June 1, 1965 M. F. HUFF 3,186,071

APPARATUS FOR ERECTING A SELF-SUPPORTING BUILDING AND THE LIKE

Filed July 16, 1962

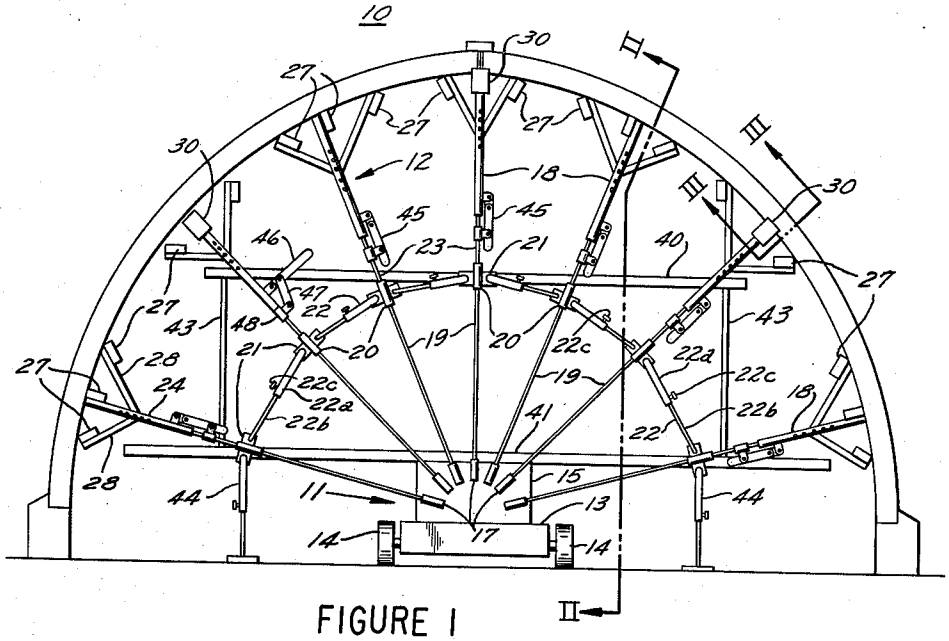


FIGURE 1

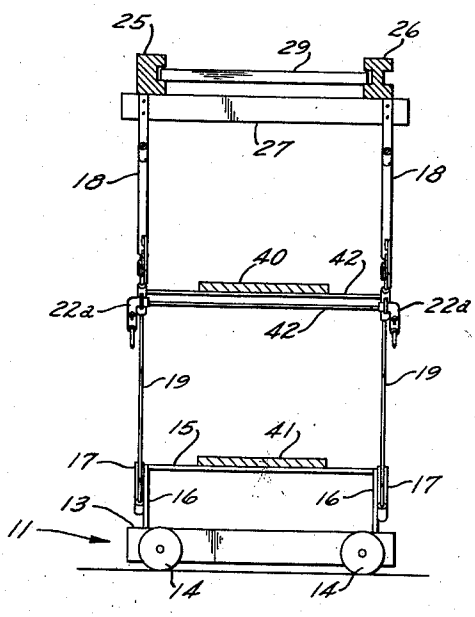


FIGURE 2

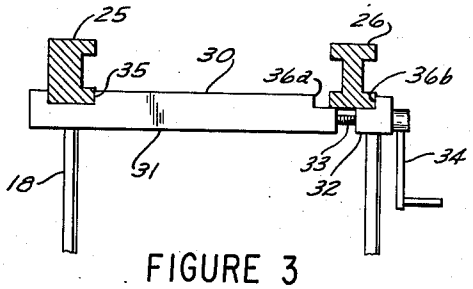


FIGURE 3

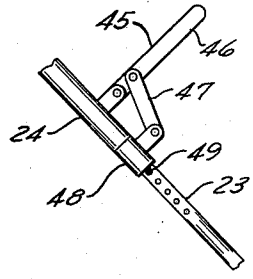


FIGURE 4

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APPARATUS FOR ERECTING A SELF-SUPPORTING BUILDING AND THE LIKE

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The present invention relates to apparatus for erecting buildings, and is more particularly concerned with apparatus for erecting a self-supporting building.

There have been available on the market for many years buildings referred to as self-supporting buildings and apparatus for assisting in the erection thereof. Recently self-supporting concrete buildings such as fallout shelters have become familiar to all. These shelters also have become quite popular for storing crops, grains, and tools as well as for use as welding shops or the like. Most of these shelters are made by pouring concrete into a form which is removed after the concrete has hardened. Doors and the like are then secured to the shelter.

Although the apparatus of the present invention has numerous other uses, it is particularly designed for rapidly erecting self-supporting concrete buildings. It will be appreciated that the size of such concrete buildings is limited unless the buildings are made from precast parts which are shipped to a site and erected thereon. An example of a self-supporting concrete building erected from precast parts is disclosed and claimed in my co-pending application, Serial No. 210,267, filed July 16, 1962. In erecting self-supporting buildings heretofore, several different types of apparatus have been available. Generally such apparatus are too complicated and limited to a specific size and type building. In any event, none of such apparatus is capable of performing the functions necessary for economical erection of a self-supporting concrete building from precast arcuate beams and planks. It would, therefore, be desirable to provide an apparatus which may be utilized to support, align, and position vertically or horizontally one beam of a self-supporting concrete building with reference to another beam during erection and assist in interlocking one section of the building to a previously erected section thereof. While particularly applicable to concrete buildings, the apparatus is obviously not limited in its range of applicability by the materials of construction employed in constructing the building, and may also be employed in erecting similar-type buildings, especially of the self-supporting type, constructed of other materials, e.g., wood, metal, plastic, expanded plastic, laminates, and the like.

Any apparatus useful for erecting self-supporting buildings should advantageously be applicable in the erection of buildings of various different dimensions. It would therefore also be desirable to provide apparatus which is rapidly adjustable for erecting self-supporting buildings of various widths.

Accordingly, it is an object of the present invention to provide an improved apparatus which is useful for erecting a self-supporting building from precast or other preformed components.

Another object of the present invention is to provide apparatus for erecting a self-supporting building which apparatus may be readily shifted as each section of the self-supporting building is completed.

A further object of the present invention is to provide apparatus which may be promptly adjusted for erecting self-supporting buildings of various widths.

Still another object of the present invention is to provide apparatus having a plurality of adjustable radial arms disposed in two rows for positioning arcuate beams vertically during erection of a self-supporting building.

A still further object of the present invention is to provide apparatus of simple and compact structure embodying means for aligning the apparatus to a previously erected section of a self-supporting building.

Yet another object of the present invention is to provide apparatus for erecting a self-supporting building having clamps for shifting one arcuate beam toward another for interlocking a plurality of planks disposed between the beams.

Additional objects and advantages of the present invention will be apparent to one skilled in the art and still other advantages will become apparent hereinafter.

To the accomplishment of the foregoing and related ends, the present invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail a certain illustrative embodiment of the invention, being indicative, however, of but one of the ways in which the principles of the invention may be employed.

Briefly, the present invention is concerned with apparatus for erecting a self-supporting building from precast arcuate beams and planks. The base of the apparatus is provided with rollable means or mounted on an ambulatory platform for horizontal movement on a supporting surface from one position to another, as each section of the building is erected, and from one building site to another. Extending radially outwardly from the base are a plurality of adjustable arms having cross arms at the distal ends thereof for supporting the concrete beams during erection of the building. Clamp members are also carried by some of the distal ends of the arms for altering the dimension between the beams disposed on the cross arms and for aligning the apparatus to a previously erected section of the building.

For a better understanding of the present invention, reference may be had to the accompanying drawings in which all of the parts are numbered, the same numbers are used to refer to the corresponding parts throughout, and wherein:

FIGURE 1 is a front elevational view of an apparatus embodying the present invention for erecting a self-supporting building;

FIGURE 2 is a sectional view taken along line II—II of FIGURE 1;

FIGURE 3 is an enlarged fragmentary view taken along line III—III of FIGURE 1; and

FIGURE 4 is an enlarged fragmentary view of a portion of one of the radial arms shown in FIGURE 1.

Referring now to FIGURE 1 of the drawings, there is illustrated an apparatus, generally indicated at **10**, for erecting a self-supporting building especially such a building of precast arcuate concrete beams and precast concrete planks. The apparatus **10** comprises a supporting platform **11** and a frame **12**.

Considering first the supporting platform **11**, it preferably comprises an ambulatory base **13**, which may be mounted to the bed of a conventional truck or trailer. For facilitating horizontal movement of the base **13** from one position to another as each succeeding section of the building is erected or for movement from one building site to another, the base is provided with a plurality of rollable means, e.g., rollers or wheels **14**. Thus, the building may be promptly erected since very little time is necessary for repositioning erecting apparatus **10**.

As best illustrated in FIGURES 1 and 2 of the drawings, a superstructure **15** suitably secured to the base **13** of the platform **11** is provided with a pair of vertically disposed plates **16** in spaced parallel relationship to each other. A plurality of sleeves or cup-shaped members **17** radially secured to the outer faces of the plates **16** either adjustably or by welding or the like carry adjustable arms **18** which extend radially outwardly in two parallel rows

which will hereinafter be referred to as the first row and the second row. More specifically, each arm 18 comprises a rod or pipe 19, the lower end thereof being received by each of the sleeves 17. The length of each rod 19 depends to a certain extent upon the width of the building being erected and may be of one or more sections. A coupling 20 carried by the upper end of each of the rods 19 is provided with a pair of opposed ears 21, and each of the couplings 20 is connected to an adjacent coupling 20 in the same row by a chord member 22 having hooked end portions which are received by suitable openings provided in the ears 21. As illustrated, the chord members 22 are of telescopic construction so as to permit angular adjustment of the arms 18 in each row for optimum support of various type arcuate concrete beams as the curvature and distance between the ends thereof change. Each of the chord members 22 comprises a tubular member 22*a* and a rod 22*b* received thereby. A spring biased latch 22*c* carried by each of the tubular members 22*a* and received by one of several spaced apertures in the rod 22*b* adjustably secures each of the rods 22*b* to its respective tubular member.

Additional radial rods 23 suitably carried by the couplings 20 extend coaxially of the rods 19, and each of the upper ends of the rods 23 is telescopically received by a tubular member 24. With the arrangement illustrated in the drawings, the tubular members 24 may be extended radially outwardly approximately forty percent. In a device built in accord with the present invention, the arms of the frame are telescopically adjustable for erecting self-supporting concrete buildings from fourteen to twenty feet wide. It is apparent that longer or shorter rods 19 can also readily be employed to alter the radial length of the arms of the apparatus, and the subtended chord members 22 can readily be adjusted to the proper length to maintain the proper angle between adjacent arms.

To support the arcuate concrete beams 25 and 26 of the building on the frame 12 of the apparatus 10, there are provided a plurality of cross arms 27 suitably secured to the distal ends of some of the tubular members 24 of the arms 18. For additional support, one or more obliquely disposed arms 28 are adjustably secured to the central portion of each of the tubular members 24, and one cross arm 27 is carried by each of the arms 28 in the first row and by its related arm 28 in the second row. Such an arrangement has the same effect as if additional arms 18 were employed for supporting the arcuate concrete beams 25 and 26.

After the arcuate concrete beams 25 and 26 are supported by the apparatus 10, a plurality of concrete planks 29 (see FIGURE 2) are disposed transversely of the beams with the ends of the planks 29 disposed between the flanges of the beams. Specifically, one end of each plank is inserted between the flanges of one beam. Each plank is then rotated until the other end thereof is in alignment with the flanges of the adjacent beam, and the plank is thus centered between the beams.

For convenience and as shown in FIGURES 2 and 3 of the drawings, the following description will refer to the inner arcuate concrete beam 26 as the last erected beam and to the outer arcuate concrete beam 25 as the prior erected or adjacent beam. Obviously, the beams or the apparatus could readily be reversed, and both beams could be inner or outer arcuate concrete beams. From the above description, it is apparent that the dimension between the last erected beam and the adjacent beam is critical. If the dimension slightly exceeds the requisite distance, then the planks 29 will not be supported when substantially centered between the beams. Alternatively, if the dimension is not sufficient, then the planks 29 cannot be disposed transversely of the beams with the ends of the planks disposed between the flanges of the beams.

It will be understood that even if the dimension between the beams is of the requisite distance before the planks are inserted and centered therebetween, some means must be provided to reduce the dimension sufficiently to preclude longitudinal movement of the planks. In order to control the dimension between the last preferred arcuate concrete beam 26 and the adjacent beam 25 of the erected section of the self-supporting concrete building before and after the planks are transversely disposed with relation to the beams, clamps 30 are suitably mounted to the distal ends of some of the tubular members 24 of the arms 18 of the first row and to the distal ends of the related arms in the second row. Although preferred, the clamps 30 need not necessarily be mounted to the tubular members 24 in every application or modification of the apparatus and, when not attached to the apparatus, clamps may be disposed over or under the beams when necessary to decrease the dimension therebetween. In a device built in accord with the present invention, it has been found that three clamps 30 are sufficient for controlling the dimension between beams disposed on the clamps, e.g., one clamp is mounted to each pair of related radial arms 18 extending outwardly at approximately 45° from the vertical and one clamp is centrally disposed between the outer clamps. More or less than three clamps may, of course, be employed for controlling the dimensions between beams supported thereon.

As shown in FIGURE 3 of the drawings, each clamp 30 comprises a stationary member 31 and a movable member 32. A screw 33 passing through an opening in the movable member 32 and having its inner end threadedly received by an internally threaded opening in the stationary member is employed for operating the clamp 30. A suitable handle 34 secured to the exterior end of the screw 33 is employed for turning the screw. Other conventional hydraulic, pneumatic, or electrical means may be employed for operating the clamps. Stationary member 31 of the clamp 30 is provided with a recess 35 for receiving the prior erected arcuate concrete beam 25 and with a recess 36*a* for receiving one side of the last erected arcuate concrete beam 26. The recess 36*a* limits the minimum dimension between adjacent beams. A complementary recess 36*b* is provided in the movable member 32 for receiving the other side of the last erected arcuate concrete beam 26. It is apparent that the recess 35 in the stationary member 31 of the clamp 30 and the associated arms 18 in the first row are employed primarily for aligning the apparatus to the erected section of the building while the recesses 36*a* and 36*b* of the clamp 30 and the arms in the second row control the dimensional limits between the last erected beam and the prior erected beam as well as the vertical disposition of the last erected beam. It is preferable to operate all of the clamps simultaneously when altering the dimension between the beams; however, the clamps may be operated in succession one or more times until the requisite dimension between the beams is obtained. After the section of the building comprising the prior erected arcuate beam 25 and the last erected arcuate beam 26 is complete and the concrete planks longitudinally restricted with respect to the beams by means of the clamps, the apparatus 10 is shifted to erect another section of the building.

Inasmuch as it is not necessary to employ a clamp 30 with each pair of arms 18, additional cross arms 27 for supporting the beams are mounted to the pairs of related arms not provided with clamps. Further, although the illustrated arrangement shows seven arms 18 carried by each plate 16, the number of arms may be increased or decreased depending upon the size and weight of the arcuate concrete beams to be supported thereby. I prefer to employ as few arms as possible and, as shown in FIGURE 1 of the drawings, to provide each pair of arms with three supporting connectors one of which may be the clamp 30; otherwise, all three connectors are cross arms 27.

To support the workmen while they are inserting the precast concrete planks 29 transversely of the beams,

scaffolds 40 and 41 are carried by the frame 12. The upper scaffold 40 is mounted on one of several cross members 42 (see FIGURE 2) suitably connected to related arms 18 and on a pair of standards 43. The lower scaffold 41 is mounted on the superstructure 15. As illustrated in FIGURE 1, the frame 12 is prevented from rotating angularly from one side to the other by a pair of auxiliary jacks 44. The jacks 44 may also be employed for supporting the ends of the scaffold 41.

With the above-described apparatus, some means must be provided for adjustably securing the tubular members 24 to the radial rods 23. To this end, lever jacks 45 are suitably connected to the tubular members 24 for adjustably securing the tubular members 24 to the rods 23. In particular, each jack 45 comprises a lever arm 46 pivotally secured by a pin to a tab extending from the lower portion of the tubular member 24. A connecting arm 47 is pivotally secured to the intermediate portion of the lever arm 46 and to a tab extending from an anchoring dog 48 circumposing the rod 23. As best shown in FIGURES 1 and 4 of the drawings, and specifically the second jack 45 from the left in FIGURE 1, the tubular member 24 with the jack in the released position is shifted until the cross arms 27 are in close proximity to the arcuate beams. A pin 49 disposed in one of several openings in the rod 23 beneath the anchoring dog 48 adjustably limits downward movement of the tubular member 24 when the lever arm 46 is in the released position. Upon initial downward movement of the lever arm 46, the anchoring dog 48 bites into the rod 23, and upon further downward movement of the lever arm 46, the tubular member 24 telescopes outwardly until the clamp 30 and the cross arms 27 engage and lift the arcute concrete beams in each row as required. Upon releasing the lever jacks 45, the downward movement of each tubular member 24 is limited by the anchoring dog which in turn is limited by the pin 49 disposed in one of the openings in each of the rods. Other conventional hydraulic, pneumatic, or electrical means may be employed for operating the jacks.

In operation, the apparatus is assembled after being delivered to the site where the building is to be erected. A precast arcuate beam, preferably an outer arcuate concrete beam, is erected over a foundation, and the arms of the apparatus are extended until all of the cross arms and the clamps engage the outer arcuate beam. A precast inner arcuate concrete beam is then lifted and lowered in the recesses provided by the movable members of the clamps. The two beams are dimensionally spaced from each other so that a plurality of precast concrete planks may be disposed transversely of the beams with the ends disposed between the flanges thereof. The clamps are then operated to shift one of the beams with respect to the other until the concrete planks are interlocked between the beams. After the beams are secured together by suitable means to prevent spreading, the clamps and lever jacks are released, and the apparatus is repositioned for erecting another section of the building. If auxiliary jacks are employed for stabilizing the apparatus, they are retracted before the apparatus is repositioned.

It will be apparent to one skilled in the art that the present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof. It is, therefore, desired and intended that the embodiment herein specifically set forth be considered in all respects as illustrative and not restrictive, reference being made to the appended claims rather than the foregoing description and drawings to indicate the scope of the invention, which is to be understood as limited only by the scope of the appended claims. For example, pin 49 and hole 23 may be replaced by a set screw to releasably secure anchoring dog 48 to the rod 23, or by a plurality of jacks in association with tubular member 24, whereby one jack 45 holds while a second jack 45 is used to advance tubular member 24 along rod 23.

I claim:

1. Apparatus useful in the erection of a building comprising a base, a plurality of radial arms, each being adjustable lengthwise and mounted at its proximal end on said base, a plurality of adjustable chord members connecting the radial arms together at a point of each radial arm intermediate the ends thereof, and means carried by the distal ends of said radial arms for supporting a pair of arcuate beams of the building.

2. Apparatus useful in the erection of a building comprising a base, rollable means supporting said base, a plurality of radial arms, each being adjustable in length and mounted at its proximal end on said base and disposed in a first row and in a second row parallel thereto, a plurality of adjustable chord members connecting the radial arms of said rows, a plurality of cross members connecting the radial arms of said first row to the related radial arms of said second row, and means carried by the distal ends of said radial arms for supporting a pair of arcuate beams of the building.

3. In an apparatus useful in the erection of a building, the combination of a base, a plurality of radial arms extending outwardly from said base, a jack operatively connected to each of said arms for altering the length of said arms, said arms being disposed in a first row and in a second row in spaced parallel relationship to the first row, a chord member subtending each angle formed by said arms in each of said rows, said chord members being adjustable for varying each of the angles subtended, a pair of oblique arms carried by at least one of said radial arms, and a cross arm mounted to each oblique arm in the first row and extending to and mounted to the corresponding oblique arm in the second row for supporting the arcuate beams of the building.

4. Apparatus useful in the erection of a building comprising a base, rollable means supporting said base, a plurality of radial arms carried by said base and disposed in a first row and in a second row parallel thereto, a plurality of chord members connecting the radial arms of said rows, a plurality of cross members connecting the radial arms of said first row to the related radial arms of said second row, and means carried by the distal ends of said radial arms for supporting and altering the dimension between a pair of arcuate beams of the building, said dimension being variable by said last mentioned means between a maximum which allows insertion of a plurality of planks longitudinally between said beams and a minimum which restricts movement of inserted planks longitudinally between said beams.

5. Apparatus useful in the erection of a building comprising a base, rollable means supporting said base for movement, a plurality of radial arms carried by said base and disposed in a first row and in a second row parallel thereto, a plurality of chord members connecting the radial arms of said rows, a plurality of cross members connecting said radial arms of said first row to the related radial arms of said second row, means carried by the distal ends of said radial arms for supporting a pair of arcuate beams of the building in spaced parallel relationship to each other, and clamp means associated with said radial arms for altering the dimension between the arcuate beams of the building, said dimension being variable by said last mentioned means between a maximum which allows insertion of a plurality of planks longitudinally between said beams and a minimum which restricts movement of inserted planks longitudinally between said beams.

6. In an apparatus useful in the erection of a building, the combination of a base, a plurality of radial arms extending outwardly from said base, a jack operatively connected to each of said arms for altering the length of said arms, said arms being disposed in a first row and in a second row in spaced parallel relationship to the first row, a chord member subtending each angle formed by said arms, said chord members being adjustable for varying each of said angles, an oblique arm carried by at

least one of said radial arms in each row, a cross arm mounted to the oblique arm in the first row and extending to and mounted to the oblique arm in the second row for supporting the arcuate beams of the building, and a clamp operatively connected to at least one of said radial arms in each row for altering the dimension between adjacent beams.

7. In an apparaus useful in the erection of a building, the combination of a base, a plurality of radial arms extending outwardly from said base, a jack operatively connected to each of said arms for altering the length of said arms, said arms being disposed in a first row and in a second row in spaced parallel relationship to the first row, a chord member subtending each angle formed by said arms in each of said rows, said chord members being adjustable for varying each of the angles subtended, a pair of oblique arms carried by at least one of said radial arms, a cross arm mounted to each oblique arm in the first row and extending to and mounted to the corresponding oblique arm in the second row for supporting the arcuate beams of the building, and at least one pair of clamps operatively connected to said radial arms, each clamp member of said pair of clamps being on opposite sides of the vertical for altering the dimension between adjacent beams.

8. A device useful in the erection of a building comprising a surface traversing platform supported on rollable means, a plurality of arms each being adjustable in length mounted at their proximal ends to said platform and extending radially outwardly therefrom, said arms being disposed in two parallel planes, a plurality of adjustable chord members connecting the arms in each plane together, and means associated with each of said arms for altering the length thereof whereby during erection of the building the arms in the first parallel plane orient the device with an erected section of the building and the arms in the second parallel plane support an arcuate concrete beam for vertical movement.

9. Apparatus useful in the erection of a building comprising a base, rollable means supporting said base, a plurality of radial arms carried by said base and disposed in two parallel rows, a plurality of members connecting the radial arms in each row, a plurality of cross arms carried by said radial arms for supporting erected arcuate beams of the building, a clamp associated with one of said radial arms in the first row and with the related radial arm in the second row, and a jack secured to each of said radial arms for altering the length thereof.

10. A device useful in the erection of a building comprising an ambulatory platform, a plurality of extensible radial arms carried by said platform, said arms being disposed in a first row and in a second row for supporting a first erected arcuate beam and a second erected arcuate beam of the building, a plurality of chord members connecting the arms in each of said rows, a plurality of clamps connecting the arms in the first row to the related arms in the second row, said clamps having recesses for receiving the first and second beams whereby upon insertion of a row of planks longitudinally between the beams said clamps are tightenable to shift the second beam toward the first beam.

11. In an apparatus useful in the erection of a building, the combination of a base mounted on a supporting surface, a plurality of arms, each being adjustable in length and mounted at their proximal ends on said base extending radially of said base in two rows in spaced parallel relation for supporting a plurality of arcuate beams of the building, and means associated with said arms for moving one of said beams with respect to the adjacent beam.

12. The apparatus of claim 11, wherein said means comprises a jack operatively connected to each of said arms for moving one of said beams in a vertical direction.

13. The apparatus of claim 11, wherein said means comprises a clamp operatively associated with said arms for shifting one of said beams in a horizontal direction with respect to the other beam.

14. Apparatus useful in the erection of a building comprising an ambulatory base, a plurality of radial arms extending outwardly from said base, a telescopic chord member connecting said radial arms in adjacent relationship to each other, and a clamp mounted to the distal end of each of several of said arms and normal to the longitudinal axis thereof, said clamps adapted to support a pair of spaced arcuate beams of the building in erected position whereby upon tightening of said clamps one of said arcuate beams is shifted toward the other to restrict longitudinal movement of a plurality of planks disposed transversely of said beams.

15. The apparatus of claim 14, wherein each of said arms is adjustable for altering the elevation of one of said beams with respect to the other.

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