base to form substantially the sole reenforcement for the concrete, said tower being formed of fabricated metal bars rigidly connected together and being of light construction and sufficiently strong to be self-sustaining, erecting molds around the tower, adjusting the molds to position by spacing means cooperating with the tower structure and filling the molds with concrete.

2. Steps in the method of forming a reenforced concrete structure, which steps consist in securing together metal bars to form a tall rigid framework designed to be encased in cement, constructing a mold, by securing together around the framework, frames forming sides of the mold, spacing the frames from the metal framework by concrete blocks inserted between the frames and framework and filling the mold with concrete.

3. The method of building a reenforced concrete structure, which consists in erecting a tall self-sustaining rigid reenforcing structure consisting of a framework of relatively light construction formed of metal bars connected together, erecting frames around the reenforcing structure so as to form a mold for concrete, inserting spacing members between the frames and reenforcing structure, adjusting the frames to position in contact with said spacing members by cables surrounding said frames and filling the mold with concrete.

4. The method of building a reenforced concrete structure, which consists in erecting a tall self-sustaining rigid reenforcing structure comprising a framework of relatively light construction composed of metal bars connected together, erecting frames around the reenforcing structure so as to form a mold, adjusting the frames to position by means engaging said frame and reenforcing structure and filling the mold with concrete, said rigid structure forming the entire reenforcement for the concrete.

5. The method of building a reenforced concrete structure, which consists in erecting a tall self-sustaining rigid reenforcing structure consisting of a framework of a relatively light construction composed of metal bars rigidly connected together, erecting frames around the reenforcing structure so as to form a mold for concrete, connecting screw-threaded members to the frames and adjusting the frames to position in respect to said framework by means of said screw-threaded members and introducing concrete into the mold, said rigid structure forming the entire reenforcement for the concrete.

6. The method of building a reenforced concrete structure, which consists of fabricating reenforcing bars or beams accurately formed for quick, accurate and simple assemblage at the place of building, assembling and rigidly connecting said bars to form a self-supporting and substantially self-aligning reenforcing skeleton construction of sufficient size to permit entry of workmen to the interior thereof, erecting molds around the construction, positioning said molds from the interior of such construction and employing such construction to so position the molds and filling the molds with concrete by apparatus supported in part by said reenforcing construction, said rigid skeleton forming substantially the sole reenforcement for said concrete.

Signed at New York in the county of New York and State of New York.

SAMUEL KENT.