

Jan. 7, 1969

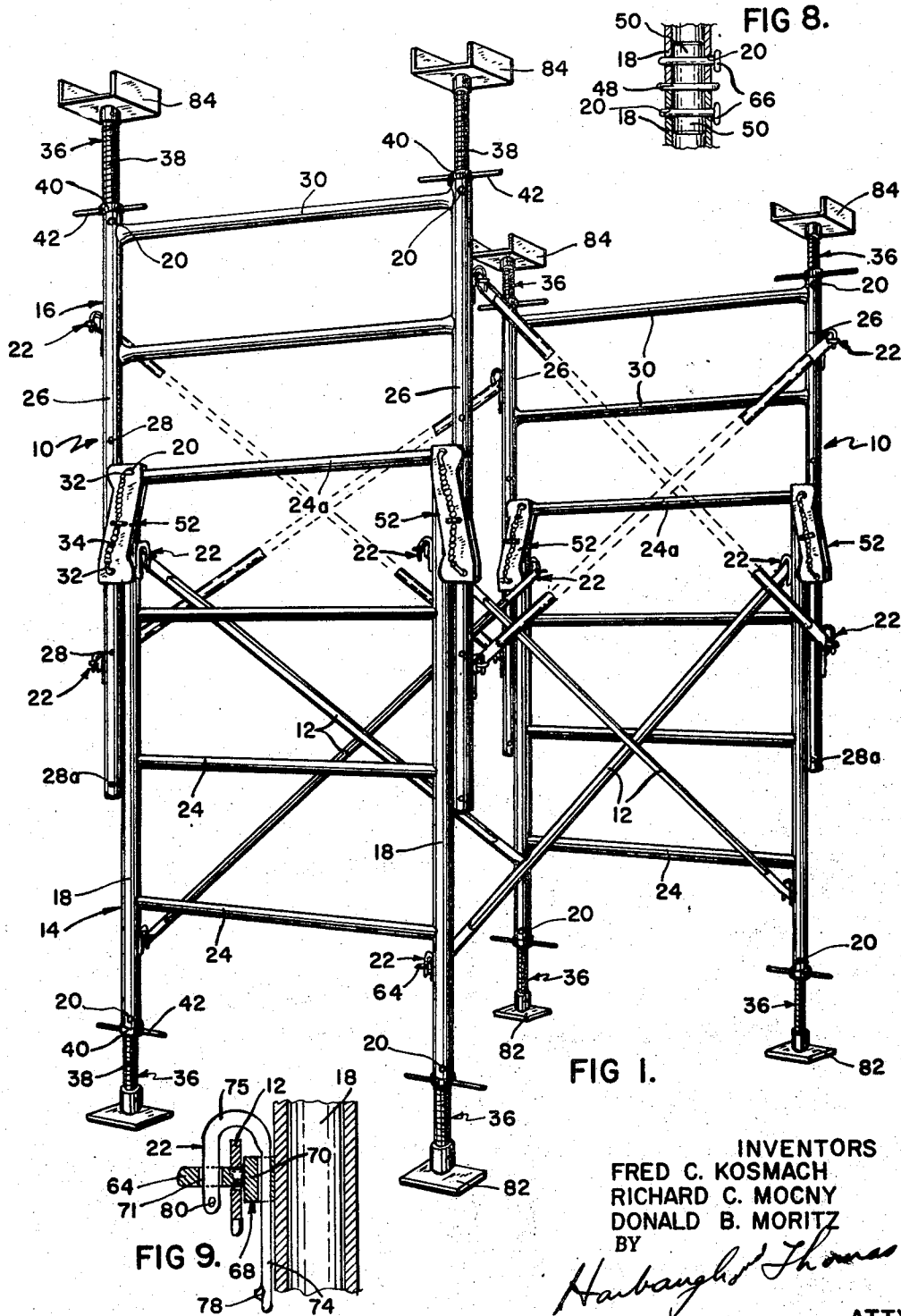
F. C. KOSMACH ETAL

3,420,030

KNOCKDOWN SCAFFOLDING

Filed July 27, 1967

Sheet 1 of 2



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Sheet 2 of 2

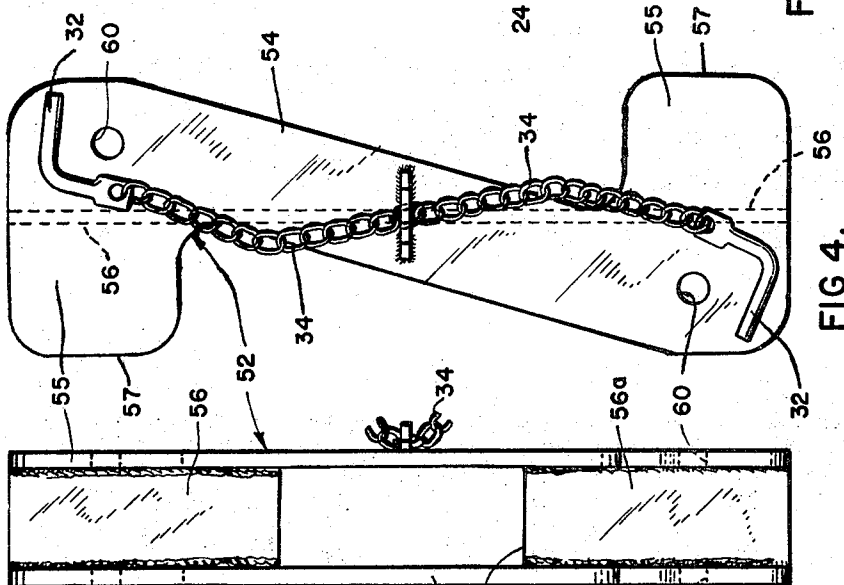
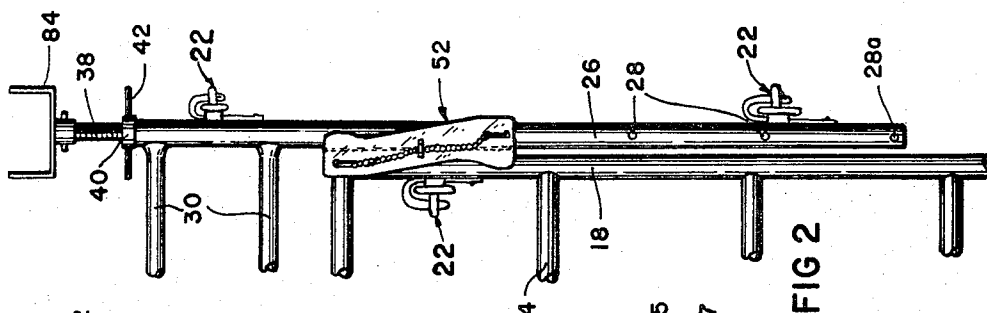
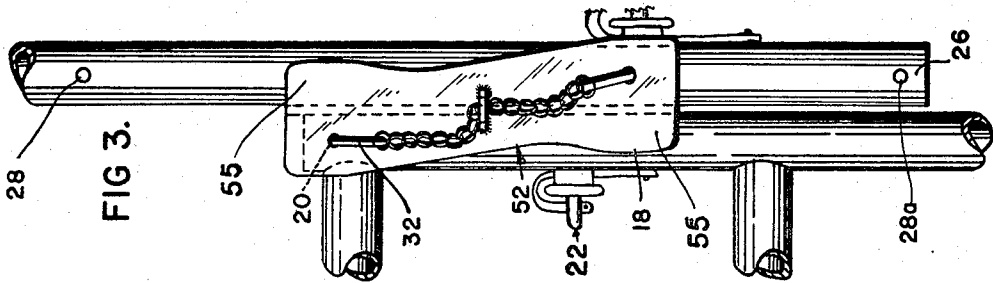


FIG 5.

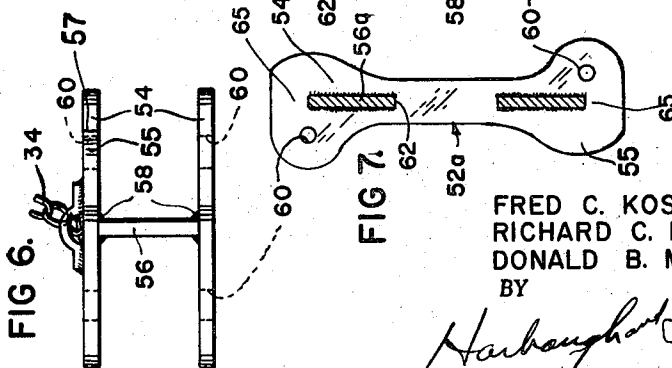


FIG 7

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KNOCKDOWN SCAFFOLDING

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Filed July 27, 1967, Ser. No. 656,512

U.S. Cl. 52-637

15 Claims

Int. Cl. E04g 7/00; E04h 12/10

ABSTRACT OF THE DISCLOSURE

Demountable scaffolding in which stirrup type hanger brackets operating in tension adjustably interengage upper securements on upright supporting members and lower securements on overlapping like-size supported members to hold them parallel in weight bearing relationship with great rigidity and strength. Accordingly, either end of the assembly can serve as the lower end and full size cooperating levelling and securing elements can be used interchangeably on ends of the assembly.

In conventional extendable demountable shoring and scaffolding, herein referred to generically as shoring, easily handled two-legged frames, are erected one upon another to form vertical panels. Two spaced panels erected side-by-side are cross braced at each frame level to form a four-legged unit. In the unit any two cross-braced frames comprise a section. The legs of the bottom section receive screw jacks for levelling or plumbing the unit and the uppermost section is adjustably mounted in place on the next lower section to receive screw jacks for properly engaging and supporting the load.

Vertical load carrying strength, weight of parts, ease of handling and assembly, and height adjustability are the most important considerations. Heretofore, various of these objectives have been reasonably well attained but at the expense of others. In the present invention all are attained.

Considering strength, it is well known as a matter of physics, that because of length between points of lateral support it is impossible to hold a shoring column in a straight line under axial compression. Sidewise bending always occurs causing flexure stresses as well as compression strains induced directly by load. The ability to withstand flexure in a tubular column is related principally to its slenderness ratio (l/r) in which l is length and r the radius of gyration. Radius of gyration (r) is defined as the square root of the result obtained by dividing the amount of inertia (I) of the cross-sectional area by the area (A) of the cross-section ($r=\sqrt{I/A}$) and since the least radius of gyration (r) occurs when the axis about which (r) is computed passes through the center of gravity it can be shown that (r) of an axially loaded hollow cylindrical column can be expressed as

$$r=\sqrt{\frac{D_1^2+D_2^2}{4}}$$

when D_1 is outside diameter and D_2 is inside diameter of the hollow cylinder.

Thus, by way of example with a conventional shoring as shown in Squire 3,190,405 where the extension frames have columns of a smaller diameter to telescope within base columns for vertical adjustment and lateral support of the extension columns is only at the top and bottom of the extension column, it will be observed that the slenderness ratio is comparatively quite great and much greater than that of the base columns. It is obvious that

2

outside D_3 and inside D_4 of the extension tubular column in FIGS. 5-8 of the above patent warrant the conclusion $D_1>D_2>D_3>D_4$, and the deduction that

$$\sqrt{\frac{D_1^2+D_2^2}{4}}>\sqrt{\frac{D_3^2+D_4^2}{4}}$$

Therefore, if the two columns have the same effective length (l) then design formulae for slender shoring columns, indicate that the allowable unit stress varies inversely in proportion to the square of the slenderness ratio and the telescoping member is a much weaker member to withstand axial load stress.

Moreover, it will be observed that because of telescoping function the effective length of the extension column is much greater, thereby warranting the conclusion that $l_2>l_1$ in the above comparative slenderness ratio formulae which in turn indicates an even greater weakness of the extension columns when extended and supporting the conclusion that the conventional shoring shown in the patent is no stronger than the extension columns irrespective of a much greater usable strength present in the base columns. If this were to be remedied, varying (l) or (A) in the equations, it would greatly reduce the safe useful extendable length of the extension columns or greatly increase the weight and cost of the extension frames, or both.

It will be further observed that the conventional shoring shown requires additional time to adjust the bracing if the height setting of either frame is to be changed, and also, any solid shaft screw jacks telescopically supported on the smaller size supports of the extension frames is obviously much smaller and weaker than those used with the larger diameter jacks and supports of the lower frames.

In the present invention the cross-sectional size of the vertical support members is uniform throughout their composite height and thereby are capable compositely of carrying the fullest load capacity of any portion thereof.

Although the uniform size of vertical support members is greatly to be desired, such presents many problems relating to an adjustable connection between an extension section and the adjacent main section.

The frames of the extension section have their legs more widely spread than those of the main section frames so that they lie in the same plane in adjustable overlapping relationship therewith and are adjustably supported by a novel arrangement.

All legs being of the same size, large screw jacks are used interchangeably at the top and bottom of the scaffolding unit. The large jacks generally have a longer excursion and therefore as part of the novel arrangement the legs of the extension section can have through-holes or apertures more widely spaced for vertical adjustable extension than would be safe or possible with jacks of smaller diameters.

The novel stirrup type hanger bracket is very rugged and simply made and is easily secured, with some pivotal movement, at its top and by means of a removable cross pin to the top of each leg of the top main section, and at its lower end to the lower end of an overlapping extension leg by means of another cross-pin engaging in one of said spaced extension leg apertures. Side plates of the hanger align the engaged ends of the respective legs within comparatively close tolerances and a cross plate means interconnecting the two side plates is disposed between the overlapping leg portions. The two cross-pins are out of vertical alignment with each other whereby the lower end of the extension frame leg under its weight load is forced towards the upper end of the leg of the supporting main frame to rigidify the interconnection with a strength and

tightness not possible with conventional telescoping legs that fit loose enough to be easily assembled.

Moreover, the extension frame need not be raised any higher than its final position in order to establish the novel engagement and level desired. Furthermore, the level of the extension section can be changed merely by withdrawing the lower pins on the four extension legs and reinserting them in other selected apertures in the legs. It is also noted that only one aperture is required at opposite ends of the legs of the main frames and these apertures can also be used in pinning intermediate coupling members in place between superposed main frame leg members.

In the present invention superior full weight-bearing strength is provided without any bracing interconnecting superposed sections and the bracing on the extension section moves with the section when being adjusted without disturbing the bracing on the main sections.

The invention is also characterized by an external adjustment for the extension frame that provides a greater radius of gyration as related to unsupported length which results in larger carrying capacities at maximum extensions to eliminate the need for bracing in the plane of the frame and to decrease the time required to set up the shoring system.

Another object is to provide a stirrup-type adapter bracket which does not require the close manufacturing tolerance of telescoping members, yet provides closer operational tolerances with minimal damage from rough treatment in construction projects.

The invention has a universal adaptability which can be used on main frames presently manufactured according to standards in the industry without special modification.

A further object of the invention is to provide large size vertical legs for extension frames of the class described which utilize larger size adjusting equipment having greater carrying capacity along with a greater capacity of the extension frame for a superior shoring system of a strength greater than conventionally provided.

These being among the objects of the invention, other and further objects will be observed from the drawings and the description relating thereto.

In the drawings:

FIG. 1 is a perspective view of a shoring or scaffold unit embodying the invention having an extension section supported by a main section, the main section being also representative of a plurality of superposed main sections if higher heights are desired.

FIG. 2 is an enlarged side elevational view of the adjustable connection between the overlapping main and extension section legs.

FIG. 3 is a further enlarged side elevational view at a connection showing the extension leg raised to a higher position than in FIG. 2.

FIG. 4 is an enlarged side elevation of the bracket shown in FIGS. 2 and 3.

FIG. 5 is an edge view of a modification of the bracket shown in FIG. 4.

FIG. 6 is an end view of both brackets shown in FIGS. 4 and 5.

FIG. 7 is a side elevational view of another embodiment of the bracket.

FIG. 8 is a vertical sectional view at a connection between two superposed main frame legs, and

FIG. 9 is a side elevation partly in section of the cross bracing fastener shown in FIG. 1.

Referring now to FIG. 1 in further detail a shoring or scaffolding system is shown in which two shoring panels 10 are spaced from each other and braced with respect to each other by cross braces 12. Each panel 10 as shown comprises two frames, a main frame 14 and an extension frame 16. The main frame comprises two spaced vertical legs 18 of tubular stock each with an aperture 20 there-through adjacent their upper ends and disposed transversely to the plane of the panel 10; vertically spaced latching means 22 located inside the legs 18 carrying latch

pins 24 pivotally securing the ends of the cross brace members 12; and, ladder-like horizontal cross struts 24 terminally welded to the legs 18 at vertically spaced points to brace and maintain the legs vertically parallel. Planks can be received across the struts 24 where needed to support workmen thereon when using the shoring as scaffolding. The upper strut 24a is close to the top of the legs 18.

The extension frames 16 are mounted on the main frames 14 and are adjustable thereon as to height. They comprise vertical parallel legs 26 of the same size tubing as the main frame legs 18, but are provided with vertically spaced apertures 28 throughout their length below two vertically spaced rigidifying cross struts 30. Removable pins 32 for the apertures 28 are secured against loss by chains 34 that are welded at their midpoint to the center of the respective bracket plates.

Screw jacks 36 of like construction are provided at the bottom of the legs 18 of the lowest main section 14 and at the top of the legs 26 of the extension section 16. The jacks comprise full size screw threaded shafts telescoping in the respective ends of the legs (18 and 26) as extensibly supported by adjustment nuts 40 having wing handles 42. At their exposed extremities the shafts receive fixed or changeable heads 82 and 84. Adjustment of the lower jacks levels the bottoms of the legs 18 to plumb them, and adjustment of the upper jacks accommodates the top of the shoring to the load to be borne. It will be observed that the panels can be inverted without loss of strength if grade variations or irregularities are greater between panels than the adjustable lengths of the bottom jacks. Furthermore, extension panels can be used at both the top and bottom if desired without loss of strength or adjustability.

The main frames 14 are all alike and can be superposed one on another for any height desired and the extension frames 16 are generally mounted as the topmost unit for final height adjustment of the upper jacks. The interconnection between the main panels is accomplished by a connector 46 (FIG. 8) having an annular flange 48 intermediate two cylindrical plug ends 50 telescoped into the adjacent ends of the frame legs 18 to hold them in alignment where they are cross-pinned by pins 66 as later described. The leg ends are terminally disposed upon opposite sides of the flange 48 in weight bearing relationship in suspension or compression depending where the shoring is supported either at its top or bottom.

The support of the extension frame 16 on the adjacent main frame 14 is accomplished by a novel bracket 52 in which two parallel side plates 54 are spaced from each other a distance approximately the outside diameter of the tubular stock of the legs 18 and 26, and are secured together by vertically spaced cross plates 56 (FIG. 5) at the top and bottom as by welding 58, to form a cross-sectional configuration similar to an "H" in which the cross plates 56 are engaged on opposite faces by the overlapping tubular legs 26 and 18, and the tubular legs diametrically engage the sides 54 against side sway.

The side plates 54 are essentially parallelepiped in shape (FIGS. 4 and 5), preferably with geometrically unequal adjacent angles and have lateral extensions or ears 55 adjacent to the obtuse angles. The cross plates 56 are disposed on the short diagonal thereof and openings 60 aligned in pairs are disposed adjacent the ends of the long diagonal thereof. This geometrical concept can be embodied in various marginal shapes one of which is shown in FIG. 7, where metal has been cut away from the side plates 54a to save weight, without loss of function or strength. The ears 55 have edge extremities at 57 which extend from the cross plates a distance greater than the radius of the legs 18 and 26 to assure diametrical line contact therewith for full lateral bracing.

It will be observed that all apertures are disposed normal to the plane of the panels and regardless of which end of the hanger bracket 52 is upward, it can be received only in one orientation at either end of the main frame legs 18. This orientation is accomplished directly,

or by a half turn of the bracket, to locate the upper bracket apertures 60 in alignment with the end aperture 20 in the leg 18. Thereupon, one of the pins 32 is inserted in place holding the bracket in position with the other pair of apertures 60 of the bracket disposed to receive the legs 26 of extension frame 16 therebetween at any one of its apertures 28 whereupon the other pin 32 is slipped into place to support the legs 26 of the extension frame 16 in place on the upper end of the uppermost main frame legs 18 in weight bearing relationship. The bracket cannot be installed in any other way than one in which weight on the extension leg 26 drives the lower pin 32 downwardly and inwardly, bringing and holding the extension leg 26 solidly and forcefully against the cross plate portion 56 located between the legs and against the main frame leg 18 and the legs between the ears 55 to rigidify the connection. Thereafter, whenever it is desired to raise or lower the extension panel, the lower pin 32 is withdrawn, the extension frame leg 26 is then raised or lowered to a newly selected leg aperture 26 and the pin reinserted to establish the new level.

The bracket 52 has several further advantageous characteristics depending on expediency and habits of journeymen. If desired, the extension frames can be located at their proper level and the brackets, as loosely handled, can be slipped upwardly or downwardly between the overlap of the legs and then pinned in place as described in interconnecting relationship. Moreover, the space between the spaced cross plates 56 serves as an opening 62 which receives the upper end of a main panel leg 18 therein for temporary hanging thereon at the site of connection while the extension frame 16 is being brought into position. At that time the bracket 52 is lifted free, the extension frame located in place, and the bracket slipped into place as already described.

A further advantage resides in the use of the bracket 52 without it being handled as a loose element that could be dropped inadvertently and injure someone. In its preferred embodiment as shown in FIGS. 6 and 7, the intermediate plates 56 are short enough from the end of the bracket, as at 64, for the end of the bracket to be pivotally pinned to the upper end of the main frame leg 18 and pivotally moved manually through a 270° arc, namely, from a vertical depending working position, up and over to a horizontal position resting against the top cross strut 24a. These brackets can be thus secured on the upper ends of the uppermost main frame legs when it is raised to position and then when the extension frames are raised into place, the brackets can be pivoted or released and slipped directly into their operative position where they are pinned to the respective legs as shown.

With the embodiments shown in FIGS. 4 and 5 where the intermediate plate or plates extend to the ends of the bracket side plates 54, the brackets can be sent up when the extension frame is lifted from the ground. Under these circumstances, they are pinned to the next aperture 28 that is higher than their ultimate position and lean inwardly at a slightly acute angle. This enables the extension frame to be raised into alignment within the ceiling of movement permitted to it and then lowered, whereupon, the brackets 52 engage the tops of the main frame legs 18 and guide the legs 18 and 26 into their parallel overlapping relationship. The upper pin 32 is then inserted into its working position on the main frame leg 18 during downward movement. Thereupon, the lower pin is removed from the bracket, the extension frame is then raised back to its final position and the lower pin 32 reinserted in the next lower aperture 26 on the extension frame legs. In this procedure the bracket is never free from securement to scaffolding members which would prevent accidental dropping.

Referring again to FIG. 1, whenever the shoring height desired is higher than two sections 14 and 16, more main frames are superposed one upon each other as supported between their ends by the connector 46 as already de-

scribed. These connections as shown in FIG. 8 can be pinned by cross pins 66 as shown, if desired. As the frames are placed one on top of another to form sections, it is preferred that the frames be used in pairs, spaced from each other and all frames including the extension frames braced by cross bracing confined exclusively to each section level. The main frames are braced on the inside and the extension frames on the outside so that they supplement each other without interference between them. The cross bracing comprises the braces 12 and vertically spaced brackets with U-brackets 68 (FIG. 9) terminally welded to the legs 18. The cross member 70 of the U-shape carries the outwardly extending pin 64 welded thereto which has a vertical slot 71 therein. The space defined between the U-bracket and leg 18 provides a slideway 72 in which the long leg 74 of a "J" shaped latch member 75 is vertically slidable with the short leg 76 blocking removal of any element received on the pin. Both legs of the "J" latch are flat-tended as shown. The long leg 74 is crimped at 78 to prevent removal, and the short leg 76 is apertured as at 80 to receive a wire or cotter pin (not shown) that prevents inadvertent release of the latch. With the "J" latch raised, the apertured end of a cross brace is received on the pin 24 and the "J" latch is dropped into place to secure the brace as more particularly shown in U.S. Patent Nos. 3,174,779 and 2,635,717 reference to which is hereby made.

In connection with the crossbracing, it will be observed that the bracing geometry is uniform for both the main and extension sections, the braces are interchangeable and the distance from the end of each leg for brace attachment is identical in all sections.

Referring again to FIG. 1, in the event that the supporting surface is level then base plates 82 may be secured directly to the lower ends of the lowermost section legs of the extension frame by pins 66 received in their end apertures 20 and 28a, respectively, if it is the only frame used. Otherwise, the base plates 82 are secured to the outer end of the threaded portion of the jack shaft 38 that is telescopically received in the lower ends of the legs 18 as already described. The upper ends of identical jacks carried by the extension section 16 are provided with shore heads 84 of any configuration desired to support the load. In both instances, the base plates and shore heads are cross-pinned to the shaft of the jacks by pins 66.

Having thus described the invention and several embodiments thereof, and their operative characteristics, the complete interchangeability of parts, the inversion of panels, and their use in tension as well as compression, it will be understood how the stated objects are attained and how various modifications can be made therein without departing from the spirit of the invention, the scope of which is commensurate with the appended claims.

What is claimed is:

1. In a knockdown scaffolding assembly the combination of a main panel comprising parallel upright side members horizontally spaced a predetermined distance, an extension panel comprising parallel vertical side members spaced a distance greater than said predetermined distance whereby the lower ends of the extension side members are disposed outside and in the same plane as the main side members in terminally overlapping relationship, said extension side members having fastening means spaced vertically from the upper end of said main side member, and means adjustably interengaging the upper ends of said main side members and said fastening means under tension in a vertical direction and including elements interengaging the sides of said overlapping portions holding said overlapping portions of said members in said common plane against relative longitudinal displacement.

2. The combination called for in claim 1 in which said main side members comprise tubular members each having apertures therethrough like distances from their top

ends and said extension side members comprise tubular members having cross apertures therethrough spaced vertically longitudinally from said main side members aperture, said apertures being disposed normal to the planes of said frames.

3. The combination called for in claim 1 in which said main side members are interconnected by vertically spaced rigidifying struts one of which is spaced a short distance below the upper ends of said main side members, and said extension side members are interconnected at their top by two vertically spaced rigidifying horizontal struts disposed in the same plane as the first mentioned struts.

4. The combination called for in claim 1 in which said side members are all of the same cross-sectional dimension.

5. The combination called for in claim 1, in which all of said side members are tubular members having equal radii of gyration.

6. In a knockdown scaffolding assembly the combination of a pair of main frames disposed with their planes parallel and spaced from each other, each comprising parallel upright side members horizontally spaced a predetermined distance, spaced extension frames disposed with their planes lying in said parallel planes, each comprising parallel vertical side members spaced a distance greater than said predetermined distance whereby the lower ends of the extension side members are disposed outside and in the same respective planes as the main side members in terminally overlapping relationship, said extension side members having fastening means spaced vertically from the upper ends of said main side members, means adjustably interengaging the upper ends of said main side members and said fastening means under tension in a vertical direction, and means interengaging the side members to hold said overlapping portions of said members in said common planes against relative longitudinal displacement.

7. The combination called for in claim 6 in which the last mentioned means includes two spaced side plates engaging opposite sides of said overlapping portions, means between said overlapping portions securing said side plates rigidly together, and cross-brace members lying in planes normal to said parallel planes interconnecting the legs of the uppermost main side frames holding them perpendicular.

8. The combination called for in claim 6, in which the last mentioned means includes elements cross connecting the legs of said spaced frames, said adjustable means including a stirrup-type bracket having a pair of spaced parallel side plates secured together engaging opposite sides of said overlapping members, and said fastening means including apertures in the lower end of said plates receiving releasable pins therethrough.

9. The combination called for in claim 6 in which the tubular members are of the same cross-sectional dimensions and including identical screw jacks having support shanks interchangeably received in snug telescoping relationship in the ends of said tubular members.

10. In a knockdown scaffolding assembly having supporting legs a stirrup-type bracket comprising a pair of spaced parallel side plates, means securing said side plates together along a predetermined line, said side plates having at opposite ends apertures disposed on opposite sides of said line.

11. The combination called for in claim 10 in which said side plates define essentially a parallelepiped having unequal adjacent angles and said line is disposed on the shorter geometric diagonal and the apertures are disposed on the longer geometric diagonal.

12. The combination called for in claim 10 in which said securing means includes a cross plate member which at one end terminates approximately even with one of said apertures.

13. The combination called for in claim 10 including two pins receivable in said apertures, and means for securing said pins to one of said side plates.

14. In a knockdown scaffolding assembly the combination of a main panel comprising parallel columns horizontally spaced a predetermined distance, vertically spaced cross-brace recurring means carried on the adjacent sides of said columns, an extension panel comprising parallel columns spaced a distance greater than said predetermined distance whereby the lower ends of the extension columns are disposed outside of and in the same plane as the main columns in terminally overlapping relationship, vertically spaced cross-brace securing means carried on the remote sides of said extension columns, and bracket means adjustably interengaging the upper ends of said main columns and the lower portion of said extension columns under tension in a vertical direction.

15. In a knockdown scaffolding assembly the combination of an extension tubular frame column having spaced through apertures, a main tubular frame column overlapping and parallel with said extension column having a through aperture parallel to and spaced from a selected one of said extension frame apertures, and bracket means interconnecting said tubular columns comprising a pair of spaced side plates engaging opposite sides of said overlapping columns and having cross apertures at opposite ends disposed in registry with said selected aperture and said main column aperture, respectively, removable pins received in said respective apertures, and means interconnecting said side plates and interengaging said overlapping columns.

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U.S. Cl. X.R.

182—178; 248—354