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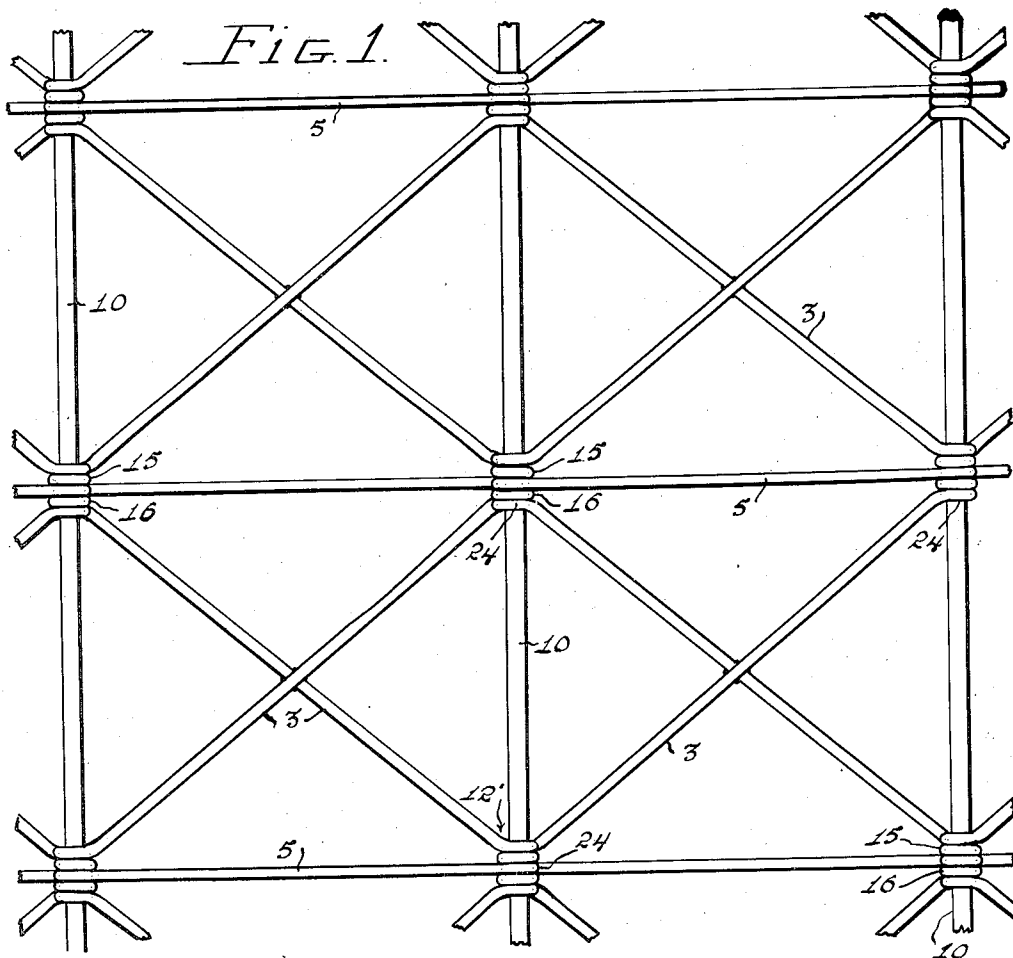
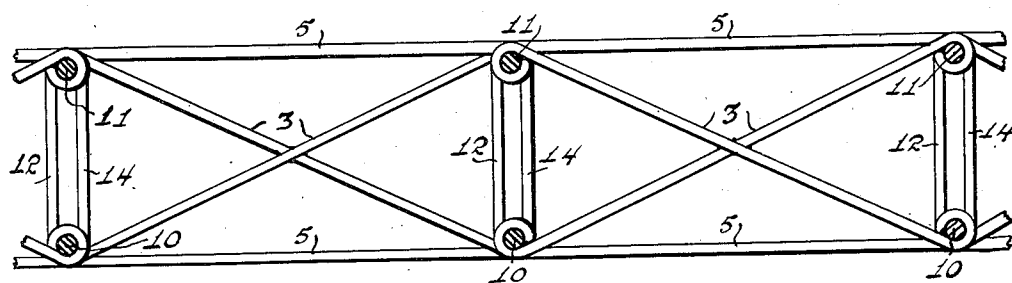
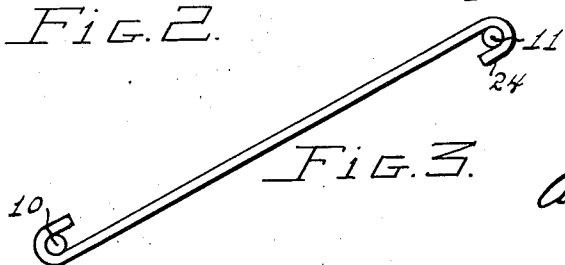
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2,053,487

BUILDING CONSTRUCTION

Filed March 4, 1935

2 Sheets-Sheet 1



INVENTOR.

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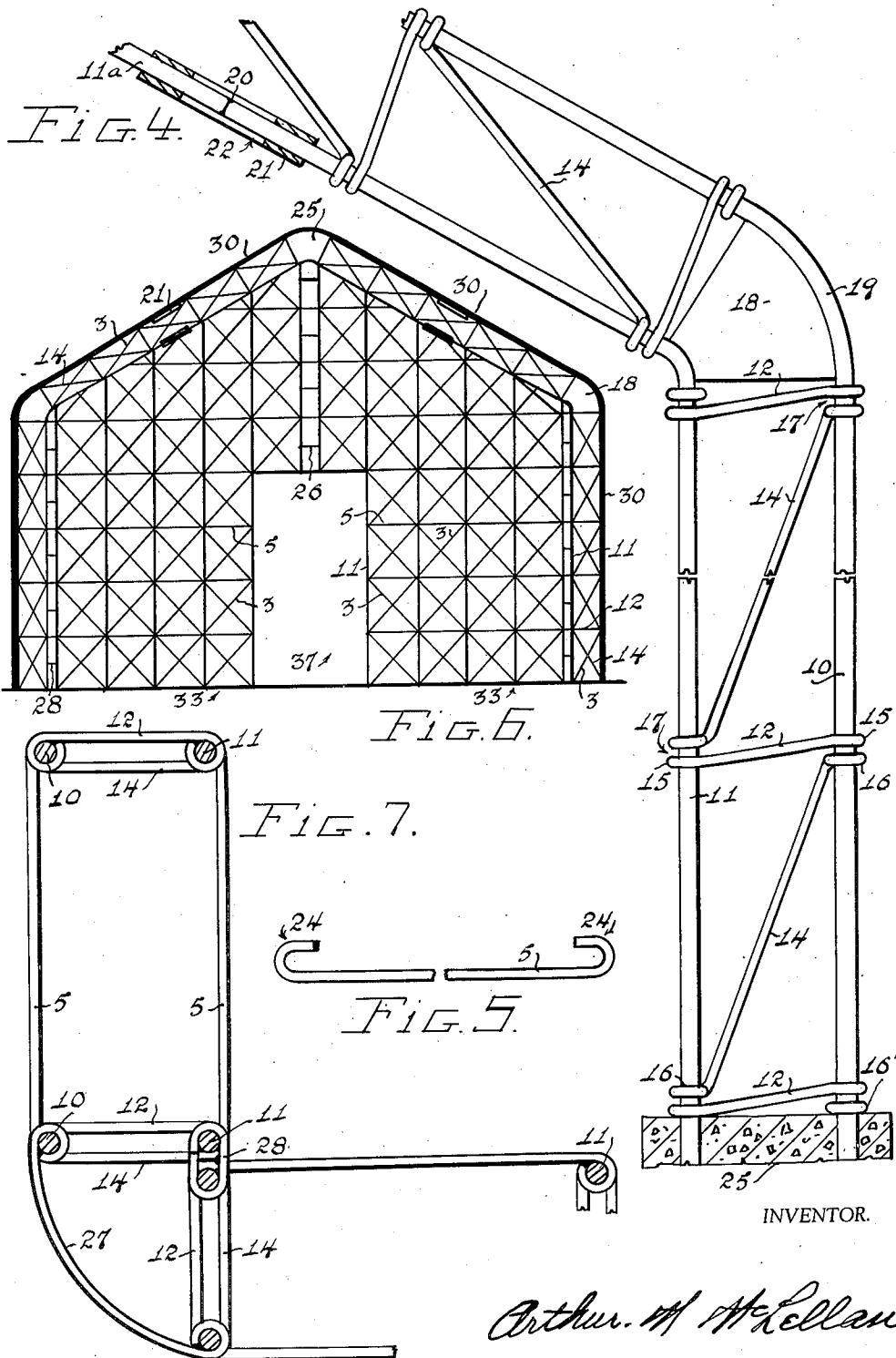
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UNITED STATES PATENT OFFICE

2,053,487

BUILDING CONSTRUCTION

Arthur M. McLellan, Los Angeles, Calif.

Application March 4, 1935, Serial No. 9,221

16 Claims. (Cl. 189—1)

My invention relates to the construction of light weight and strong steel buildings and has for one of its objects the provision of a building which is proof against fire, wind storms, termites, earthquakes and other destructive forces.

Another and important object of the invention is the provision of a steel-frame for moderate sized dwellings particularly, which may be partially fabricated in a manufacturing plant and subsequently moved to the site where it may be quickly and accurately erected without exercise of more than ordinary skill, and which frame while being erected will become self-centering, self-leveling and also self-plumbing.

The present invention makes it possible to provide a building in which the roof and side walls are integral with the main struts or columns of the vertical walls continuing over the roof areas. This feature makes for greater strength and ease of assembly.

Another object of the invention is the provision of a new construction and method for erection whereby all materials for an average size dwelling may be transported to the site in a very few loads with the frame being transported in the form of partially fabricated girders which embody both a side-wall joist and a roof rafter. In keeping with the objects of the invention the other members of the frame comprise a multiplicity of short accurately shaped pre-manufactured members which act as highly accurate means for causing the frame to become self-aligning.

The short members are so arranged and manufactured with respect to the aforesaid girders that there is only one way in which they can be put in place and that is the right way. One of the salient features of this invention makes it possible for an amateur to erect a complete frame with the use of only one tool. Where the structure is large or of complex architecture electric welding at certain points is the only other fastening required.

Nails, bolts, screws and like fasteners are not required by reason of this invention and in keeping with the present trend for better housing it is an object of the invention to provide a home low in first cost and which represents a good loan by reason of the fact that it will be in the best of condition even after the loan is absorbed.

Buildings in conformity with this invention are at once practical and possible by reason of the fact that they may be both pre-manufactured and erected singly or in quantities at a moderate initial investment on the part of the manufacturer. Also this invention is an economic advantage

in that the material used is standard small-size round steel stock such as can be obtained from any mill or local dealer. Transportation of the partially manufactured structure to the site is facilitated by reason of the fact that the largest parts or girders are only a fraction of an inch in thickness and yet when two or more of these are later interconnected according to this invention they provide a column of equally as great strength as if they had been fully fabricated in a large mill. The invention permits of using the same parts in partitions, floors, fences, garden walls and the like as are used in the main outside walls and roof.

It is another object of the invention to provide a frame to which any form of outside and inside wall may be added with ease. It is commonly believed that lath or wire and stucco walls are the most economical and accordingly the invention is directed to a frame to which building felt, wire, and the like may be actually "sewed" to the frame with the use of fine wire. Resistance to quakes and windstorms is best promoted by having the plaster and stucco walls as a substantially integral part of the frame.

Air-space insulation between the walls is another object of the invention and general suitability for economic year-around air-conditioning. Also the space between walls may be free from "fire-stops" as there is nothing to burn.

Obviously such construction makes for easy installation of air-ducts, conduits, piping and the like as well as permitting the newer practice of warming the inner walls of a building by first conducting heated air over the surface thereof before same is allowed to directly enter the rooms. It is believed that conditions indicate the advantage of a building which may be added to from time to time and to which other wiring or plumbing may be easily added. Such is among the objects of the invention. In this connection it will be understood that the usual dwelling of appreciable architectural skill is in reality a plurality of small interconnected units. The present invention makes it possible to construct each unit or wing, or even each room as a unitary part or structure; all of which may be interconnected to provide an inexpensive but extremely rigid building.

In carrying out the invention the only dimension to be known to the manufacturer is the wall height and roof pitch. From this the thin girders are fashioned. These girders are provided in a novel manner with shoulders and recesses on which, or in which all other parts must be posi-

tioned and thus the girders, which are accurately tho easily manufactured insure great accuracy and ease of erection.

I have illustrated my invention by the accompanying drawings in which:

Figure 1 is a front elevation of a section of a building wall constructed according to the invention; this view showing all parts as having been interconnected and shows the same girder spacing as is used for ordinary wood joists.

Figure 2 is a horizontal sectional view of the parts shown in Figure 1.

Figure 3 is a plan view of one of the diagonal or load-supporting braces shown in the shape in which it is manufactured prior to being put in place.

Figure 4 is a fragmentary side view of one of the girders showing it before the other parts are applied by which it is so incorporated in the structure. In this view the girder is shown as extending integrally into the roof area where it is extended by another piece to which it is secured by means hereinafter more specifically described.

Figure 5 is a plan view of one of the horizontal braces or links just as it comes from the manufacturer.

Figure 6 is a diagram showing the side walls, roof and one end wall of a structure erected according to this invention.

Figure 7 is a horizontal-sectional view of two adjacent walls of any building constructed by this invention and showing the manner in which walls at right or other angular disposition with respect to each other may be rigidly interconnected to form any desired contour thereat, such as a rounded corner.

More specifically a girder comprises the outer rod 10, the inner rod 11, the diagonal braces 14, 14 etc. and the short horizontal braces 12, 12 etc. The braces 12 have their ends 15, 15 looped tightly around the corresponding rods on the horizontal plane or normal to the axis of the rods while the braces 14 have their ends 16, 16 similarly fashioned and secured to rods. Between brace-ends 15 and 16 where they are adjacent there is invariably provided, in the form being now described, a space 17. Each end of each brace forms that which is hereinafter known as a load-supporting or thrust collar or shoulder. At points where it is not expedient to provide the type of braces shown, sheet metal gusset such as 18, in Figure 4, and such as 25, in Figure 6, may be employed and attached by welding.

The rods 10 and 11 are of relatively small diameter inexpensive round steel stock and irrespective of length only the compression strength and shear need be taken into consideration since it will appear hereinafter to those skilled in the art that bending moments of the rods are absorbed by and distributed thru the entire steel structure into which the rods are incorporated. The braces are of even smaller diameter stock and are accurately formed and positioned by suitable jigs or fixtures employed in the manufacture of this girder to insure all spaces 17 and all ends 15, 16 etc., being equally spaced with respect to another. Such uniformity and such accuracy is easily obtained in the manufacturing plant but to make the girder easily transported after being manufactured, it is by reason of this invention thin and very light in weight. As at 19 where the girder turns to extend over the roof area, both rods are integral and as shown in Figure 6 may continue well up the corresponding

slope of the roof. While a single girder should continue up one wall of the building over one roof slope, over the peak, down the other slope and back to the foundation 25, it is sometimes necessary to have the girder in sections. Such sections however are joined by sleeves such as 21 which cover the break 20 in the rods ends. These sleeves are provided with elongated slots 22 which facilitate welding the rod ends to the corresponding sleeve. Since a brace such as 14, and other diagonal braces later described, connected to opposite rods extend over the divided area, the entire sectional or multi-piece girder is just as strong as if the rods were not divided. In fact the girder is continuous in any event and it is apparent from Figure 6 that the side walls and roof of the building are all one.

The braces 12 and 14 have their principal extents tangential to the rods to which they connect; braces 12 being to one side of the girder and braces 14 to the other side so that greater strength is provided than if the axes of the braces were all normal to the axis of the rods. Where the braces tangentially connect with the rods, as well as at other points of encompassment of the rods, they are securely welded so that the finished girder is an accurately assembled, strong and easily handled product furnished to the builder at less cost than he could possibly construct a similar article at the site.

Along with a plurality of such girders the manufacturer supplies a multiplicity of members 3, hereinafter known as the diagonal braces, and a multiplicity of the simple members 5 which are hereinafter known as the horizontal connecting links. Before the foundation such as 25 is poured, or before there is need to anchor the girder to the foundation, two such girders are by any suitable means held side-by-side and connected as shown in Figure 2 first by connecting adjacent rods with the links 5, 5, 5, etc. These links are provided with the ends only partially looped as shown in Figure 5 so that they are readily hooked over the rods and these loops are very slightly contracted in manufacture so that they are a snug fit and will not readily drop out of place before being finally cinched. It will be understood that any well known large size of wire forming or bending tool is finally employed to bend the ends 24 of the braces 5 completely around the corresponding rods. The rods being provided with the spaces 17 between the brace ends 15 and 16, the links 5 may be quickly and accurately positioned and the parts are manufactured so that an end 24 will initially fit easily but closely in a space 17. When the end 24 is finally cinched around the rod the slight deformation of the steel will cause the end 24 to fit very snugly in space 17, so securely in fact that in moderate sizes of building there is no need to weld the end 24 to the rod since the ends 15 and 16 are securely welded at the factory.

While there are various methods which will suggest themselves for interconnecting the girders the following is one method which is advocated:—When two such girders are hooked together by the links 5 and before these links are cinched around the rods, the diagonal links such as 3 are put in position and cinched around the rods until two girders are interconnected thruout their lengths; whereupon the links 5 are finally cinched around the rods. The reason for this will be apparent hereinafter.

The diagonal truss-links 3 are each identical

and interchangeable and are accurately manufactured so that the partially looped ends 24 thereof are accurately spaced. Since the main extent of these loops are diagonal and since the shoulders 15 and 16 provided on the girders are horizontal, the ends 24 of links 3 are bent to a horizontal plane by an accurate jig used in their manufacture. These links are of greater length than the spacing of the rods which they are to interconnect. Therefore, while the two adjacent girders are hooked together in spaced relationship by the links 5, the links 3 when held horizontally will permit of their ends being hooked over the rods which they are to engage. Now from such position a link 3 may be turned to rock its upper end up under the shoulder 15 or 16 which it is to abut while the other end of the link 3 will be rocked into abutment with a corresponding shoulder of the other rod which it is to engage. Held in this position the act of cinching the ends of the links 3 around the corresponding rods will result in one girder being accurately centered with respect to the other. These diagonal braces are connected as shown in Figure 1 until there is a pair of diagonal braces in each rectangular frame space bounded by two girders and two of the braces 5, with one end of each diagonal brace connected to a girder rod and with the other end connected to the other or opposite rod of another girder. These diagonal braces in addition to taking the major part of the load act at the same time to locate or position the girders both vertically and horizontally. The ends of these diagonal braces may be welded to the rods if required but if welding is to be employed, or under any condition, the ends of the horizontal links are cinched into position.

When these latter ends are finally clamped around the rods there is a final take-up of all slack and a slight forcible movement of the girders into closer proximity. This movement puts a final compression on the load-supporting diagonal braces which locks their ends 24 in final position against the shoulders provided by the ends 15 and 16 respectively of the girder braces. In this way one girder after another is added to the structure until side walls and roof are complete.

An end wall composed of two units 33, fashioned the same as the side walls, is shown in Figure 6 and in this view is shown the application of improvised or special links such as 26. These are used to join two wall sections when the dimension of a wall is not a multiple of the girder spacings. This wall is shown as provided with an opening or door 37 which is formed by leaving out the corresponding ends of overhead girders. Owing to the fact that both by the horizontal links and by the diagonal links each girder is connected to those girders at either side of it, the entire structure is self supporting even where the girders do not continue down to the foundations.

Illustrating how a side wall and an end wall may be connected by improvised links such as 28 and 27, I have shown in Figure 7 the ends of two walls at right angle to each other. The inner rods at the extreme ends of these walls are interconnected by the short links 28 (also shown in Figure 6) and the outer rods 10 are interconnected by curved links 27 which provided for well rounded corners where they are advantageous.

From the use of three parts; girder, links 3 and links 5 in suitable number any other wall or partition, floor, ceiling or the like (not shown in Figure 6) may be constructed. Likewise garage

walls, garden walls, fences, etc., may be constructed from the same parts.

Particularly by reason of the continuity of a girder from the foundation at one side of the building to the foundation at the other side a complete covering such as indicated by the heavy line 30 in Figure 6 may be extended over the entire building and there are then no joints to leak at the roof peak or at the eaves.

It will be observed and particularly appreciated by those skilled in the building arts that by reason of the accurate and interchangeable parts supplied by the manufacturer, little skill is required and when the building of full size is finished it will be found to have as much strength combined with light weight as is found proportionately in a wire-bird-cage. Likewise, to use a homely but very apt comparison, the entire structure goes together with the ease, accuracy and dispatch of mechanical erector toys.

When the structure or wall built by this method is complete and suitably anchored in the foundation it will be found that all forces are evenly distributed and resolved and since the shoulders 15 and 16 are welded to the rods at close intervals there is practically no opportunity for bending moment in the rods and the total cross sectional area of the rods, even tho they be very small diameter stock, will be ample to withstand the compressive force of the entire building.

By the construction employed the planes of both the inner and outer surfaces of the frame are defined by the horizontal braces 5 which are purposely placed forwardly of the corresponding vertical rods. These links so positioned provide an accurate plane on which inner and outer wall materials may be built up. Of course these braces provide an excellent attachment for pre-cast building slabs, flat wall tile, masonry veneers or the like but they are even better suited to use as a foundation for the less expensive wire and plaster or wire and stucco walls. In such case it is proposed to lay the usual combination of paper or felt and hog-wire or lath contiguous to these links with the wire preferably held in slight spaced relationship to the felt or paper by usual furring clips or the like.

Owing to the horizontal plane of the links 5 and their accurate disposition, such combination of paper and wire may be actually "stitched" to the frame by the use of fine wire so that when the monolithic plaster wall is eventually built up it becomes a substantially structural part of the frame as distinguished from wood joist practice in which the stucco is held only by the sparse engagement of nail-heads with a few strands of wire.

It will be apparent now that I have provided articles of manufacture and a method or methods for fabricating same by their interconnection to form all types of buildings; all within the objects of the invention. The foregoing disclosure has been quite specific as to design of parts, construction of the entire building and as to the methods and steps to be followed; this being done only by way of example and to make a full disclosure of all ideas and inventions suggested by this disclosure, and not with any intent to limit the scope of this invention which is of a broad nature and set forth in the appended claims.

I claim:

1. As an article of manufacture a knock-down building frame comprising a plurality of girders and a multiplicity of links; each girder comprising a pair of spaced parallel rods and spaced

braces connected at their ends to interconnect said rods and thereat forming load supporting shoulders; said links formed for interconnection of a plurality of said girders and having rod-engaging ends formed to rest each in load-supporting engagement with a corresponding shoulder.

2. As an article of manufacture a knock-down building frame comprising a plurality of round-stock girders and a multiplicity of links; each girder comprising a pair of spaced round-stock rods held in spaced parallel relationship by spaced interconnecting braces having their ends wound around said rods to form load-supporting shoulders; said links formed for interconnection of a plurality of such girders and having rod-engaging looped ends formed to rest each in load-supporting and girder-spacing abutment with a corresponding shoulder.

3. As an article of manufacture a knock-down building frame comprising a plurality of girders and a multiplicity of links having diagonal extents and horizontal ends; said girders each comprising a pair of spaced parallel rods interconnected by spaced braces having their ends forming load supporting shoulders on said rods where they engage same; said links formed for interconnection of a plurality of said girders and having rod-engaging ends formed to rest each in load-supporting and girder-spacing abutment with said shoulders.

4. As an article of manufacture a knock-down building frame comprising a plurality of girders and a multiplicity of links; each girder comprising a pair of spaced parallel rods and spaced braces connected at their ends to interconnect said rods and forming thereat groups of evenly spaced load supporting shoulders providing a defined space between each adjacent pair of shoulders; said links formed for interconnection of a plurality of said girders and having rod engaging ends formed for abutment with said shoulders; some of said links formed for diagonal interconnection of a forward rod of one girder with the rear rod of another girder; other of said links formed for positions normal to the rods and with their ends to fit in the spaces provided between shoulders.

5. As an article of manufacture the combination of a plurality of girders and a multiplicity of links; each girder comprising a pair of spaced parallel round rods held in position by braces having their ends turned about the corresponding rod to form shoulders thereat, and the links being formed with rod-engaging ends spaced to interconnect rods of opposed girders by load-supporting abutment with said shoulders.

6. As an article of manufacture a knock-down building frame comprising vertical rods formed with horizontal circumferential shoulders, said shoulders being arranged in spaced pairs, and a multiplicity of links for interconnection of said rods having their ends originally bent in U-shape to hook over said rods and having been bent subsequently for circumferential engagement of said rods; each end abutting a corresponding shoulder.

7. The frame as in claim 6 and further including; certain of said links having their ends formed and positioned to fit in the spaces between said shoulders to hold said rods in spaced position; other of said links having their ends angularly disposed so that one end of such link in abutment with a shoulder on one of said rods positions the other end of said link in similar

abutment with a shoulder on a diagonally opposed rod at a higher elevation.

8. The frame as in claim 6 and in which said rod-engaging ends of said links are inclined with respect to intermediate parts of the link for diagonal interconnection of adjacent rods.

9. As an article of manufacture a plurality of rods formed with evenly spaced annular enlargements thereon forming load supporting shoulders, and a plurality of links formed originally with U ends for hooking engagement with said rods; said ends having been subsequently bent around a rod; each bent end abutting an annular enlargement.

10. The article as in claim 9 and in which the ends of said links are disposed on parallel planes and the intermediate portion of each link is inclined with respect to such plane so that one end of a link abuts one shoulder on one rod and the other end abuts a shoulder at another elevation on a diagonally opposed rod.

11. The article as in claim 9 and in which the ends of certain of said links are disposed on parallel planes and the intermediate portion thereof is inclined with respect to such plane so that one end of a link abuts one shoulder of one rod and the other end abuts a shoulder at another elevation on a diagonally opposed rod; other of said links being shorter and having all portions on a common plane.

12. In a building frame the combination of four struts each formed with equally spaced load supporting shoulders normal to their axis, a link having one end looped around one of said struts and thereat resting on said shoulder with the other end correspondingly engaging a diagonally opposite strut and abutting a shoulder on the second named strut at higher elevation, a second link having its ends similarly engaging a shoulder of the third strut corresponding to the shoulder first named on the first named strut, with a shoulder on the fourth strut corresponding to the first named shoulder on the second named strut.

13. The frame as in claim 12 and further including links disposed normal to the axes of said struts and tending to bring said struts into a smaller-dimension rectangular relationship and thereby placing the first named links under compression between said shoulders.

14. The hereindescribed method for erecting a steel building consisting in first providing a plurality of rods with spaced load supporting shoulders, then linking the rods in spaced pairs, then linking the pairs together in parallel spaced relationship, and then wedging diagonal braces between the shoulders of each rod and the next uppermost or lowermost shoulder of a diagonally opposed rod.

15. The hereindescribed method for manufacturing and erecting a building consisting in; placing pairs of rods in spaced relationship at the factory and connecting them with braces having their ends turned around the rods to form shoulders arranged in pairs with a space between each pair, then transporting the so formed girder to the site, then erecting the girder, then erecting a similar girder beside it, then loosely linking the girders together, then providing diagonal braces having rod encompassing ends spaced so that one end will abut the underside of a shoulder of one rod of a girder while the other abuts the top surface of a lower shoulder of the other rod of an adjacent girder, cinching the diagonal brace ends in such positions and

then completing the aforesaid linking together of the girders.

16. In a building wall the combination of a plurality of rods arranged in spaced rows, and links connecting the rods of one row with the rods of the other row; each end of each link where it connects with a rod being in load-transmitting abutment with the corresponding end of another link; some of said links extending hori-

zontally and some extending diagonally; some of the links extending from rods of one row each to the directly opposed rod of the other row; other links extending from rods of one row each diagonally to a relatively offset rod of the other row; said links distributed evenly and co-extensively of the wall to form a homogeneous structure.

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