Oct. 7, 1969 J. I. WHITEHEAD 3,470,664

ADJUSTABLE STAIRCASE

Filed May 23, 1968 2 Sheets-Sheet 1

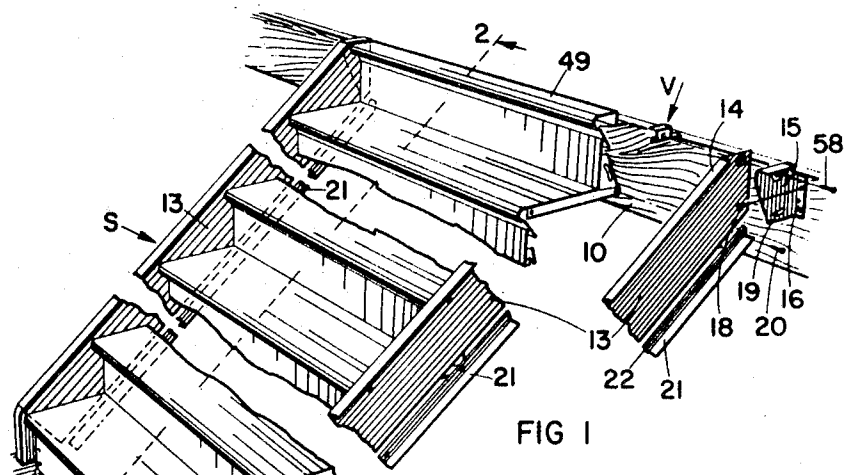


FIG 1

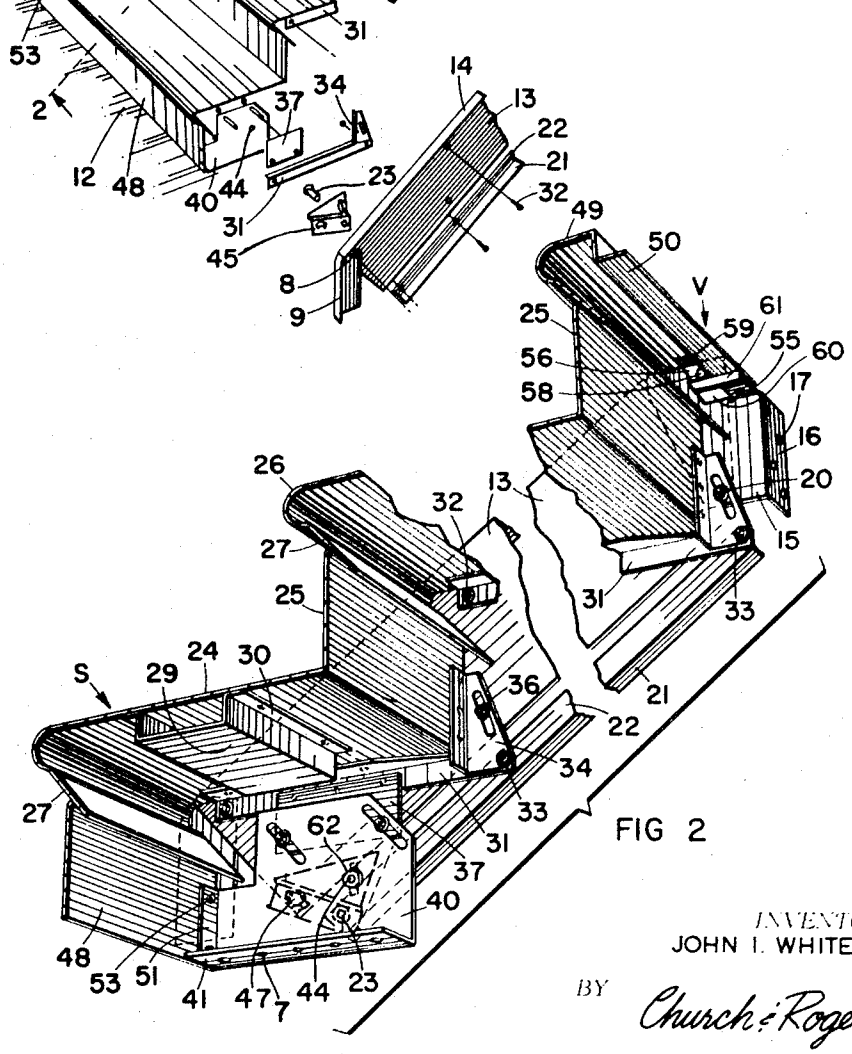


FIG 2

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FIG 3

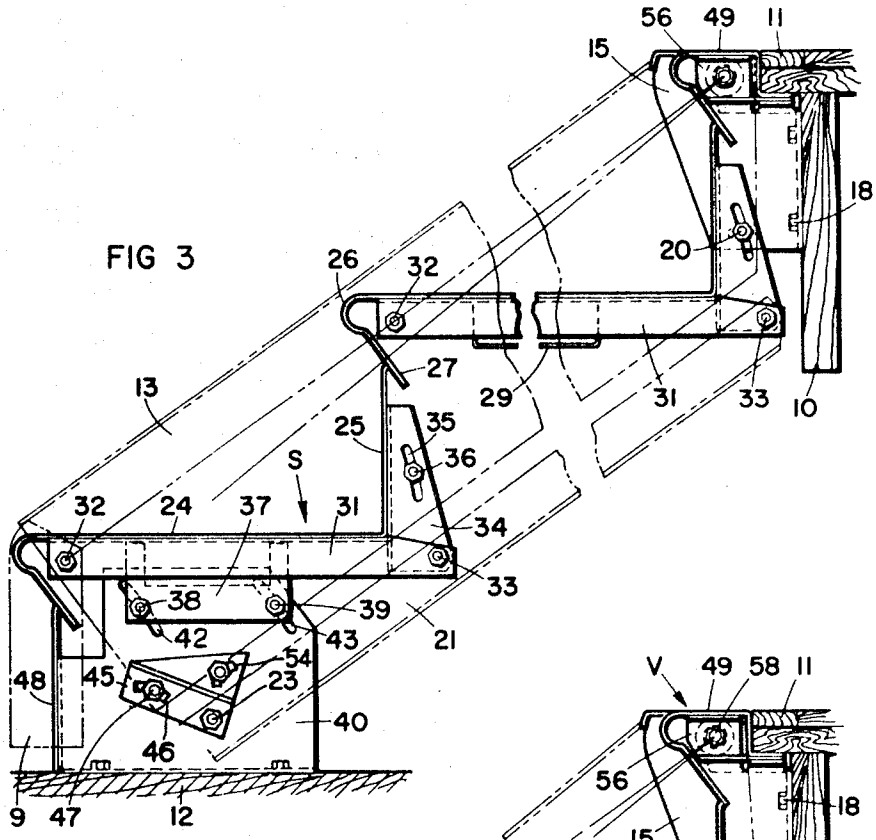
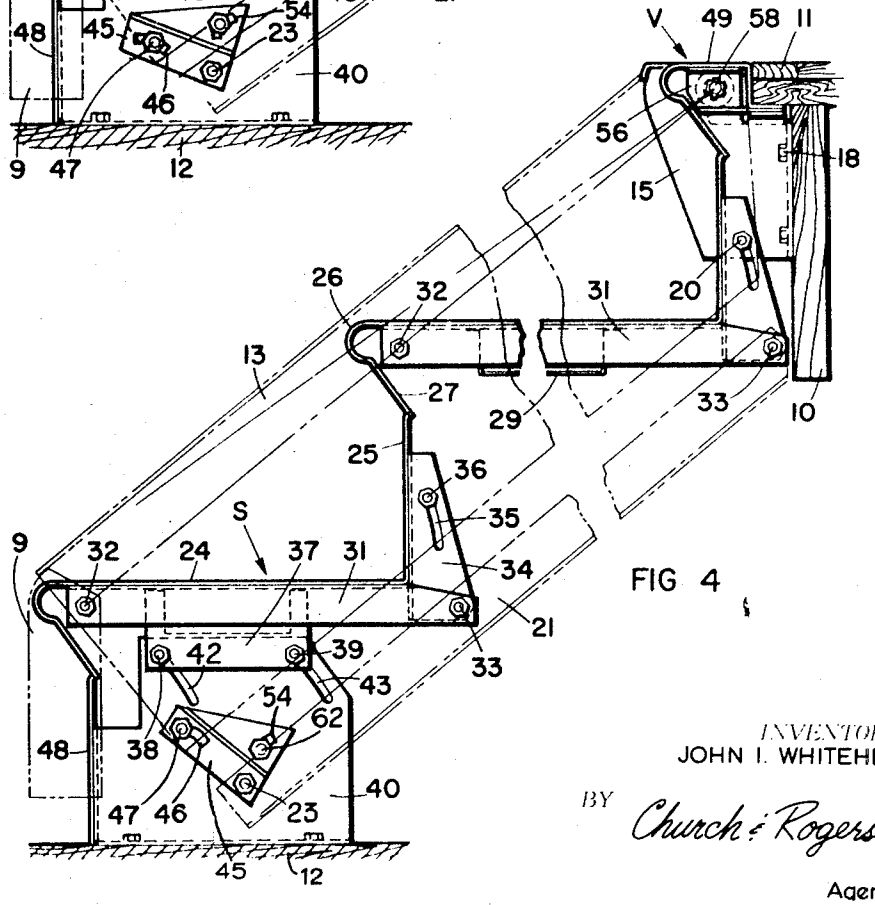


FIG 4



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ADJUSTABLE STAIRCASE

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U.S. Cl. 52—183 11 Claims

ABSTRACT OF THE DISCLOSURE

An adjustable staircase comprises a plurality of stairs each comprising an integral sheet metal unit providing a tread, a riser upstanding from the rear edge of the tread, a rounded toe at the front edge of the tread, and an inwardly inclined apron depending from the lower edge of the toe; these stairs are supported between two parallel stringer structures, each of which structures comprises parallel-connected upper and lower stringers; a pivotal connection is provided between the front end of each stair and said upper stringer, and another pivotal connection is provided between the rear end of each stair and said lower stringer; there are also provided means for connecting the upper end of said upper stringers to an upper floor with an adjustable connection; and means for adjustably securing the lower ends of said lower stringers to a lower floor; the length of the stringer structures can be accommodated to different spacings between the floors and the stairs will automatically remain level.

Field of the invention

The present invention relates to adjustable staircases and especially to a metallic staircase comprising elements that can be prefabricated off the job site and assembled on the job with the assurance that the distance between the two connected floor levels is accurately bridged, each stair has substantially the same rise as every other stair, and each stair tread is level.

Description of the prior art

It is a recognized requirement in the building trade that the rise for each stair of a staircase should be constant and uniform, as compared to the rise of the other stairs, a discrepancy of as little as one-half inch creating an unsatisfactory condition. Moreover, the tread of each stair should be level in all directions. For these reasons, and also because the structural conditions vary with each job, it has usually been necessary for each staircase to be a custom-built structure, and it has been considered impractical, if not impossible, for example, to prefabricate the staircases for a large number of houses in a building development. The same negative view has been taken of making the staircases of sheet metal such as steel, because of the necessity of fitting each staircase to the particular building in which it is installed.

Summary of the invention

It is an object of the present invention to provide an adjustable staircase comprising elements that may be prefabricated and assembled on the job site with the assembled staircase being susceptible of adjustment to accommodate the structural conditions of the particular building in which it is installed.

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In accordance with the present invention there is provided an adjustable staircase; a plurality of stairs each comprising an integral sheet metal unit providing a tread, a riser upstanding from the rear edge of the tread, a toe at the front edge of the tread, and an inwardly inclined apron depending from the lower edge of the toe; a pair of parallel transversely-spaced upper stringers disposed at respective ends of the said stairs, a pair of parallel transversely-spaced lower stringers disposed at respective ends of the said stairs, each lower stringer being parallel to and operatively associated with a respective upper stringer; a pivotal connection between the front end of each stair and said upper stringer; a pivotal connection between the rear end of each stair and sail lower stringer; means for connecting the upper ends of said upper stringers to a floor beam with an adjustable connection; and means for adjustably securing the lower ends of said lower stringers to a lower floor.

Every staircase includes a stair-supporting parallelogram structure at each side, which, for the purposes of this specification is identified as parallel upper and lower stringers. The stairs are mounted between these stringers and each stair comprises a tread and a riser. The tread of the lowermost stair must be accurately positioned relative to the floor surface from which the staircase rises and the tread of the top stair must be similarly positioned relative to the upper floor surface. Moreover, each stair must have the same rise as all the other stairs.

Preferably, each sheet metal stair comprises a tread with a rounded toe at its forward or exposed edge.

As both the tread and rise of a stair are of sheet metal it becomes necessary to reinforce them to add rigidity to the structure. Preferably there is provided in a staircase of the kind described, a reinforcing member at each side edge of each riser. These reinforcing members preferably take the form of angle members. A central bracing member for each tread may be provided in the form of a sheet metal channel member that extends transversely under each tread.

An adjustable connection may be provided between the member reinforcing the risers and the upper stringer, such a connection taking the form of slightly arcuate slots in the angle members which receive bolts on the risers.

The apron which depends from the rounded toe overlies the upper edge of the riser of the stair next below to accommodate adjustment of the riser while still affording a finished appearance.

It is essential that an installed staircase offer a finished appearance at the top with the floor edge having the same structural characteristics as the toes of the stairs. Thus the connecting means for the upper end of the staircase may comprise an upper toe piece together with brackets on which it is mounted and which brackets also provide anchorage for the upper ends of the stringers.

In installing the adjustable staircase of this invention the structure at the top is first secured. This means that the effective length of the stringer structure must then be adjusted to bring the tread of the lowermost stair to the proper height above the floor, when it can be fixed in this position. With this factor in mind, an adjustable staircase in accordance with this invention comprises a base plate, the lower edge of which engages the floor, there being a base plate at each side, a bracket at each

side secured at its upper edge to the angle members of the lowermost tread and connected to the base plate by adjustable connections, and a base plate actuator at each side which is pivotally mounted on the bracket at the respective side by a fixed pivot and connected at the bottom to the base plate and lower stringer by adjustable connections.

Various other more detailed objects and advantages of the invention, such as arise in connection with carrying out the above ideas in a practical embodiment, will in part become apparent, and in part be hereinafter stated, as the description of the invention proceeds.

Description of the drawings

A particular preferred embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, wherein:

FIGURE 1 is a perspective view from above and to one side of a complete adjustable staircase, parts thereof being shown broken away and in exploded relation as necessary for clarity of illustration,

FIGURE 2 is another perspective view looking up from below with the staircase shown as cut down the centre and with parts broken away,

FIGURE 3 is a side elevation of a staircase adjusted to fit between two relatively close floor levels, and

FIGURE 4 is a view similar to FIGURE 3 showing the same staircase fitted between two more widely spaced floor levels.

Description of the preferred embodiment

Referring now to the drawings, wherein like reference characters denote corresponding parts, a beam **10** supporting an upper floor **11** is shown in FIGURES 1, 3 and 4, while the corresponding lower floor is indicated by reference **12**.

A pair of transversely-spaced upper stringers **13** of sheet metal (such as steel), each having a top out-turned flange **14**, are of sufficient length to bridge the space between adjacent floor levels, each stringer being disposed on a respective side of the stair. A side piece **9** is pivotally connected to the lower end of each upper stringer **13**, the pivot being indicated by reference **8** in FIGURE 1, while the upper end of each stringer is anchored to the beam **10** by a bracket **15**. This bracket is formed with a flange **16** having holes (FIGURE 2), through which pass fastening screws **18** embedded in the wood of the beams, and is also formed with an arcuate slot **19** through which passes a bolt **20** carried by the upper stringer **13**. This bolt and slot connection permits pivotal adjustment of the upper stringer relative to the beam **10**, and after a desired adjustment is achieved a nut (not illustrated) is applied to the bolt and tightened to secure the connection.

The staircase also comprises a pair of parallel, transversely-spaced lower stringers **21**, respectively of angular cross section and having a vertical flange **22**, each lower stringer being disposed parallel to and operatively associated with a respective upper stringer **13**, and each carrying a bolt **23** at its lower end.

An individual stair is identified by the reference character S, and a plurality of similar stairs are mounted between the pairs of parallel stringers **13** and **21**. Each stair S comprises a tread **24** of sheet steel, a riser **25** integral with the tread **24** and integrally joined thereto at its rear edge, a rounded toe portion **26** integrally connected to the front edge of the tread **24**, and an inwardly inclined apron **27** integrally joined to the toe portion **26**. The shape of the apron **27** is made such that it will always be held by its own resilience in close engagement with the upper end of the riser of the next lowest step and effectively completes and closes the riser.

A brace **29** in the form of a sheet steel channel bar extends transversely across each tread **24** on the underside thereof, the brace having side flanges **30** which are welded to the tread to secure the connection. An edge reinforcement is provided at each side of the tread **24** in the form of an angle bar **31**, the top flange of which is welded to the underside of the tread. A bolt **32** pivotally connects the front end of each angle bar **31** to the respective top stringer **13**, while a bolt **33** pivotally connects the rear end of each angle bar **31** to the associated lower stringer.

The riser **25** is reinforced at each side by an angle plate **34** having a flange welded to the rear face of the riser, each plate **34** being formed with an arcuate slot **35** which receives a bolt **36** carried by the upper stringer **13**. As in the case of the bolts **32** and **33** the bolts **36** are provided with nuts which are loosened to permit adjustment and tightened to secure an adjustment.

A bracket plate **37** is anchored to the inner face of each angle bar **31** of the lowermost stair S, this anchorage being achieved in any preferred way, as by welding. The brackets plate **37** carries two bolts **38** and **39**, by which the plate **37** is connected to base plate **40** having a bottom flange **41** (FIGURE 2) that rests on the floor **12**. The base plate **40** has two arcuate slots **42** and **43** which receive the bolts **38** and **39**, while the flange **41** is formed with openings **7** which accommodate screws (not illustrated) to anchor the base plates to the floor **12** after final adjustment of the stringers. The base plate **40** is also provided with another slot **44**.

A base plate actuator **45** is pivotally mounted on the bolt **23** with the latter constituting a fixed pivot, the actuator being of generally triangular shape with the pivot at **23** at the lower corner thereof. A forward upper corner of the actuator **45** is formed with a slot **46** which receives the pin **47** on the upper stringer **13**, while the remaining rearward upper corner of the actuator **45** is formed with a slot **54**, through which passes a bolt **62** passing through the said slot **44** in the base plate **40**.

A bottom-stair closing piece **48** extends up from the floor **12** to the apron **27** of the lowermost stair S, while a top finishing piece **49**, comparable to the toe and apron of a tread, extends from the upper floor **11**, the piece **49** including a flat portion that is flush with the floor **11** and a flange **50** that depends therefrom and abuts the edge of the flooring **11**.

Each base plate **40** is cut away at its forward upper corner to leave a front edge that is shorter than the height of the remainder of the base plate (as shown in FIGURES 2, 3 and 4), and a flange **51** (FIGURE 2) formed with openings is integrally joined to this short front edge. Fastening elements such as bolts **53** pass through the openings in the flange **51** and corresponding holes in the face plate **48** to mount the latter across the base plates at the bottom of the staircase.

Each bracket **15** is formed at its upper edge, closely adjacent to the flange **16**, with an integral tab **55** that extends inwardly therefrom parallel to the stairs, these tabs **55** performing a supporting function now to be described. An upper stringer support is referred to in its entirety by the reference character V, and one of these supports V is provided at each side of the stair. Each support V comprises a main body portion **56** which is vertical when installed and is formed with an aperture receiving a pivot bolt **58** passing through the upper stringer **13**.

A flange **59** is integral with the upper edge of the main body **56** of each support V and supportingly engages the underface of the toe piece **49** (FIGURE 2), while a flange **60** extends outwardly from the lower edge of the main body **56** and rests on the tabs **55**, to which they are secured, as by bolting. Each flange **60** is continued out beyond the main body **56** and is formed with a skirt **61** which overlies the end of the adjacent tab **55**.

It will be seen that the supports V provide the main pivotal supports for the upper ends of the upper stringers **13** via the pivot bolts **58**. The connection constituted by bolt **18**, slot **19** and nut **20** merely permits adjustment of

the upper stringers about the pivot **58**, and after each adjustment the bolts **20** are tightened to secure the connection.

As explained above, the upper stringers are effectively pivoted at their upper ends to the upper floor **11** via the bolts **58**, while they are pivoted at their lower ends to the lower floor **12** via the lowermost pivot bolts **32**, these lowermost bolts being carried by the reinforcements **31** that are secured to the base plates **40**. Each parallel lower stringer is pivoted at its upper end by the uppermost bolt **33** effectively to the upper floor level at a location almost vertically below the pivot **58**, and is pivoted effectively to the lower floor level via the bolt **23**. The special connection of the bolt **23** to the piece **45**, and the adjustable cam slot connection of the piece **45** to the base plate **40**, is required because of the difficulty in practice of locating the bolt **23** in a position relative to the pivot **32** corresponding to the relative position of the pivots **58** and **33**, so as to obtain a true parallelogram linkage. The spacing of immediately adjacent pairs of bolts **32** or **33** are made the same, while the distance between each two associated bolts **32** and **33** on the same reinforcement **31** are the same, so that the treads **24** carried by the reinforcements must remain parallel to one another as the stringers are adjusted in parallelogram linkage manner, as illustrated by FIGURES 3 and 4.

In the practical application of the invention, a staircase will be selected that has the number of stairs required to accommodate the height between the floors to be bridged. For a specific example, a five stair staircase that has actually been constructed can be fitted between levels spaced from 32.46 to 39.37 inches, while a six stair embodiment will fit from 38.95 to 47.25 inches. The following procedure for installation is recommended:

(1) All of the bolts **20**, **23**, **32**, **33** and **36** on the stringers are loosened to the extent of about one revolution.

(2) The beam **10** is now checked to ensure that it is level and in correct vertical alignment. Should any discrepancies develop they can be corrected by using wedges or by trimming certain parts.

(3) The fasteners V and the brackets **15** are fixed in position and the assembled staircase is now fixed into position so that the upper surface of the piece **49** is flush with the flooring **11** and is level.

(4) If the staircase interferes with a sidewall of the staircase well that is not square with the beam **10**, either one or both of the brackets **15** may be adjusted by inserting shims beneath the respective flange **16**.

(5) The base plates **40** are now lowered until the flanges **41** rest on the floor. The tread **24** of the lowermost stair S is now leveled transversely, if necessary either or both of the base plates being adjusted by inserting shims beneath the respective flange **41**.

(6) The level of the tread **24** of an intermediate stair S is now checked in the direction between the toe **26** and its riser **25**, any necessary adjustment being made for example by lightly tapping the tread to move it upwardly or downwardly, this movement being accommodated by the bolts **36** moving in slots **35**. This should achieve accurate leveling of the treads in both directions.

(7) All bolts are now securely tightened.

(8) The flanges **41** of the base plates **40** are screwed to the floor.

It is evident that because of the above-described parallelogram construction the rise for all the stairs is the same and the treads of all the stairs are level, while the upper edge of the riser for the top stair is finished and flush with the upper floor surface.

While a preferred specific embodiment of the invention is hereinbefore set forth, it is to be clearly understood that the invention is not to be limited to the exact constructions, mechanisms, and devices illustrated and described because various modifications of these details may be provided in putting the invention into practice within the scope of the appended claims.

What I claim is:

1. In an adjustable staircase; a plurality of stairs each comprising an integral sheet metal unit providing a tread, a riser upstanding from the rear edge of the tread, a toe at the front edge of the tread, and an inwardly inclined apron depending from the lower edge of the toe; a pair of parallel transversely-spaced upper stringers disposed at respective ends of the said stairs, a pair of parallel transversely-spaced lower stringers disposed at respective ends of the said stairs, each lower stringer being parallel to and operatively associated with a respective upper stringer; a pivotal connection between the front end of each stair and said upper stringer; a pivotal connection between the rear end of each stair and said lower stringer; means for connecting the upper ends of said upper stringers to a floor beam with an adjustable connection; and means for adjustably securing the lower ends of said lower stringers to a lower floor.

2. The adjustable staircase of claim **1**, in which each tread is braced by a transverse channel member on the underside thereof.

3. The adjustable staircase of claim **1**, in which each stair tread comprises a reinforcing member at each end on the underside thereof, and the said pivotal connections of the stringers to the stairs are to the front and rear portions respectively of the reinforcing members.

4. The adjustable staircase of claim **1**, in which each said stair sheet metal unit is provided at the rear face of each edge of the riser with a reinforcing plate formed with an arcuate slot, and an adjustable connection between each upper stringer and the adjacent reinforcing plate.

5. The adjustable staircase of claim **1**, in which the pivotal connections are provided by bolts and nuts.

6. The adjustable staircase of claim **1**, in which the means for adjustably securing the lower end of each lower stringer to a floor comprises a bracket plate at each side of the tread of the lowermost stair and anchored thereto; a base plate adjustably mounted on each bracket plate; and a base plate actuator pivotally mounted on said lower stringer and connected to said base plate and upper stringer by adjustable connections.

7. The adjustable staircase of claim **6**, in which each base plate is adjustably mounted on its respective bracket plate by means comprising a pair of bolts and a pair of corresponding parallel arcuate slots in the base plate receiving the bolts.

8. The adjustable staircase of claim **6**, in which the lower end of the lower stringer carries a bolt that is received in a hole in the actuator and the actuator carries a bolt that is received in a hole in the base plate and a bolt that is received in a hole in the upper stringer.

9. The adjustable staircase of claim **1**, in which the means for adjustably connecting the upper ends of the upper strings to a floor beam comprises a pair of brackets, each of which is adapted to be anchored to the beam and each of which has a slot receiving a bolt carried by each of the upper stringers.

10. The adjustable staircase of claim **1**, together with a finishing toe piece adapted to be secured to the upper floor with a flat portion flush with the floor surface and to which is integrally joined a rounded toe from which depends an apron passing over the upper edge of the adjacent riser.

11. In an adjustable staircase; a plurality of stairs each comprising a unit providing a tread, a riser upstanding from the rear edge of the tread, a rounded toe at the front edge of the tread, and an inwardly inclined apron depending from the lower edge of the toe; a reinforcing bar on the underside of the tread at each side thereof; a reinforcing plate on the rear face of the riser at each edge thereof and formed with a slot; a pair of parallel transversely-spaced upper stringers disposed at respective ends of the said stairs, a pair of parallel transversely-spaced lower stringers disposed at respective ends of the said stairs, each lower stringer being parallel to and operatively

associated with a respective upper stringer; bolts on said upper stringer received in said slot in the reinforcing plates; a pivotal connection between the front end of each reinforcing bar and said upper stringer; a pivotal connection between the rear end of each reinforcing bar and said lower stringer, whereby the said upper and lower stringers and the stairs constitute an effective parallelogram linkage, means for connecting the upper end of said upper stringer to an upper floor with an adjustable connection; and means for adjustably securing the lower end of said lower stringer to a lower floor.

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