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APPARATUS FOR CONSTRUCTING STAIRS

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2 Sheets-Sheet 1

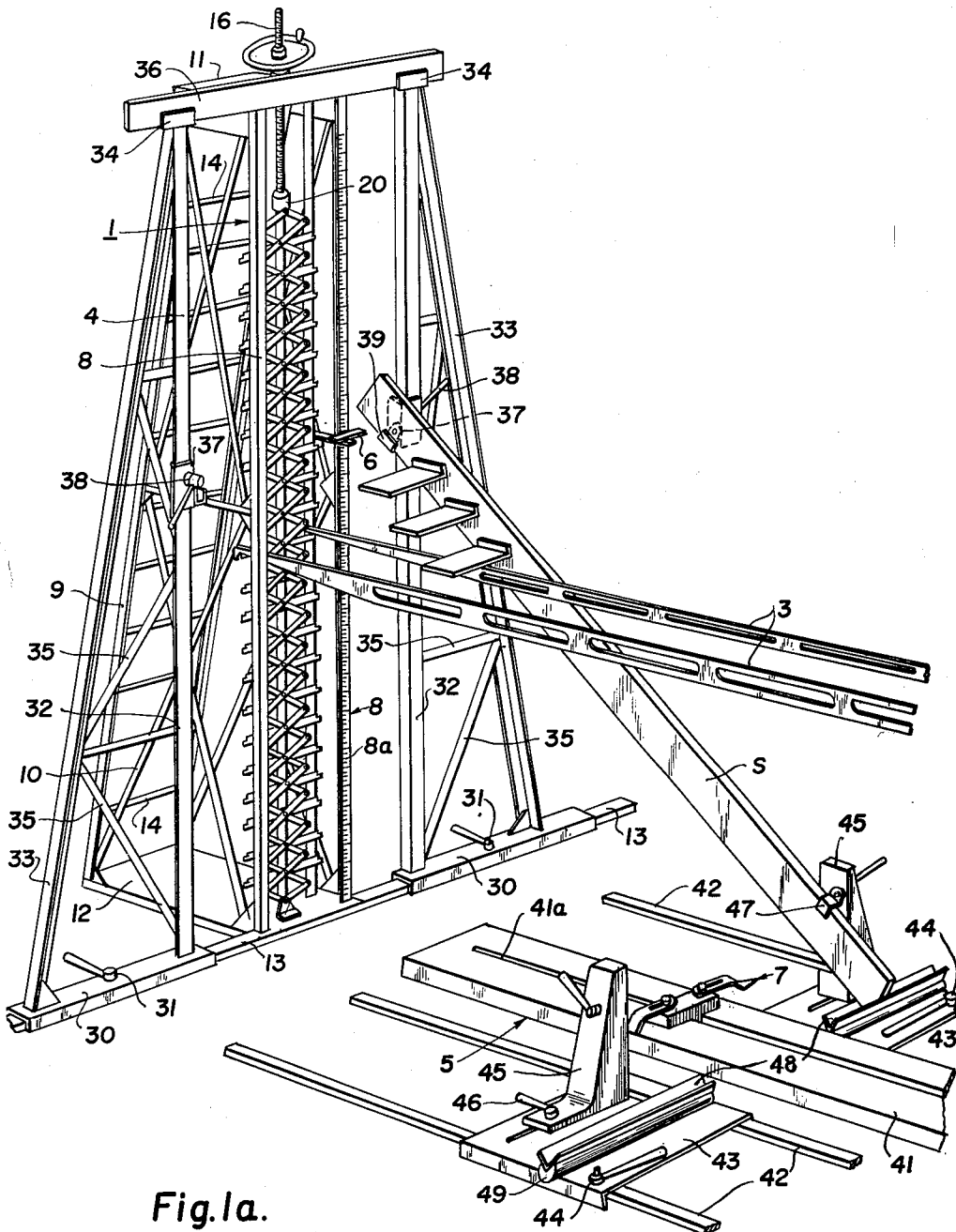


Fig. 1a.

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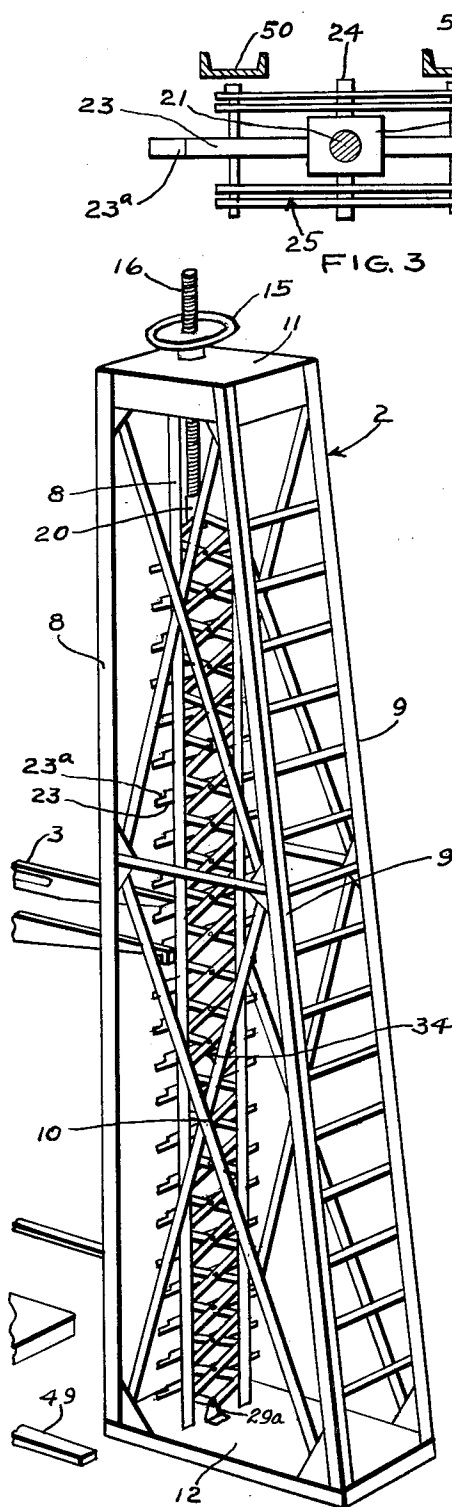


FIG. 1B

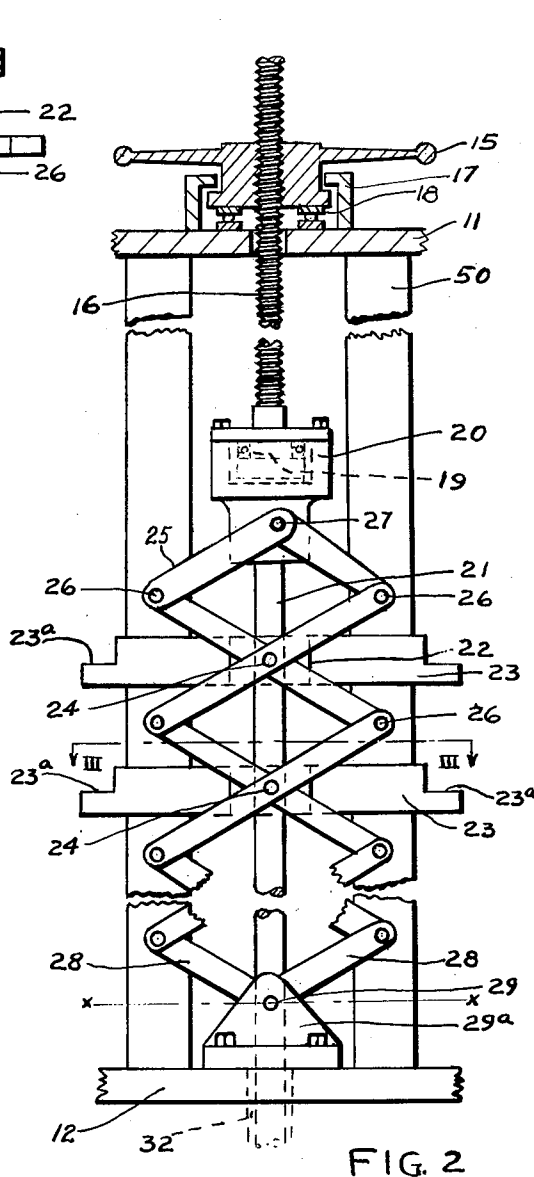


FIG. 2

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APPARATUS FOR CONSTRUCTING STAIRS

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This invention relates to the manufacture or construction of stairs, and is for a novel method of and apparatus for securing the accurate positioning of the stair treads on the stringers with equal increments of rise between treads.

The construction of stairs for a building or other structure involves an expense disproportionate to other parts of the structure because of the careful drafting and extensive shop or field layout work required in determining the correct spacing of the steps on the stringers. While this would appear from the ultimate simplicity of the finished stairway to present little difficulty, it presents to the architect and builder an annoying and time-consuming problem because the floor-to-floor dimension is often some odd figure not evenly divisible by the number stair treads to be provided between floors. The problem is further complicated by other considerations, since the slope of the stairs may vary from floor to floor or from building to building. It is apparent, for example, that as the stairway becomes less steep, the angular relation between the stair treads and the stringers which support them will vary, even though the number of risers remains the same.

Consequently some architects simply approximate the distance between treads, or allow for one tread to be higher or lower than the others to eliminate bother with odd fractions, while others simply specify the number of risers in the stair and let the builder work out the location of the stair treads. Such procedures take time and trouble, and give rise to possible error, all of which are costly.

The present invention has for its object to provide an apparatus for automatically determining the correct spacing for any number of stairs in a stairway for any given floor-to-floor dimension.

A further object of the present invention is to provide such an apparatus which will enable the risers to be set at the correct relative angle to the stringers.

A further object of this invention is to provide a novel method of constructing a stair.

These and other objects and advantages are secured by my invention as will appear from the following description in conjunction with the accompanying drawings. In the drawings:

FIGS. 1A and 1B are complementary views which, when placed side by side, illustrate an apparatus embodying my invention, the drawings being outline drawings showing the apparatus in perspective;

FIG. 2 is a front elevation of the lever system forming a part of the apparatus; and

FIG. 3 is a transverse horizontal section in the plane of line III—III of FIG. 2.

The apparatus disclosed in the drawings comprises generally two oppositely-facing spaced standards or frames designated generally as 1 and 2. Each carries a system of proportional spacing levers and indexing supports to be hereinafter described. Removable level bars

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3 mounted on one indexing support in each standard extend between the two standards 1 and 2. At each side of frame 1 there is a stringer-supporting stand 4 for supporting the upper ends of stringers to which the treads are to be attached. Located between the two main frames 1 and 2 is a stringer-supporting stand indicated generally as 5 for supporting the lower ends of the stringers. There is an upper floor level indicator 6 adjustable vertically in the frame 1, and a lower floor level guide 7 associated with frame 5.

The frame 1 may be designated the main frame, and the standard 2 the auxiliary frame. Both frames are of substantially similar construction, each comprising parallel vertical posts 8 spaced from each other at the confronting faces of the two stands; inclined posts 9 converging upwardly toward the posts 8, and side bracing 10 between the posts 8 and 9. There is a platform 11 at the top of each stand, and each standard has a base 12 at the bottom, the base of the stand 1 having lateral extensions or rails 13 at each side thereof. There are rungs 14 connecting the inclined frame members 9 providing ladders by means of which workmen may conveniently ascend and descend the frames.

On the top of each platform 11 is a handwheel 15 that has threaded engagement with a screw 16 that extends through the platform. A retaining collar 17 secured to the platform retains the handwheel in position, and encloses a thrust bearing 18 on the top of the platform under the handwheel. The lower end of the screw 16 has a swivel connection 19 with a swivel socket 20 on the upper end of rod 21 that extends through the base 12, and which requires a hole in the foundation on which the platform is set to allow for the vertical movement of the lower end of the rod.

Slidable on the rod 21 are a series of blocks 22 from each side of which project arms 23. These blocks also carry pivot pins 24 at right angles to the arms 23. At the front and back of the rod is a system of pantograph levers or lazy tong type levers 25. The pivot pins 24 pass through the centers of the levers 25 where they cross each other. The outer ends of the levers are pivotally connected by pins 26. The terminal levers 25 of the pantograph system at the top are pivoted at 27 to the swivel socket or fitting 20. The terminal levers 28 at the bottom of the pantograph system are pivotally connected at 29 to an anchor block 29a on the base.

With this arrangement, any movement of the screw 16 up or down will be transmitted to the pantograph levers, whereby each block 22 will be moved along the rod 21 in equal increments so that the vertical spacing between the arms 23 carried by the blocks 22 will always be exactly equal, and any variation will occur equally between all of them. Thus, by turning the handwheel, any vertical distance within the range of the machine may be equally divided into a selected number of equal spaces as determined by the cross arms 23. Stated differently, with each increment of vertical movement of the screw shaft 16 and swivel and swivel coupling, each of the cross arms 23 will move vertically through equal increments. To secure this action, it is of course necessary that the top lever of the pantograph system be secured to coupling 20, and the bottom levers be pivotally anchored to a fixed point 29, and that all intermediate pivotal connections float, or be free to move up and down. The rod 21 func-

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tions only as a guide for the blocks 22 and moves up and down only because this provides a guide that does not in any way hinder the up and down movement of the screw shaft 16, but is coextensive with the maximum effective height of the pantograph system.

One of the standards, such as 1, has a stringer-supporting stand 4 at each side thereof, each such stand having a base channel 30 that sets astraddle the laterally-extending rails 13 of the stand, and these base members may be moved toward and away from the standard 1 along the rails 13. A screw clamp 31 is provided for releasably locking base members 30 in the position to which they are adjusted. Each base channel 30 has an upright 32 thereon substantially coextensive in height with the standard 1. Each upright is braced with a diagonal brace 33 which is welded to the base 30, and it converges toward the top of the upright, both the brace and the upright terminating at and being welded to a channel-shaped shoe 34. Bracing struts 35 connect the brace 33 with the upright. Each of the side frames so constructed is therefore in the form of a right-angle triangle with a tall vertical leg thereof positioned alongside the standard 1. There is a rigid cross bar 36 at the top of standard 1 along which the shoes 34 are slidably fitted. The two adjustable side frames are thus held in a vertical position by the engagement of the shoes 34 with this cross bar, and the plane of the uprights 32 is substantially the same as the plane of the posts or columns 3 with which they are parallel.

Each upright 32 has a vertically slidable shoe 37 fitted thereon with a screw clamp 38 for holding it in adjusted position. Each shoe has a bracket 39 pivoted to a face thereof that confronts the column 8, the bracket being wide enough to receive edgewise the end of stringer S for the stair, the bracket being pivoted to adjust itself to the angle of the stringer.

Removably secured to the end of one of the cross bars or arms 23 is an upper floor level indicator in the form of a pointer 6 that extends close in front of one of the columns 8 and projects laterally toward one of the uprights 32 of the side frame. The front surface of one or both of the columns 8 is calibrated into vertical units of measurement, such as feet and inches, the scale of markings being designated 8a in FIG. 1. The corresponding surface of a column opposite standard 2 may be similarly calibrated, and there may be a similar pointer 6, although it is not necessary.

Between the two main standards on the level foundation or floor on which the standards are set is a structure 5 comprising a bottom floor level gauge support 41 in the form of an elongated platform with a central longitudinal slot 41a therein. There is an indicator 7 movable along this slot, and the pointers on this indicator are at the same level as the anchor point at the bottom of the pantograph systems, and this level corresponds to the level of the floor of the building in which the stair is to be used. This level is indicated by the dot-and-dash line x—x in FIG. 2.

At each side of the platform 41 there are parallel rails 42. Adjustable similar platforms 43 are guided by these rails, having a clamp 44 for releasably holding it in the position to which it is adjusted. Each platform 43 has a slot therein transverse to the length of the rails 42 along which is movable a pedestal 45 with a clamp 46 for holding it in adjusted position. The confronting inner faces of the two pedestals are plane surfaces, parallel with each other. Each has a stringer clamp 47 on its inner surface much like the bracket 39, but inverted, so as to engage over the top edge of a stringer and hold it against the face of the pedestal, the clamp being essentially a nut on a threaded bolt and handle assembly wherein a bolt passes through the pedestal with the handle at the outer end of the bolt, so that the clamp may turn to conform to the angle of the stringer and be tightened into position, as will be apparent to those skilled in the art.

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Each platform 43 has a transversely-extending member across it with a trough 48 and a rounded base 49, the rounded base forming a rocker to anchor the trough while permitting it to rock transversely of its length, this trough being designed to receive the bottom corner of the stringer S and support the lower end of the stringer at the exact angle required for the slope of the stair, while the clamp 47 holds the stringer when positioned, against displacement.

In use, the stringer-supporting frames 4 are moved to a position where the brackets 39 are the right distance apart to hold the upper ends of the stringers for the stairway to be constructed, and the pedestals 45 are similarly adjusted. One then counts up the cross arms 23 beginning from the bottom, beginning with No. 1 as the lowermost one, and continuing until the number of treads to be placed in the stair is reached. He then places the upper floor level indicator on the cross arm next above the one where the count stopped. He then turns the handwheel 15 until the indicator 6 points to a calibration on scale 8a that shows the height of the upper floor level above the lower floor level of the particular building in which the stair is to be placed. Next the operator adjusts brackets 39 to a level where a stringer, placed in such bracket, which stringer has not been trimmed to extract length, will extend above the level of the upper floor indicator 6.

The lower floor level indicator and the platforms 43 are then moved to a position where, at the predetermined angle of inclination of the stairs, the lower floor indicator 7 will be at a level where the plane of the pointer will traverse the lower end portion of the stringer. The stringer at this stage need only be cut to approximate length, since any excess will project above and beyond the bracket 39, and only the correct angle setting is required.

When both stringers have been clamped in place at the proper angle and the upper floor indicator 6 is at the level required, each of the cross arms 23 of the pantograph system will have its top edge at the exact level of the bottom of each step to be installed between the upper and lower floors. The outer ends of the arms 23 are shouldered at 23a. Level bars 3 are then placed in position with their end portions resting on shoulders 23a of one of the cross arms, and their top surfaces are then in the plane of the top of the cross arm on which they rest. The other ends of the level bars are set on the corresponding cross bar of the pantograph system of the other standard, and said system is then adjusted so that the bars are exactly level. The level bars extend between the stringers, and a stair is then set on the level bars and secured in position. If this is a metal stair, the tread may be welded, riveted or bolted, or if a wooden stair, nailed into place, or lines may be made on the stringers for subsequent assembly.

The level bars are then set on the next lower or upper cross bar and the second tread positioned on the stringers. The operator will usually start at the top and work down, or at the bottom and work up, but may start at an intermediate level. Sometimes two sets of level bars may be used and operations carried on at two levels.

After the stair has been assembled, the lines for cutting off the tops and bottoms of the stringers may be marked on the stringers by marking the stringers at the levels where the upper and lower pointers or the stairway may be first installed in the building and any excess length removed when the stair is in position.

As best seen in FIGS. 2 and 3, there may be parallel vertical rails 50 back of each pantograph system. These rails do not interfere with the operation of the pantograph system, but they are guide surfaces that steady the pantograph system and keep it from rotating about a vertical axis or imposing a twisting torque on the pivot 29 at the bottom of the pantograph system.

In the foregoing explanation I have described for pur-

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poses of illustration one method of using the apparatus. However, it is preferable that the stair be constructed upside down. The distance between floors is of course the same either way, and the spacing between steps is the same, and the stringers are always in the position of the hypotenuse of a right-angle triangle, so it makes no difference which end is called up, and which end is called down, except that the stair tread supports are usually under the stair, and if the stair is initially formed with stair tread surfaces down, and the structure subsequently inverted end-for-end, the joining of the stairs to the stringers can be accomplished more easily working down than working up under the tread. This is especially true where the stairs are welded to the stringers. It is easier to weld downwardly from above than to weld up under a structure. The only difference would be that the indexing of the supports 23 should be adjusted with this object in mind, so that the bars 3 are at the level of the stair surface which will ultimately be the top of the tread instead of the bottom. By making the stringers longer than needed, even this involves no change when making the stairway first in this upside down manner, since the only thing that would be affected if the stringers were of the exact required length to start with, would be that rise from the lower floor to the first step and from the top stair to the second floor level would not be right if provision were not made for the thickness of the tread in positioning them between the stringers.

Therefore, unless otherwise specifically indicated, the use of the terms "top" and "bottom" herein and in the claims are only for purpose of illustration and orientation of operation, and do not necessarily apply to the position of the stair in use. Also, it will be apparent that the operation, although less convenient, could be reversed to the extent of having the pantograph levers horizontal and the base supports vertical.

The apparatus as described therefore embodies means for supporting the stringers a proper width apart and at the required angle, but which does not require that they be cut to length. Cooperating with the stringer-supporting means is a tread level indexing apparatus comprising the indexing supports or cross arms 23 and means for holding said cross arms equally spaced, and for simultaneously varying the spacing of all of them equally at the same time, and this is the function of the pantograph lever system. Finally, the apparatus includes the level bars or stair level positioning support extending between the stringers for holding the treads at the levels where they are to be positioned as determined by the indexing means.

The method and apparatus will find their greatest utility in shops where prefabricated stairs are made to specification, or on large building projects where many stairs are to be manufactured on the job. The apparatus is obviously too heavy for transportation from one single house project to another.

While I have shown and described specific constructions, various changes and modifications may be made therein within the contemplation of my invention.

I claim:

1. Apparatus for constructing a stair comprising a standard having a vertical series of equally spaced movable supporting arms, means for proportionally moving all of said arms simultaneously to vary the equal spacing between them, means at each side of the standard for holding a stair tread-supporting stringer at the angle required for the completed stair, and alignment means interchangeably placed on any one of the supporting arms for aligning a stair tread to be placed horizontally between the stringers.

2. Apparatus for constructing a stair comprising a first standard having a base and an upright frame, a vertical series of equally spaced vertically movable indexing members mounted therein in the frame, means for proportionally moving all of the indexing members

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simultaneously to vary the equal spacing between them, vertically adjustable means at each side of the standard for holding the upper end of a stringer to which stair treads are to be mounted, means positioned forwardly of the base of the standard for holding the lower end of such stringer, said last-named means being movable horizontally toward and away from the base of the standard, whereby the stringer may be held in the position of the hypotenuse of a right-angle triangle, the height of the vertical leg of which may be varied by adjusting the vertically adjustable means at each side of the standard and the horizontal leg of which may be varied by movement of the means for holding the lower ends of the stringer horizontally toward and away from the base of the standard, and a tread-positioning alignment means placed selectively on one of the said vertically movable indexing members for aligning horizontally a stair tread adjacent the stringer at the level determined by the position of the indexing member on which the alignment means is placed.

3. Apparatus for constructing a stair as defined in claim 2 in which there is a second standard similar to the first in confronting relation to the first and the means for holding the lower end of the stringer is positioned between the two standards, the said horizontal tread position support extending from the indexing member on the first standard to a correspondingly positioned one on the second standard.

4. Apparatus for constructing a stair as defined in claim 2 in which the means for proportionally moving all of the indexing members simultaneously comprises a system of pantograph levers anchored at the base to a fixed pivot and operatively connected at its upper end to a vertically adjustable member on the frame.

5. Apparatus for constructing a stair as defined in claim 2 in which the vertically-adjustable means at each side of the first standard and the means positioned forwardly of the base of the standard for holding the lower end of such stringer are laterally adjustable for building stairs of different widths.

6. Apparatus for constructing a stair comprising a pair of standards placed in spaced confronting relation, each standard having a base and a vertical upright, each standard being taller than the maximum vertical height of the stairs to be constructed thereon, each standard having a vertically movable member at the top, means for moving said member vertically and holding it in any position to which it is moved, a system of pivoted pantograph levers having the uppermost levers of the system pivotally secured to the vertically movable member and having the lowermost levers of the system pivotally anchored to the base whereby vertical movement of said member extends or collapses the pantograph system, a vertical guide in each standard, a plurality of indexing supports vertically movable along the guide, all of the indexing supports being pivotally connected to the pantograph system at corresponding pivot points in the system whereby said indexing supports may be moved relatively to each other along the guide and maintained separated by equal distances when the pantograph system of levers is operated by the vertically-movable member, vertically adjustable means at each side of one standard for supporting the sides of the one standard and for supporting the upper ends of the stair stringers, horizontally-adjustable means between the bases of the two standards for supporting the lower ends of said stringers with the stringers being in the attitude of the hypotenuses of right-angle triangles of which the uprights of the standards are the vertical sides of such triangles, and a stair tread positioning structure extending horizontally between an indexing support on one standard and the corresponding indexing support of the other standard.

7. Apparatus for constructing a stair comprising a pair of standards placed in spaced confronting relation, each standard having a base and a vertical upright, each stand-

ard being taller than the maximum vertical height of the stairs to be constructed thereon, each standard having a vertically movable member at the top, means for moving said member vertically and holding it in any position to which it is moved, a system of pivoted pantograph levers having the uppermost levers of the system pivotally secured to the vertically movable member and having the lowermost levers of the system pivotally anchored to the base whereby vertical movement of said member extends or collapses the pantograph system, a vertical guide in each standard, a plurality of indexing supports vertically movable along the guide, all of the indexing supports being pivotally connected to the pantograph system at corresponding pivot points in the system whereby said indexing supports may be moved relatively to each other along the guide and maintained separated by equal distances when the pantograph system of levers is operated by the vertically-movable member, vertically adjustable means at each side of one standard for supporting the sides of one standard and for supporting the upper ends of the stair stringers, horizontally-adjustable means between the bases of the two standards for supporting the lower ends of said stringers with the stringers being in the attitude of the hypotenuses of right-angle triangles of which the uprights of the standards are the vertical sides of such triangles, and a stair tread positioning structure extending horizontally between an indexing support on one standard and the corresponding indexing support of the other standard, the stair tread-positioning structure being removably carried on the said indexing supports whereby it may be interchangeably placed on any selected corresponding indexing supports of the two standards.

8. Apparatus for constructing a stair comprising a pair of standards placed in spaced confronting relation, each standard having a base and a vertical upright, each standard being taller than the maximum vertical height of the stairs to be constructed thereon, each standard having a vertically movable member at the top, means for moving said member vertically and holding it in any position to which it is moved, a system of pivoted pantograph levers having the uppermost levers of the system pivotally secured to the vertically movable member and having the lowermost levers of the system pivotally anchored to the base whereby vertical movement of said member extends or collapses the pantograph system, a vertical guide in each standard, a plurality of indexing supports vertically movable along the guide, all of the indexing supports being pivotally connected to the pantograph system at corresponding pivot points in the system whereby said indexing supports may be moved relatively to each other along the guide and maintained separated by equal distances when the pantograph system of levers is operated by the vertically-movable member, vertically adjustable means at each side of one standard for supporting the sides of one standard and for supporting the upper ends of the stair stringers, horizontally-adjustable means between the bases of the two standards for supporting the lower ends of said stringers with the stringers being in the attitude of the hypotenuses of right-angle triangles of which the uprights of the standards are the vertical sides of such triangles, and a stair tread positioning structure extending horizontally between an indexing support on one standard and the corresponding indexing support of the other standard, the stair tread-positioning structure being removably carried on the said indexing supports whereby it may be interchangeably placed on any selected corresponding indexing supports of the two standards, the vertically-adjustable means on each side of the one standard and the horizontally-adjustable means between the bases being angularly adjustable.

9. Apparatus for constructing a stair comprising a pair of standards placed in spaced confronting relation, each standard having a base and a vertical upright, each standard being taller than the maximum vertical height of the

stairs to be constructed thereon, each standard having a vertically movable member at the top, means for moving said member vertically and holding it in any position to which it is moved, a system of pivoted pantograph levers having the uppermost levers of the system pivotally secured to the vertically movable member and having the lowermost levers of the system pivotally anchored to the base whereby vertical movement of said member extends or collapses the pantograph system, a vertical guide in each standard, a plurality of indexing supports vertically movable along the guide, all of the indexing supports being pivotally connected to the pantograph system at corresponding pivot points in the system whereby said indexing supports may be moved relatively to each other along the guide and maintained separated by equal distances when the pantograph system of levers is operated by the vertically-movable member, vertically adjustable means at each side of one standard for supporting the sides of one standard and for supporting the upper ends of the stair stringers, horizontally-adjustable means between the bases of the two standards for supporting the lower ends of said stringers with the stringers being in the attitude of the hypotenuses of right-angle triangles of which the uprights of the standards are the vertical sides of such triangles, and a stair tread positioning structure extending horizontally between an indexing support on one standard and the corresponding indexing support of the other standard, the stair tread-positioning structure being removably carried on the said indexing supports whereby it may be interchangeably placed on any selected corresponding indexing supports of the two standards, the vertically-adjustable means on each side of the one standard and the horizontally-adjustable means between the bases being angularly and laterally adjustable.

10. In an apparatus for building stairs, a means for predetermining the location of a selected number of equally spaced treads between a pair of stringers inclined at an angle at which they will be placed in a building including a vertical standard, a vertical series of equally spaced indexing supports mounted for vertical movement relative to each other in the standard, and means for simultaneously moving said indexing supports vertically in the standard and relatively to each other to maintain them equally spaced.

11. In an apparatus for building stairs, a means for predetermining the location of a selected number of equally spaced treads between two inclined stringers on which the treads are to be mounted, said means including an upright standard having a top and a base, a vertical system of pantograph levers in the standard between the base and the top, and indexing supporting means at equally spaced corresponding points on the system which are moved simultaneously to vary the equal spacing of the indexing supporting means with the extension and contraction of the system, and means for extending and contracting the system and holding it in adjusted position.

12. Apparatus for fabricating stairs comprising a vertical support for holding the ends of two spaced parallel stringers at a selected elevation, a horizontal support for holding the other ends of the stringers at a predetermined distance from the vertical support to predetermine the slope of the stringers, and indexing means on one of the supports for determining the location of a selected number of equally spaced stair treads between stringers mounted in said supports, said indexing means including a system of pantograph levers having one end pivotally anchored in the support in which the system is located and the other end movably fixed to an operating member, an operating member for expanding and contracting the system and holding it in a selected position, equally spaced indexing supports connected with the pantograph system of levers and held in equally spaced relation to one another thereby, said indexing supports being distributed

along the pantograph system of levers and attached thereto at corresponding positions along its length whereby the operation of the pantograph system of levers simultaneously moves the indexing supports relatively to one another while maintaining equal spacing between the successive indexing support, and stair tread position-indicating means extending from such an indexing support in a direction normal to the plane of movement of said indexing supports to a position where it intersects the angular plane of stringers mounted on the vertical and horizontal supports.

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1,618,536
1,745,471
1,753,051
2,030,594
2,234,906
2,588,810
2,648,896
2,787,825
2,870,531

References Cited in the file of this patent

UNITED STATES PATENTS

Junkers -----Feb. 22, 1927
Bickel et al. -----Feb. 4, 1930
Junkers -----Apr. 1, 1930
Hyde et al. -----Feb. 11, 1936
Wallis -----Mar. 11, 1941
Dietrich -----Mar. 11, 1952
Krumm -----Aug. 18, 1953
Haliday -----Apr. 9, 1957
Hudson -----Jan. 27, 1959