Jan. 19, 1954 C. D. RUARK 2,666,507

BUILDING STRUCTURE

Filed Oct. 21, 1949 2 Sheets-Sheet 1

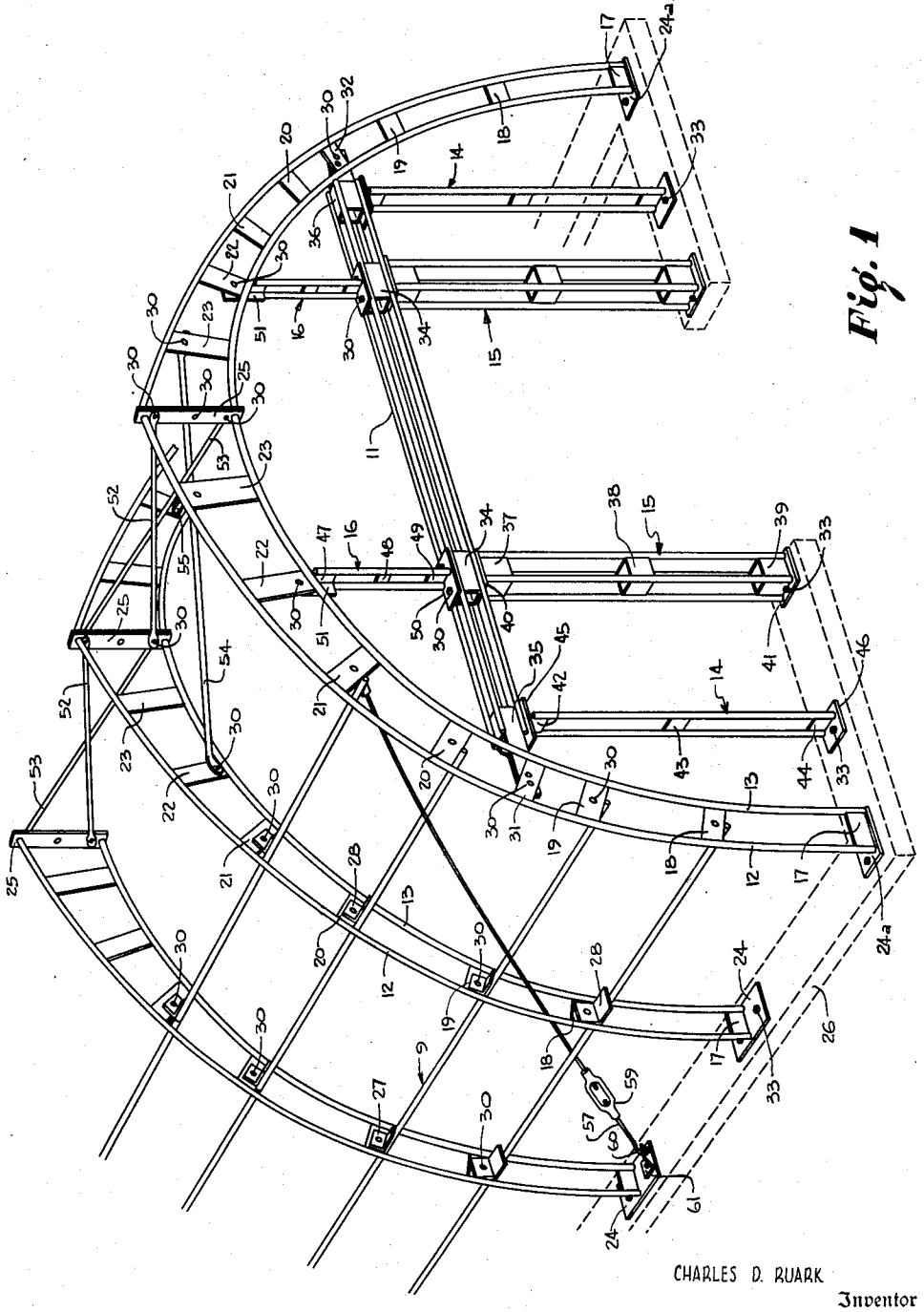


Fig. 1

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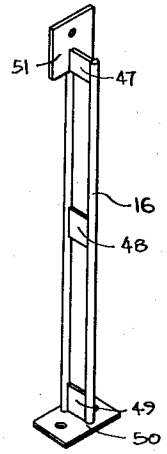


Fig. 4

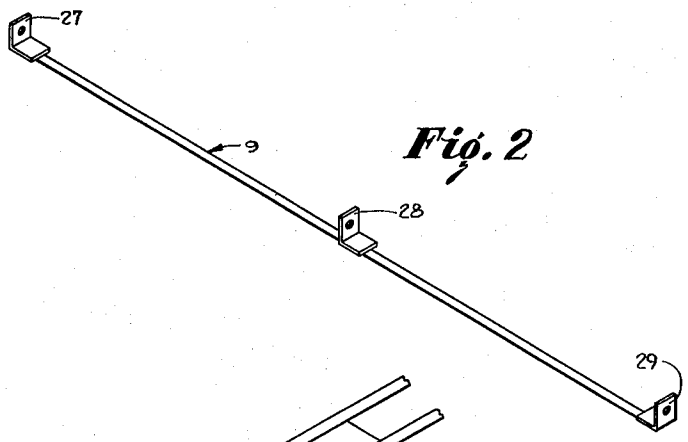


Fig. 2

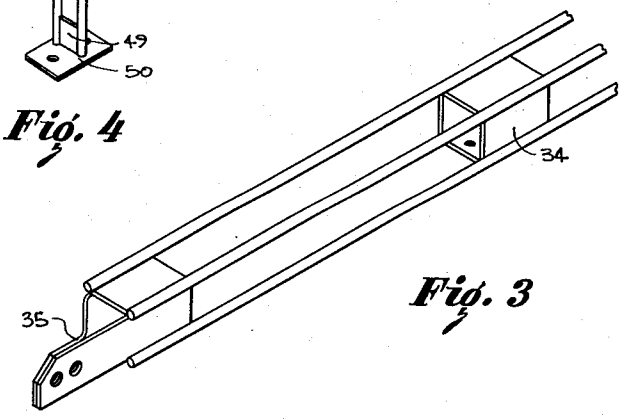


Fig. 3

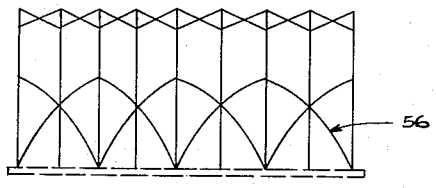


Fig. 5

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BUILDING STRUCTURE

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3 Claims. (Cl. 189—2)

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This invention relates to building construction and more particularly to an arched type building framework made in prefabricated structural steel sections and parts adapted to be easily and quickly assembled at the building site.

It is an important object of the invention to provide a framework of this class which has unusual strength and resistance to load and wind pressures, yet which is much lighter in weight than structures of similar strength.

Another object is to provide a building framework of this class which leaves the entire interior of the building free of upright columns, even in buildings as large as 60 feet by 150 feet.

Another object is to provide a sectional framework, the sections of which can be bolted together to form a rigid unitary structure.

Another object is to provide a framework of this class, many of the parts and sections of which can be reversed for use on either side or either end of the structure.

Another object is to provide a framework, the various parts of which may be initially loosely secured together, the framework trued, and the parts then rigidly secured together.

Still another object is to provide a means for truing the assembled parts after they have been initially loosely assembled, and for holding them in their proper relative positions while they are being finally and rigidly secured together.

An additional object is to provide sectional framework which can be assembled into a rigid unitary framework with a minimum of skilled labor.

The invention, together with other objects attending its production, will be more clearly understood when the following description is read in connection with the accompanying drawings, in which:

Fig. 1 is a perspective view of a portion of a building framework embodying the invention, certain parts having been omitted for drawing clarity, the omitted parts being identical to certain of those shown;

Figs. 2, 3, and 4 are perspective views of certain parts of the framework, and show details of construction; and

Fig. 5 is a schematic side view of an assembled framework constructed in accordance with the invention.

General description

As will be seen in Fig. 1, a building framework embodying the invention includes a series of parallel identical truss-like arches disposed laterally with respect to the building, and spaced

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longitudinally with respect thereto. Longitudinal strength is provided by parallel horizontal stringers 9, which also serve to maintain the spacing of the arches. Additional strength is provided by X-bracing connecting the centers of each adjacent pair of arches and lying in a substantially vertical plane, and by additional X-bracing lying in a near horizontal plane. Diagonal turnbuckle bracing serves to initially true the various arches during assembly and to subsequently maintain them in their proper relative positions. Each end of the framework includes a horizontal tie beam 11, and a desired number of upright columns 14, 15, and 16, rigidly connected together to form a unitary end arch with a doorway opening of desired size.

Prefabricated parts description

Each arch is made up of a right and a left hand section adapted to be joined together at their upper ends. Each arch section is made up of two structural steel members 12 and 13, defining the outer and inner chord members of the arch, respectively. These chord members are preferably circular in cross section, and bent into substantially semi-circular form. The radius of a curvature of the inner member is preferably but not necessarily less than that of the outer member 12, and their lower ends are thus shown positioned closer together than their upper ends. These members are rigidly connected together and held in spaced relation by means of spacer plates 17 to 23 inclusive, the opposite ends of which are welded rigidly to the arch members. In addition, the lower ends of the members 12 and 13 are rigidly welded to one surface of an anchor plate 24 which lies in a plane normal to that plane in which the assembled members 12 and 13 lie. The opposite ends of the members 12 and 13 are rigidly welded to one surface of an elongated keystone plate 25, near its opposite ends. The anchor plates 24 are perforated to receive the ends of properly spaced bolts 33 set in the concrete building foundation 26, which bolts serve to firmly anchor the base of each arch section and each upright column to the foundation. The plates 25 are perforated to receive bolts 30 for rigidly connecting the upper ends of right and left hand arch sections together.

The longitudinal stringers 9 are also made in sections, as clearly shown in Fig. 2. Each stringer section includes a rod to which are welded a plurality of equally spaced rigid angle brackets 27, 28, and 29. That portion of each bracket which lies in a plane at right angles to the rod

is perforated, as shown in Fig. 2, and the brackets are positioned on the rod so that the perforations are in substantial alignment.

The two end arches of each building frame, according to this invention, differ from the other arches only in the type of anchor plate provided for the right and left hand arch sections, and in the inclusion of additional spacer plates 31—32, welded in desired positions. The anchor plates 24a are simply half plates, and project inwardly only from the plane of the end arch.

Each end of the framework includes a horizontal tie beam, designated as a whole by the numeral 11, and several different types of upright columns, their number and positioning depending on the span and height of the assembled arches used. The different types of columns are designated as a whole by the numerals 14, 15, and 16.

The tie beam construction is clearly shown in Fig. 3. It includes four spaced parallel rods held rigidly in assembled position by being welded to the four corners of open ended structural steel plate boxes 34, and likewise to the four corners of similar right and left hand end boxes 35—36. The opposite side plates of the end boxes are extended outwardly beyond the ends of the top and bottom plate members, as clearly shown in Fig. 3, and their outer ends are rigidly welded together and provided with bolt holes to form an attaching flange.

The upright columns 15 are formed in much the same manner as the tie beams. Four spaced parallel rods are welded to the respective corners of spacer boxes 37, 38 and 39, built of steel plates welded together. The opposite ends of the rods and the outer ends of the plates which form the end boxes, however, are welded to heavy anchor plates 40—41 which lie at right angles to the longitudinal center lines of the columns. Bolt holes in the plates 40—41 permit the respective ends of the columns 15 to be rigidly secured to the foundation 26 and to the bottom plates of the tie beam boxes 34 by means of bolts 33 and 30 respectively.

The columns 14 are made up of two parallel rods held in spaced position by means of spacer plates 42—43—44,, welded to the rods. Parallel top and bottom plates 45—46 are welded to the opposite ends of the rods and to the outer ends of the end spacer plates 42—44, in positions normal to the longitudinal axis of the column. Bolt holes in the plates 45—46 permit their rigid attachment to the bottom plate of the end boxes 35—36 of the tie beam, and to the building foundation, by means of suitable stud bolts 33 set in the concrete.

The upright columns 16 (Fig. 4) are similar in construction to the columns 15, just described. They include parallel rods, spacer plates 47—48—49 welded to the rods, a base plate 50 welded to the rods and lower end plates in a plane normal to the length of the column, and an upper end plate 51. This latter plate is positioned in a transverse plane normal to the plane of the plate 50 and also normal to the plane in which the two rods and the spacer plates lie. The bottom plate 50 is provided with bolt holes to facilitate its rigid attachment to the top plate of one of the boxes 34, which is provided with matching bolt holes. The end plate 51 is also provided with one or more bolt holes to facilitate its rigid attachment to one of the arch spacer plates 21—22—23, depending on the span and height of the arches used. Naturally the length of all the described members 11, 14, 15 and 16 will vary with the size of the building being constructed.

Erection and assembly

The various parts thus far described, together with certain other parts to be subsequently mentioned, may be prefabricated at a central factory and shipped disassembled to the building site.

Right and left hand arch sections are rigidly secured together at their upper ends by heavy bolts 30 passed through matching holes in the plates 25, and the assembled arches are raised into position on the foundation 26. The base end of each arch section is securely bolted to the foundation. The arches may be held in upright position by guy wires until several arches have been assembled and raised into position on the foundation. Rigid bracing rods 52—53 having flattened drilled ends are next placed in the positions shown in Fig. 1 and bolted to the upright plates 25 of adjacent arches to form X-braces which lie in a substantially vertical plane. The nuts on the bolts 30 which connect these rods to the plates 25 are not fully tightened at this time.

Next, similar brace rods 54—55 have their respective ends connected to opposed right and left hand spacer plates 22 and 23 of adjacent arches by means of additional bolts 30, to form additional X-bracing lying in a plane substantially at right angles to the previously formed X-braces.

In the meantime stringer sections 9 have been bolted to the various horizontally alined spacer plates 18 to 21 inclusive by means of additional bolts 30, in the manner clearly shown in Fig. 1.

Next the tie beams 11, and upright columns 14—15—16 are placed in position as shown, and as previously described, and the nuts on all the bolts 30 only partially tightened.

When the proper number of arches have been assembled and erected, and the stringers and X-bracing are in position, turnbuckle type truing braces are placed in position. A preferred arrangement of these truing braces is shown schematically in Fig. 5, each brace being designated as a whole by the numeral 56. The details in the construction of such a brace are shown in Fig. 1. It consists of two rods 57—58 having threaded ends connected together by a conventional heavy turnbuckle 59. The respective outer ends of the rods are bent to form hooks 60. Identical anchor plates 61 are bolted to a chosen one of the arch base plates 24, and to a desired one of the arch spacer plates 20—21—22. The free upturned end of each anchor plate 61 is perforated to receive the hook 60 of one of the rods 57—58.

When the turnbuckle braces 56 have been placed in position on both sides of the framework, the turnbuckles are tightened gradually and in varying degrees to pull all the assembled arches into vertical and transverse parallelism. Thereafter, all the nuts on all the bolts 30 which connect the various parts together are tightened, and the building framework is ready for the application of exterior siding and roofing of any desired type. By threading the truing braces 56 over the intervening stringer rods 9, as clearly shown in Fig. 1, the truing braces are confined to the space within the upper and lower chord members of the arches, thus leaving the ceiling face of the arches entirely unobstructed.

From the above description it is apparent that this invention provides a framework which is free of internal upright bracing, yet which is so con-

structed that both the downward roof loading forces and the horizontal wind forces are transmitted and evenly distributed throughout the structure, thus eliminating the concentration of high bending moments or compressive forces in any one or any small group of parts, and producing an unusually strong structure.

Having described the invention with sufficient clarity to enable those familiar with the art to construct, assemble, and use it, I claim:

1. A skeleton building framework including transverse truss-like arch members disposed in spaced parallel vertical planes, X-brace rods disposed in a substantially vertical plane and connecting the upper central portions of each adjacent pair of arch members at vertically spaced points; and X-brace rods disposed in a substantially horizontal plane and beneath the first mentioned X-brace rods also connecting the upper portions of each adjacent pair of arch members at points spaced laterally of the respective centers thereof, said second mentioned X-brace rods crossing one another substantially in the vertical plane in which said first mentioned X-braces lie.

2. A skeleton building framework including transverse truss-like arch members disposed in spaced parallel vertical planes, each arch member including inner and outer chord members which are spaced a greater distance at the top central portion of the arch than at its lower ends; X-brace rods disposed in a substantially vertical plane connecting the top central portion of each adjacent pair of arch members at vertically spaced points; and X-brace rods disposed in a substantially horizontal plane and beneath the first mentioned X-brace rods also connecting the upper central portions of each adjacent pair of arch members at points spaced laterally of the respective centers thereof; the second mentioned X-braces crossing one another substantially in the vertical plane in which the first mentioned X-braces lie, spaced horizontal longitudinally disposed stringer rods rigidly connecting the various arch members and disposed between the inner and outer chord members of said arches, and diagonally disposed truing braces each having one end connected to one arch member at an elevated level and its opposite end connected to a remote arch member near the lower end of one of its legs and threaded over the intervening stringer rods so as to be confined thereby to the spaces between the inner and outer chord members of the arches.

3. In a building framework, the combination of a plurality of upright truss-like arch members arranged in spaced parallel planes, each arch member comprising separably connected complemental right and left hand arch sections, and each arch section comprising inner and outer chord members arranged in a common vertical plane, the chord members of each arch section being spaced apart a greater distance at the top portion thereof than at the lower end thereof; a keystone plate rigidly connecting the chord members of each complemental arch section at the upper end thereof; means securing the keystone plate of each right hand arch section to the keystone plate of its corresponding and complemental left hand arch section with the line of juncture therebetween lying substantially in the central longitudinal vertical plane of the building framework; crossed bracing rods lying substantially in said vertical plane rigidly connecting the keystone plates of each adjacent pair of arch sections at vertically spaced points; longitudinally disposed stringer rods passing between the chord members of each arch and connected to adjacent arch members for bracing them and maintaining their spacing; and diagonally disposed truing braces each having an end connected to an arch section spacer plate at an elevated level, and its opposite end connected to the base plate of a remote arch member and threaded over the intervening stringer rods so as to be confined thereby to the space within the chord members of the arches.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,363,407	Gourdie	Dec. 28, 1920
1,753,862	Johnson	Apr. 8, 1930
1,841,321	Arnstein et al.	Jan. 12, 1932
2,013,820	Wilson	Sept. 10, 1935
2,199,152	Edge et al.	Apr. 30, 1940
2,225,972	Brogren	Dec. 24, 1940
2,256,812	Miller	Sept. 23, 1941
2,353,071	Pitou	July 4, 1944
2,390,418	Brown	Dec. 4, 1945
2,392,920	Hanisch et al.	Jan. 15, 1946
2,407,252	Closs	Sept. 10, 1946

FOREIGN PATENTS

Number	Country	Date
493,247	France	Aug. 21, 1919