P. AYLETT.

SYSTEM OF CONCRETE CONSTRUCTION.

APPLICATION FILED OCT. 26, 1907.

965,358. Patented July 26, 1910.

3 SHEETS—SHEET 1.

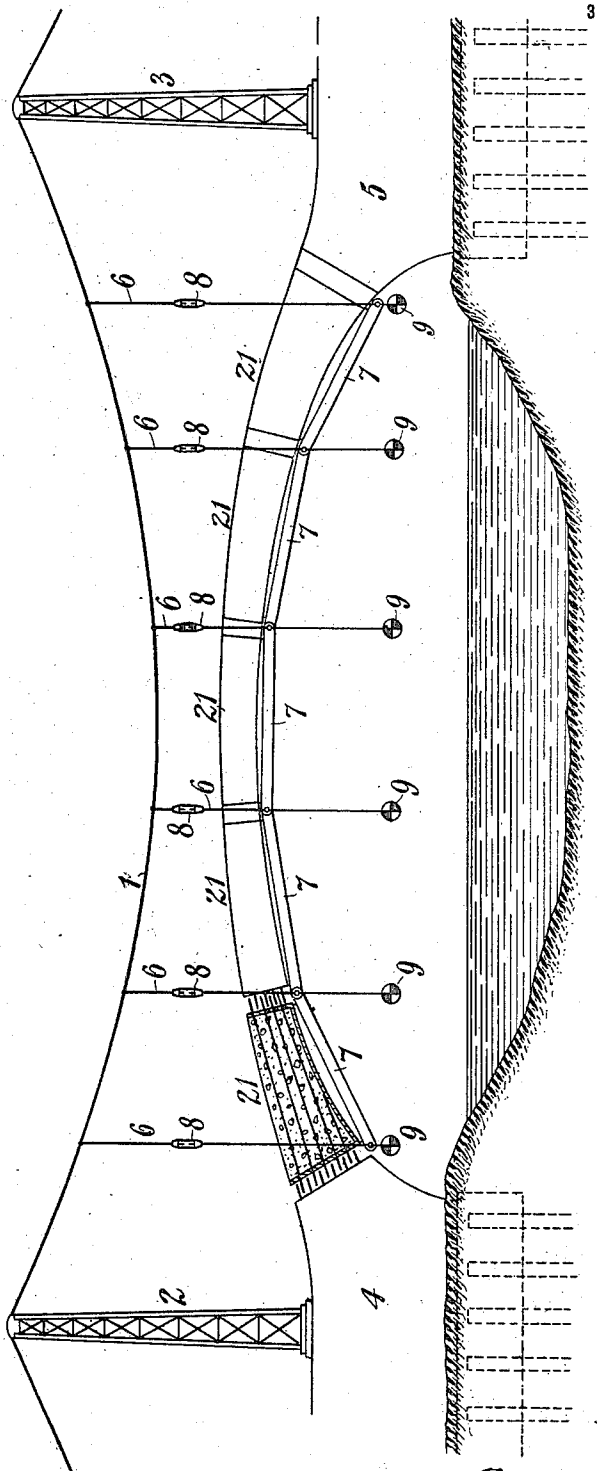

Fig. 1

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3 SHEETS—SHEET 2.

Fig. 2

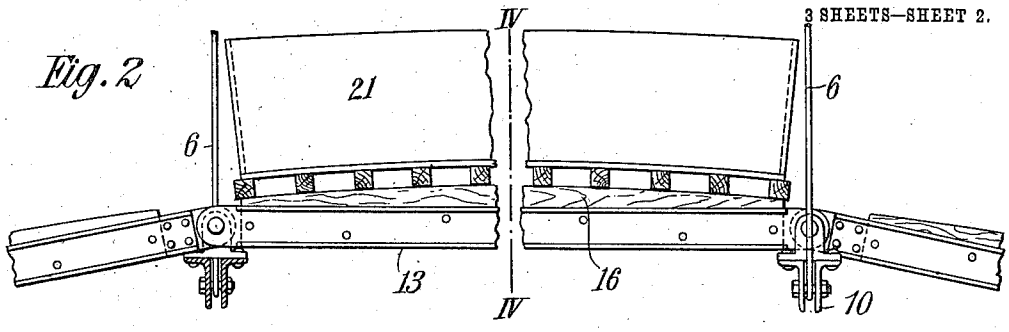


Fig. 3

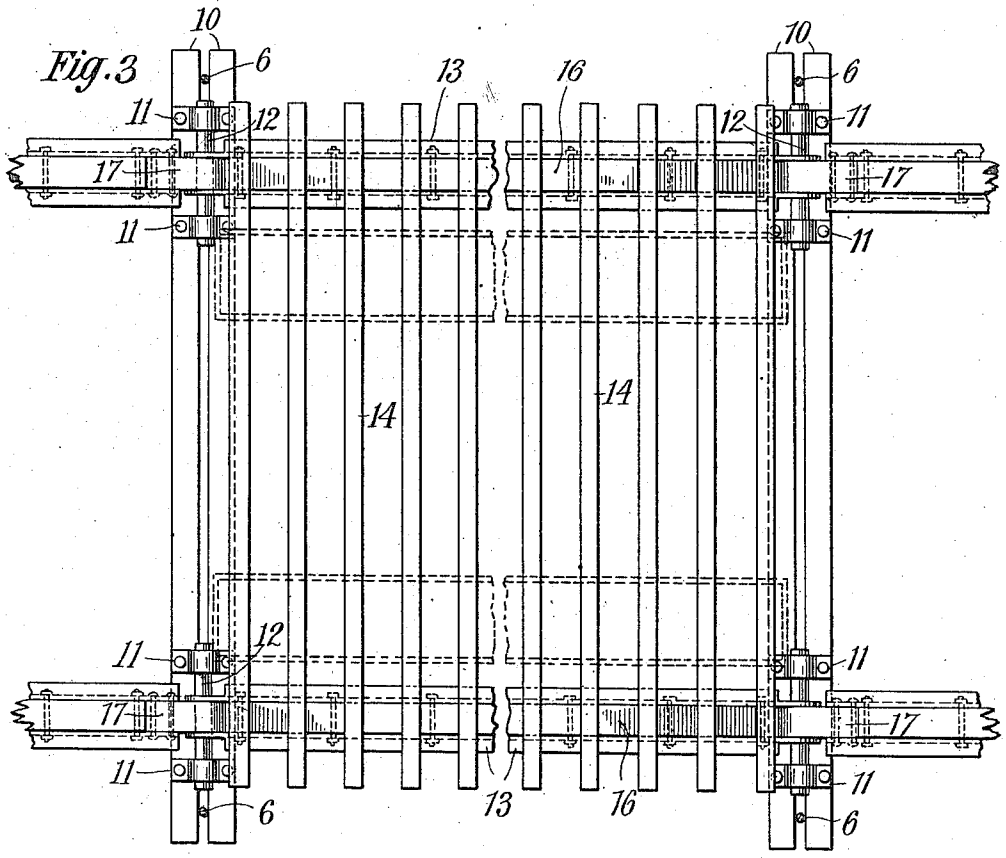


Fig. 4

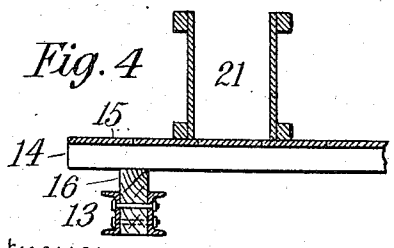
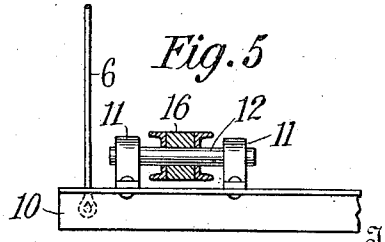


Fig. 5



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3 SHEETS—SHEET 3.

Fig. 7

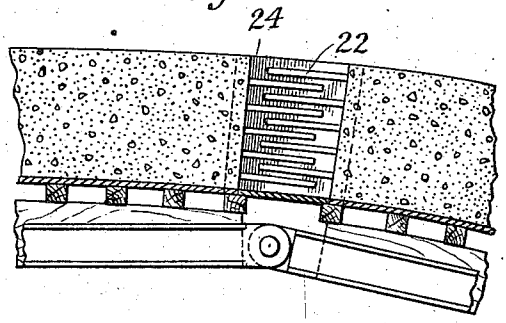


Fig. 6

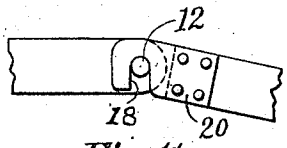


Fig. 8.

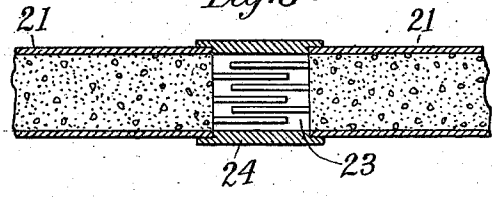


Fig. 11

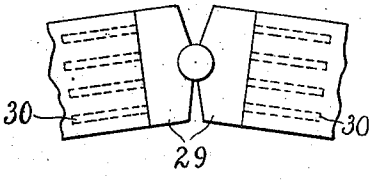


Fig. 9

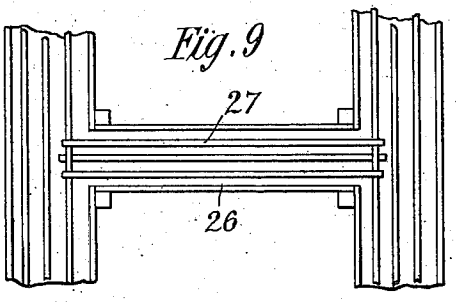
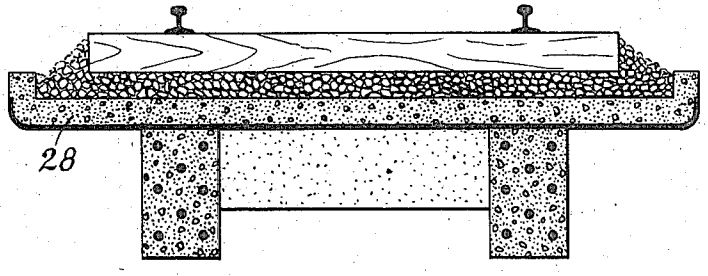


Fig. 10



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UNITED STATES PATENT OFFICE.

PHILIP AYLETT, OF PORTSMOUTH, VIRGINIA.

SYSTEM OF CONCRETE CONSTRUCTION.

965,358. Specification of Letters Patent. Patented July 26, 1910.

Application filed October 26, 1907. Serial No. 399,235.

To all whom it may concern:

Be it known that I, PHILIP AYLETT, a citizen of the United States, residing at Portsmouth, in the county of Norfolk and State of Virginia, having invented certain new and useful Improvements in Systems of Concrete Construction, of which the following is a specification.

Numerous methods, some more or less satisfactory, have been employed by engineers in the erection of concrete structures. For certain purposes, however, all the systems of construction with which I am familiar possess disadvantages which militate very strongly against their success. For example, a system which is convenient and otherwise satisfactory for erecting small structures may become extremely complicated and costly when applied to structures of greater magnitude, so that the usual economy of concrete construction may be greatly reduced, if not entirely eliminated. An instance of this kind is the erection of concrete arches, for bridges and other purposes. With small arches the false work necessary to support the unfinished arch may be simple and inexpensive, but for an arch of long span, say a hundred and fifty or two hundred feet in length and of corresponding height, the falsework is, as will be readily seen, extremely complicated, and is expensive not only in materials employed but also in the labor and time involved in erection. In fact, the cost of the temporary support increases out of all proportion to the increase in size of the structure to be erected thereon.

I have therefore been led to devise my present invention, which has for its chief object to provide a system of construction of the simplest character and of low cost, by which concrete structures of any size can be erected with marked economy.

Briefly stated, the essential feature of my invention is the use of a "centering" or temporary support consisting of a plurality of hinged sections arranged end to end and supported by one or more cables extending over the space to be spanned by the structure in course of erection. The hinging or jointing of the supporting members or sections makes the whole flexible, as it were, so that it may be arranged to lie in a horizontal plane, or at any angle to the horizontal, or in the form of an arch of any desired curvature, merely by lengthening or shortening, as the case may require, the rods or equivalent devices which support the same on the cable or cables.

To those skilled in the art it will be apparent from the above that the invention can be used in the erection of structures of widely different kinds.

In the annexed drawings I have shown the invention employed in the construction of a concrete arch, using a bridge arch as an example.

Referring now to the drawings, Figure 1 is a side elevation, somewhat diagrammatic in character, of an application of my invention to the construction of an arched bridge. Fig. 2 is a detail view in side elevation of a section of the temporary supporting structure or centering. Fig. 3 is a detail plan view of Fig. 2. Fig. 4 is a detail cross section on line IV—IV of Fig. 2. Fig. 5 is a detail view, partly in section, of the preferred type of hinge or pivot joint between supporting sections. Fig. 6 is a detail view of another form of hinge joint. Fig. 7 is a detail side elevation illustrating a convenient method of keying together the sections of the arch, and Fig. 8 is a sectional plan view of the same. Fig. 9 is a sectional plan view showing an arrangement of molds for forming a cross member between concrete arches. Fig. 10 is a cross-section of the completed bridge, taken at or near the center of the span. Fig. 11 is a side view of a portion of a so-called hinged arch, a type of arch which may be constructed by means of my system.

In the embodiment of the invention illustrated in the drawings, the cables, one of which is indicated at 1, are hung from suitable elevated supports, such as the towers, 2, 3, located preferably at or near the abutments 4, 5 of the arch or other structure which is to be erected. The cables are anchored in any convenient and suitable manner, not shown. Depending from the cables are the hangers 6, carrying cross members which in turn carry the longitudinal supports 7. The latter are hinged to each other at the cross members, so that by lengthening or shortening the hangers 6 the series of supports 7 can be made to assume any desired curvature, according to the arch which is to be erected. In practice the lengths of the hangers are preferably determined in advance, so that when the cables and flexible centering are in place the latter will have the desired curvature; but to permit adjust-

ment at any time the hangers may be provided with turnbuckles, 8, or equivalent means, whereby they may be radily let out or taken up as desired, so as to correct the curvature of the centering whenever necessary. Hanging from the ends of the hinged sections is a row of targets 9, on cords of such lengths, easily determined in advance by calculation, that when the curvature of the flexible centering is correct the targets will all be at the same level. Thus, under the direction of an engineer with an instrument on the bank of the stream, the sag of the cables and the lengths of the hangers can be varied until the targets are all at the same level, whereupon it is known that the centering is in proper form.

The cross members carried by the hangers 6 consist preferably of a pair of angle irons 10, fastened together with their flanges uppermost and with the hangers extending between them at the ends, as shown in Figs. 2, 3, and 5. At the ends of the cross members are bearing blocks 11, securely fastened to the flanges of the angle irons, affording bearings for the pivots 12 of the longitudinal supports. The latter consist of a pair of side members 13, across which is a suitable number of joists 14, and above the latter a flooring 15 if desired,—see Fig. 4. Each side member consists of a pair of channel irons securely fastened by bolts, or otherwise, to a filling member 16. Since the channel irons are preferably straight, the fillers 16 have their upper edges curved to the arcs of which their respective channel irons are chords, thereby making the complete centering conform to the curvature of the arch which is to be erected. By substituting differently curved fillers, and altering the lengths of the hangers 6, as previously mentioned, any curvature of arch may be provided for. The fillers terminate short of the ends of the side members, and in alternate sections the projecting ends of the channel irons constitute gussets, to receive filling blocks 17, fastened between the channel irons of the adjacent sections. The pivots 12 extend through the gussets and filling blocks. The pivot bearings in the gussets (and in the adjacent section also) may, if desired, be formed by upwardly extending slots, as shown at 18, Fig. 6, so that the sections can be assembled by merely dropping them in place on the pivots. This figure also shows side members formed by single elements, for example simple wooden beams 19, one of which has gussets 20 secured to it.

As previously stated, the longitudinal sections are preferably constructed and arranged as above described, but it is to be understood that numerous other constructions and arrangements can be employed with satisfactory results. The scheme selected will usually depend upon the circumstances of use, cost, etc., and is to be determined by the engineer who undertakes to practice the invention.

The temporary structure provided by my invention may be utilized in various ways. In concrete work, however, I prefer to proceed as follows:—On each section 7, I place one or more molds 21, in which may be cast the corresponding sections of the arch, the number of molds on each centering section being determined by the width of the latter, the number of arches to be constructed, the distance between the same, etc. The molds are shorter than the supporting sections, as shown in Figs. 1 and 7, and extending through the molds lengthwise, into the spaces between the same, are reinforcing bars 22, of suitable number and character. Similar bars extend from the abutments into the spaces between the same and the adjacent arch molds. The molds being in place, they are now filled with concrete. Of course the molds may be filled in any order, but to keep the arch well balanced and minimize the tendency to distortion the center mold or molds should be filled first; next the end molds are filled simultaneously; then the molds midway between the center and the ends, and so on until all are filled. When the concrete has set, the ends of the molds are broken out or otherwise removed and the spaces between sections inclosed in any convenient and suitable manner, as by means of bottom pieces 23 and side pieces 24, Figs. 7 and 8. The key-molds thus formed are now filled with concrete, embedding the overlapping reinforcements and keying the arch sections together. Where two or more arches are constructed side by side, as in Fig. 10, they may be connected by cross beams, as shown at 25, cast in molds extending between the arch molds at suitable points. Such a cross mold is shown at 26, Fig. 9, and, as will be seen, is in communication with its arch molds, so that the three can be cast integral with each other. Reinforcing bars 27 may be provided, extending through the cross molds into the adjoining arch molds. The arch beams being now completed, the cables and centering are taken down and the roadway, of any desired kind, is constructed on the arches.

In Fig. 10, which shows a railway bridge, the track is laid on a bed 28 of reinforced concrete.

One or more of the spaces between the arch sections can be readily utilized for the construction of so-called "hinged" arches. Thus, instead of filling all the spaces with concrete, one, two, or more as may be desired, may have "hinges", say of the type shown in Fig. 11. As shown in this figure, the hinge members 29 are provided with dowels 30, extending into the arch sections and em-

bedded therein in the operation of casting the latter.

To those skilled in the art it will be apparent that the system above described provides an exceedingly inexpensive method of construction. The temporary structure, consisting of the cables and flexible floor or centering, is not only inexpensive in itself but being adaptable to widely varying conditions, merely by adding or omitting sections and by varying the lengths of the hangers, is capable of repeated use, thus still further reducing the cost of erecting concrete structures. Furthermore, less labor is required, both in the erection of the centering and in the construction of the concrete work, than in any system with which I am familiar.

Other advantages might be mentioned, but those referred to are sufficient to show the marked utility of the invention.

As previously stated, the embodiment herein specifically illustrated and described is merely the preferred way of carrying out the invention and may be modified widely without departing from the spirit of the invention, which I believe to be defined by the following claims.

What I claim is:

1. In a system of concrete construction, the combination of supports arranged on opposite sides of a space to be spanned by a concrete structure; cables mounted on said supports and extending across the space to be spanned by the concrete structure; a centering comprising a plurality of flexibly jointed sections; and means for supporting the centering on the cables.

2. In a system of concrete construction, the combination of supporting cables arranged over a space to be spanned, a centering comprising a plurality of flexibly jointed sections, and hangers suspending the said sections from the cables.

3. In a system of concrete construction, the combination of supporting cables arranged over a space to be spanned, a centering comprising a plurality of flexibly jointed sections, and hangers, adjustable in length, suspending the said sections from the cables.

4. In a system of concrete construction, the combination of supporting cables arranged over a space to be spanned, hangers depending from the cables, cross supports carried by the hangers, and a series of longitudinal supports, flexibly jointed end to end, carried on the cross supports.

5. In a system of concrete construction, the combination of elevated supports arranged on opposite sides of a space to be spanned by a concrete structure; cables mounted on said supports and extending across the space to be spanned by the concrete structure; a centering composed of a plurality of flexibly jointed sections; and means for suspending the said centering from the cables.

6. In a system of concrete construction, the combination of a series of supporting sections flexibly jointed end to end to constitute a centering of variable form, means for suspending the said centering in predetermined form over a space to be spanned by a concrete structure, said suspending means comprising cables extending over the centering and hangers depending from the cables and connected to the centering sections at the ends thereof.

7. In a system of concrete construction, the combination with a plurality of sections arranged end to end, to constitute a centering; of a plurality of transverse supports, located at the adjoining ends of the said centering sections; means carried by the transverse supports for pivotally connecting the centering sections; and means connected with the transverse supports for supporting the structure over a space to be spanned.

8. In a system of concrete construction, the combination of a series of supporting sections flexibly jointed end to end, means for suspending the series of sections as a centering over a space to be spanned and in predetermined form, and a series of molds on the said supporting members, arranged in alinement but spaced apart at their ends.

9. In a system of concrete construction, the combination of a plurality of centering sections flexibly jointed together, molds on the said sections, spaced apart at their ends, reinforcing bars extending from the ends of the molds into the spaces between the same, and means for molding concrete keys in the said spaces.

10. In a system of concrete construction, the combination of a centering, a series of spaced molds for casting sections of a concrete structure on the centering, reinforcing bars extending through the respective molds and into the spaces between the same, and means for casting concrete keys in the spaces between the molds.

11. In a system of concrete construction, the combination of a centering, a series of spaced molds for casting sections of a concrete structure thereon, and molds for casting keys between the structural sections.

12. In a system of concrete construction, the combination of centering, a series of spaced sections of a concrete structure on the centering, and molds inclosing the spaces between the sections for casting keys between the same.

13. In an apparatus for erecting structural elements by arranging sections of the elements in the positions which they are to occupy in the finished structure and subsequently keying the sections together, in com-

bination, supporting cables extending across the space to be spanned by the structural element, means for suspending from the cables the sections of the element in pivotal relation to each other end to end, and adjusting devices associated with said means for effecting pivotal adjustment of the sections relative to each other to bring the same into desired alinement before keying them together.

14. In an apparatus for erecting structural elements by arranging sections of the elements in the positions which they are to occupy in the finished structure and subsequently keying the sections together, in combination, supporting cables extending across the space to be spanned by the structural element, hangers depending from the cables, means carried by the hangers for supporting the sections of the structural element in pivotal relation to each other end to end, and means for varying the lengths of said hangers to effect pivotal adjustment of the sections relative to each other to bring the same into desired alinement before keying them together.

15. In an apparatus for erecting structural elements by arranging sections of the elements in the positions which they are to occupy in the finished structure and subsequently keying the sections together, in combination, cables extending across the space to be spanned by the structural element, supports for the sections of the structural element suspended from the cables and pivotally connected together, and means for effecting pivotal adjustment of the supports to bring the sections into desired alinement with each other before keying them together.

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