Sept. 16, 1969 F. B. SMITH ET AL 3,467,220

STAIRWAY CONSTRUCTION

Filed March 20, 1967 2 Sheets-Sheet 1

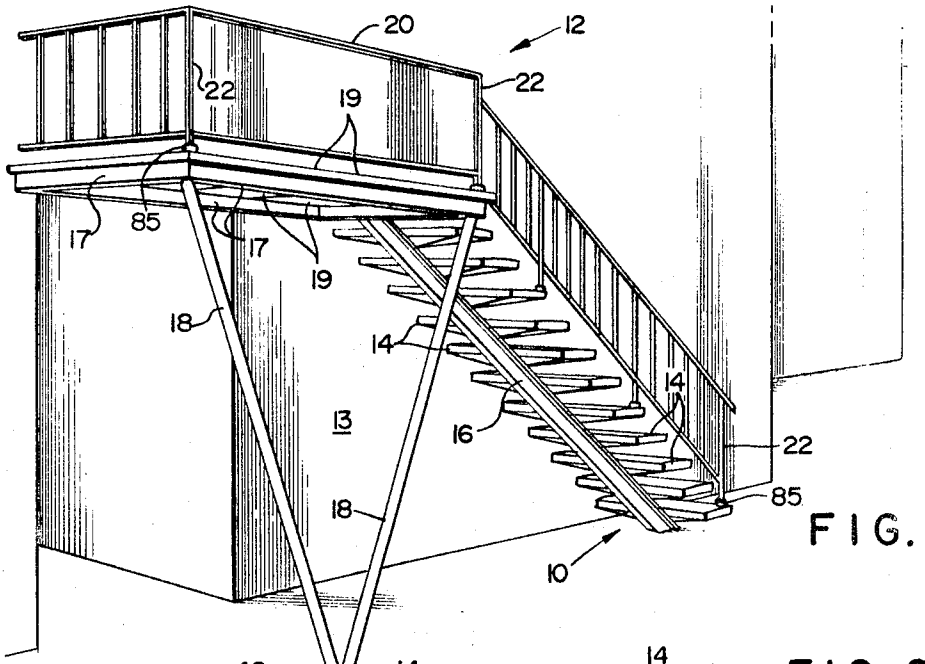



FIG. 1

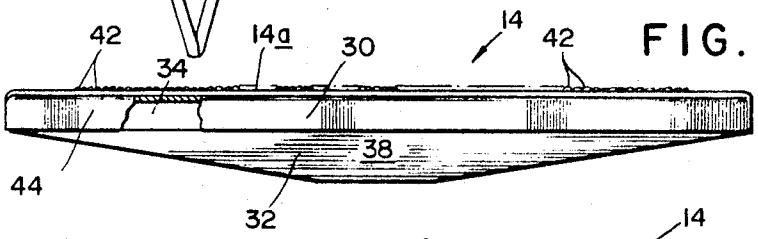
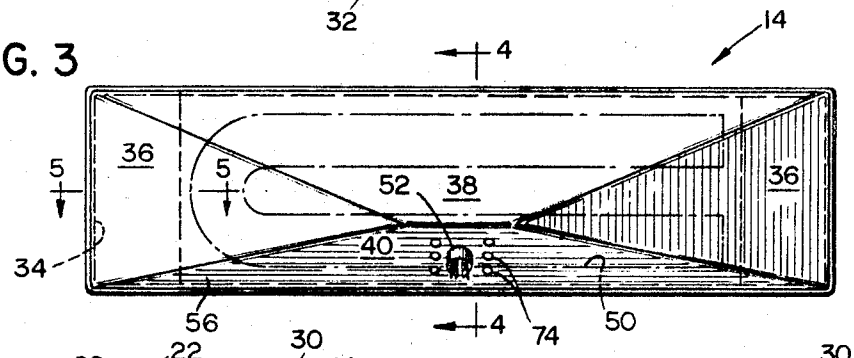



FIG. 2

FIG. 3



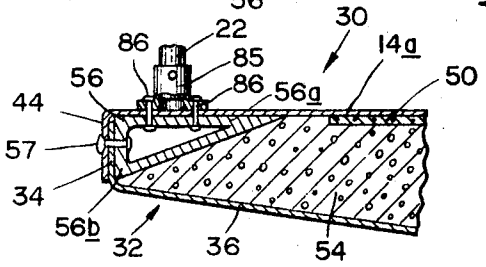




FIG. 5

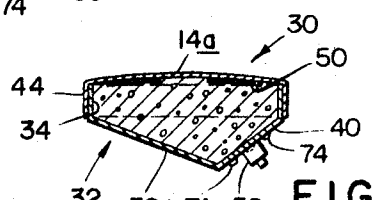



FIG. 4

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STAIRWAY CONSTRUCTION

Filed March 20, 1967 2 Sheets-Sheet 2

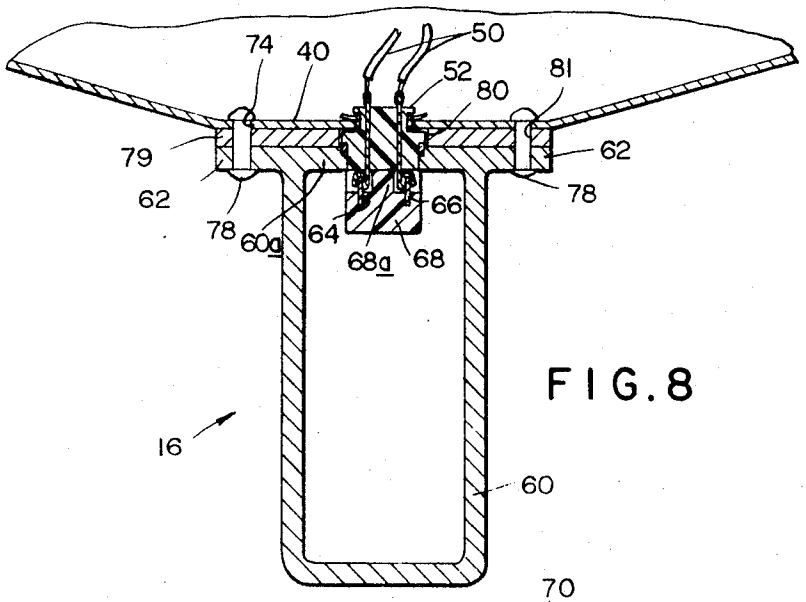



FIG. 8

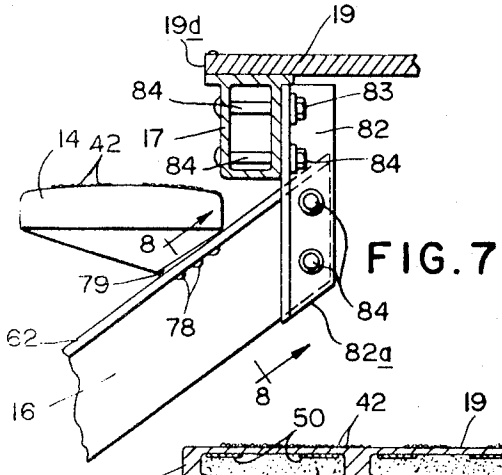



FIG. 7

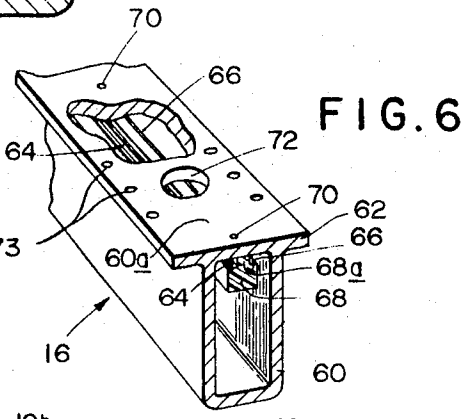



FIG. 6

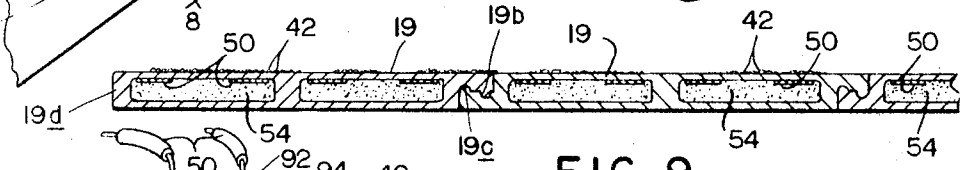



FIG. 9

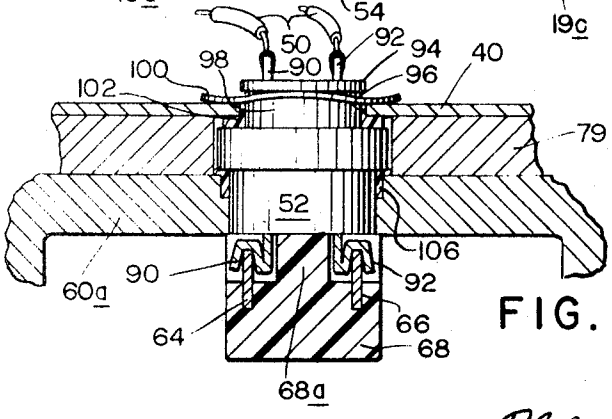



FIG. 10

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# STAIRWAY CONSTRUCTION

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Int. Cl. E04f 11/12
U.S. Cl. 182—115 25 Claims

## ABSTRACT OF THE DISCLOSURE

An improved open-riser stairway comprises an integrated system of standard stairway components made of lightweight anodized aluminum stampings and extrusions. The stairway includes a single hollow flanged stringer and hollow, wedge-shaped steps. The steps are readily secured at their centers to the stringer flanges by means of rivets. An open network of these stringers form the framing for the stairway landing, and the deck thereof consists of matched interlocking panels riveted to the stringers. The tread surfaces of the stairs and landing are treated to resist accumulation of ice and snow thereon. Also, for this reason electric heating elements are included inside the steps and panels and connected by conductors in the stringers to a current source. The stairway also has a railing which may be anchored to the panels and to reinforcing inserts in the steps by means of rivets.

## BACKGROUND OF THE INVENTION

### Field of the invention

This invention relates to an improved stairway construction and to various components thereof and accessories therefor. More particularly, it relates to a lightweight, metallic, open-riser type of stairway that is readily assembled on the job site by one or two men without the use of heavy equipment and without the need of heavy or elaborate tools or skilled labor.

The invention is directed primarily to the market for open-riser stairways. This style presents a pleasing, uncluttered, airy appearance that is highly desirable in many indoor and outdoor applications. This effect is generally enhanced by the use of only a single stringer supporting all of the steps at their centers.

### Description of the prior art

Prior to the present invention, stairways of this type have generally been made of concrete, which has the advantages of being durable and attractive, while at the same time providing a sturdy construction even though the steps are supported at their centers rather than at their ends.

They do, however, have several drawbacks. First, frequently the steps do not fit properly and they sometimes stain and crack. These problems are often aggravated by the fact that the concrete steps and associated stairway components are usually manufactured in small shops that lack sufficient technical services for the maintenance of optimum quality in the finished product.

Also, the conventional stairways are quite costly to install. This stems from the fact that the individual concrete steps are rather heavy, weighing typically as much as 125 lbs. each. Consequently, each hefty concrete step generally requires three construction personnel for its installation: two laborers to hold the step in place and a welder to weld anchor plates in the step to the stringer to secure the step to the stringer. Further, the fitting of a railing to concrete steps is generally a time-consuming task. To this must be added the cost of running the welding equipment, as well as the expense due to accidents



resulting from handling the unwieldy steps. Moreover, any departure from the stock construction, such as providing a non-standard stairway slope requires steps which are made to order and is unduly costly.

Additionally, the heavy weight of the concrete stairway, as contrasted with a wood construction, for example, means that stronger and more expensive structural supports must be included in the building, particularly if a multiple-story stairway is to be constructed.

## SUMMARY OF THE INVENTION

Accordingly, a principal object of this invention is to provide an improved stairway construction suitable for either indoor or outdoor installation and capable of erection with a minimum amount of labor.

A further object of the invention is to provide a stairway construction of the above type which is light in weight and therefore does not require massive supporting elements.

Another object of the invention is to provide a stairway construction of the above type which has a pleasing appearance and so is suitable for indoor usage.

A more particular object of the invention is to provide a stairway of the open-riser type in which the individual steps are supported on a single stringer.

A further object of the invention is to provide a stairway construction which is strong and sturdy and yet which is relatively inexpensive to make and install in place.

Another object of the invention is to provide a construction of the above type which can be efficiently heated to prevent the accumulation of ice and snow thereon.

Yet another object of the invention is to provide variout lightweight stairway components, such as steps, stringers, landings and railings for a stairway having the foregoing characteristics.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

Briefly, our stairway construction comprises an integrated system of standard stairway components made of lightweight anodized aluminum stampings and extrusions. The stairway employs a single hollow flanged stringer which extends up to a landing and supports a flight of steps. The steps themselves each comprise a pair of metal stampings which mate to form an enclosed, structurally-sturdy shell. The steps are anchored near their centers to the stringer flanges which shorten the lever arm between the end of the step where weight is applied and the points of securement of the step to the stringer. At the same time, the flanged construction widens the support base for the step by allowing the aforementioned points of securement to be farther part than would be possible with a non-flanged stringer. Also, each step has a truss-like configuration which reinforces the step.

By virtue of the aforementioned stress-relieving step and stringer shapes, ordinary hollow rivets of the type sold by United Shoe Machinery Company under its trademark Pop Rivet may be employed to anchor the steps to the stringer. In the event that the flight of stairs is to have a nonstandard slope, the identical step may be used in conjunction with a pitch plate secured between the step and the stringer to tilt the step so that its tread surface is horizontal. Additional such stringers arranged in an open network form the framing for the stairway landing. Matched interlocking panels made of hollow lightweight aluminum extrusions overlie the framing. These are also anchored in place by means of rivets.

The stairway may also include a railing extending up the flight of stairs and around the landing. In this event, selected steps are specially reinforced to provide a secure base in which to anchor the railing.

The fact that the entire stairway is made of aluminum gives it several important advantages over its conventional counterpart. First, the stairway components and, in fact the entire stairway are lightweight. This means that the stairway can be assembled, if need be, by a single individual quickly and economically with minimum chance of injury. Moreover, the stairway does not add materially to the overall load on the structural elements of the building in which it is installed. Second, aluminum is a relatively inexpensive material which can be formed to a variety of shapes and designs on a mass production basis so that the quality of the finished product can be carefully controlled. Third, the properties of aluminum make it receptive to anodic coating for scratch resistance, and it is easily embossed, coated and prepainted. Thus, for only a small additional material cost, the aluminum stairway components can be decorated and treated in a variety of different ways to make it very attractive; attractive enough, in fact, to compete with the more conventional decorative stairway materials such as marble, polished wood and stone. Fourth, the anodized aluminum parts are resistant to the accumulation of ice and snow, thereby reducing the possibility of a serious accident. Also, the excellent heat transfer qualities of anodized aluminum allow it to be economically heated. This permits the elimination of the arduous task of manually removing ice and snow from frozen steps. Fifth, the aluminum stairway saves maintenance costs by not cracking, rusting, or waterstaining as will its concrete counterpart. This gives the present stairway a unique advantage over conventional exterior stairways.

In short, the present stairway is not only extremely functional, inexpensive to make and easily installed using a minimum of labor and supervision, it is also quite attractive so that it can be used inside as well as outside most structures.

## DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of a stairway embodying the invention;

FIG. 2 is a front view partly broken away, of a step used in the stairway of FIG. 1;

FIG. 3 is a bottom view of the step;

FIG. 4 is a vertical section taken along the line of 4—4 of FIG. 3;

FIG. 5 is an enlarged fragmentary section of the step taken along line 5—5 of FIG. 3;

FIG. 6 is a fragmentary perspective view with parts cut away of the stairway stringer;

FIG. 7 is a fragmentary side view of the stringer showing the manner in which it is connected to the stairway landing at the upper end;

FIG. 8 is a view along line 8—8 of FIG. 7 showing the manner in which the steps are attached thereto;

FIG. 9 is a cross section of part of the landing; and

FIG. 10 is an enlarged fragmentary cross section of the stringer and an attached step showing the manner in which the electrical connections to a heating element in the step are preferably made.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 of the drawings, the present stairway comprises a stair flight indicated generally at **10** leading up to a landing **12** which extends out from a building wall **13**. The flight of stairs includes several individual steps **14** supported at their centers by a single



stringer **16** secured between the ground and landing **12**. Similar stringers **17** also form the framing for landing **12**. These are supported by conventional posts **18**. The deck of landing **12** comprises a series of matched interlocking panels **19** anchored to stringers **17**. A railing **20** is supported by posts **22** anchored firmly to panels **19** and selected steps **14**.

All of the aforementioned stairway components are constructed of lightweight aluminum extrusions and stampings which give it the unique advantages noted above, some of which will be dealt with in greater detail later.

Referring now to FIGS. 2–4, each step **14** is a shell made up of mating upper and lower anodized aluminum sections **30** and **32** respectively. The two sections are press-fit together, forming a wedge-shaped enclosure whose longitudinal medial cross section is, in essence, a trapezoid, and whose transverse medial cross section is a triangle.

More particularly, the lower step section **32** is generally rectangular, but it is also downwardly dished. It has an upright rectangular edge margin **34**, converging triangular side walls **36** and trapezoidal front and rear walls **38** and **40** respectively. The slope of rear wall **40**, i.e. the acute angle included between the extended planes of wall **40** and the top **14***a* of the step (FIG. 4), is the same as the slope of stringer **16**, i.e. the acute angle between ground and stringer **16**, when stair flight **10** has a standard slope in its ascent to landing **12** (FIG. 1). Thus, when the steps **14** are secured to stringers, their tops **14***a* are generally horizontal. While it is contemplated that the present flight of stairs will usually have a standard slope, provision is made for adjusting the tilt of steps **14** relative to stringer **16** for custom-made installations as will be described later.

The slope of front wall **38** is chosen to keep the wall out of the way and to give the stairway as a whole a pleasing overall appearance. Thus, in the illustrated embodiment of our invention, the front wall **38** of each step is wider than wall **40**, and its slope is somewhat less than that of wall **40**.

The upper step section **30** constitutes a tight cover over the lower half. The step top **14***a* constituting the top wall of section **30** is generally rectangular, but it has a slight camber (FIG. 4) to lend added structural integrity to the step and for drainage. Also, a tread design **42** (FIG. 2) may be stamped therein. A skirt **44** bends downward from step top **14***a* and engages tightly over edge margin **34** in lower section **38**. The two coupled together sections make a strong enclosed box-like structure which resists bending and twisting.

As best seen in FIGS. 1–4, the inclined walls **36**, **38** and **40** of step **14** constitute rigid struts between the points of securement of the step and stringer **16** and the edges of the step. Consequently, they firmly support and reinforce the step particularly at the ends and front of the step top **14***a*.

The step construction just described is not only utilitarian, but also, when joined to stringer **16**, yields an open-riser stairway, which is aesthetically appealing and particularly pleasing to the eye. Consequently, it has far-reaching application in the interiors of offices, apartments and other buildings.

Referring now to FIGS. 3–5, when the present stairway is used exteriorly, a heating element **50** is preferably bonded to the inside of each stop top **14***a*. Heating element **50** connects with a plug **52** protruding from wall **40**. The plug is, in turn, coupled to electrical conductors in stringer **16** when the step is secured thereto as will be described later. Preferably also, an insulating fill **54** (FIG. 5) such as a nonflammable, non-absorbent foam scrap is placed in each step **14** below heating element **50** prior to assembling the step. This minimizes heat loss through the bottom of step **14**. In addition, it damps metallic ringing sounds due to the box-like construction of the metal

step and gives the step the sound of a solid, sturdy structure.

The fact that the step is anodized increases its heat transfer capabilities drastically. Typically, it may improve by as much as 40% over an equivalent nonanodized member. Moreover, the physical properties of the anodic coating itself make it resistant not only to scratches, but also to the accummulation of ice. The latter property can be enhanced even more by impregnating the anodic coating with glycerine or graphite. All of these factors maximize the heating effect of element **50** so that it can consist of a simple electrical tape which consumes relatively little power.

Referring particularly to FIGS. 1 and 5, those of steps **14** supporting railing **20** are reinforced to provide very secure anchoring points for the posts **22**. More particularly, a generally triangular reinforcing member **56** in the form of a hollow aluminum extrustion is seated inside each of these steps below post **22**. The cross section of reinforcing member **56** has the general shape of a right triangle and is dimensioned to fit so that its longer leg **56***a* engages the top **14***a* of step **14** and its shorter leg **56***b* engages edge margin **34**. Member **56** is held in place by means of ordinary hollow rivets **57** applied at the end of the step through its margin **34** and skirt **44**. Other rivets **57** are installed, in like manner, through the opposite end of step **14** so that sections **30** and **32** are held together permanently. The actual securement of railing **20** to the steps will be described later.

Referring now to FIGS. 6 and 8, the stringer **16** (as well as stringers **17**, FIG. 1) comprises a hollow extruded aluminum box girder **60** having integral, oppositely extending flanges **62** adjacent to its top wall **60***a*. A pair of electrical busses **64** and **66** are mounted inside box girder **60** for supplying current to the heating elements **50** in steps **14**. Busses **64** and **66** consist of a pair of spaced parallel conductors mounted in and projecting up from an insulating fixture **68** extending along through the stringer. Fixture **68** is secured to top wall **60***a* by a series of countersunk screws **70** (FIG. 6) screwed through wall **60***a* into a longitudinal rib **68***a* which extends up between busses **64** and **66**.

A series of plug openings **72** are formed in top wall **60***a* of stringer **16** at points therealong where steps **14** are secured (FIG. 1). These openings are shaped to receive plugs **52** when the steps **14** are anchored to the stringer.

Referring particularly to FIG. 8, when installing the stairway, each step **14** is positioned transversely on stringer **16** so that its plug **52** extends through the corresponding plug opening **72** in the stringer and makes electrical contact with busses **64** and **66**. The step **14** is then anchored to the stringer by means of hollow rivets **78** inserted into holes **73** extending through the stringer flanges **62** (FIG. 6), and thence into registering holes **74** (FIGS. 3 and 4) in rear wall **40** of step **14**. Thus, no rivet holes are required in box girder **60** through which water could leak and short circuit the busses **64** and **66**.

The flanges **62** give the stringer a T-shaped configuration which greatly strengthens and reinforces the flight of stairs **10**, particularly at the points of securement of steps **14** to the stringer.

More particularly, flanges **62** lend a considerable amount of sideways stiffening to stringer **16**. While the same strengthening might be accomplished by enlarging box girder **60**, this would add considerable bulk and mass to the stringer and tend to spoil the appearance of the stairway. Moreover, rivets **78** could not be installed into steps **14** from below the stringer. Rather, the bottom step sections **32** would first have to be attached to the stringer, and then the steps would have to be assembled at the site. While this can be done with the present construction, it increases installation costs.

Also, flanges **62** constitute load bearing members which shorten the lever arm (i.e. the length) between rivets **78** and the end of the step on which weight is placed. At the same time, however, these flanges **62** increase the lever arm between these rivets **78** and the remaining rivets **78** on the opposite side of the stringer **16** which exert the downward force on the step opposing the aforesaid weight. This feature greatly minimizes the stresses on steps **14** in the region of rivets **78** to the extent that ordinary, inexpensive hollow rivets **78** can be used to anchor the steps. These are installed through flanges **62** quickly and easily from below stringer **16** without any elaborate equipment. Moreover, this assembly can be accomplished by one man because the steps themselves are lightweight and easy to handle. Each step **14** is automatically properly positioned on the stringer when its plug **52** is received in corresponding plug opening **72**. The installer need then only align the rivet holes **73** and **74** and insert rivets **78** through these holes.

Generally, the flight of stairs **10** will have a standard slope. In this event, steps **14** are secured directly to stringer **16** as described above. If, on the other hand, a nonstandard slope is desired, then a lightweight extruded aluminum shim or pitch plate **79** (FIGS. 7 and 8) is placed between each step **14** and the stringer **16** prior to attaching the step. The wedge angle on the shim **79** is such that it tilts step **14** so that step top **14***a* is substantially horizontal when the stringer **16** is in place as seen in FIG. 1. Of course, the shim **79** has a plug opening **80** and rivet holes **81** (FIG. 8) in register with the corresponding opening and rivet holes in stringer **16**.

Referring now to FIGS. 1 and 7, stringer **16** is suspended from landing **12** by means of an extruded aluminum right-angle bracket **82** whose lower end **82***a* may be mitered to correspond generally with the slope of stringer **16**. The bracket **82** is attached to the upper end of stringer **16** and the back of frame **17** at the front of the landing **12** by means of threaded nuts and bolts **83** and **84** respectively extending through suitable holes drilled through those elements. As the entire flight of stairs **10** weighs relatively little, all the steps **14** can be anchored to stringer **16** as aforesaid, and the whole assembly lifted up and secured quickly and easily to the landing **12** by one, or at most, two men.

As seen in FIGS. 1, 7 and 9, frame member **17** supporting panels **19** are essentially the same as the stringer **16** described above. They are bolted together and to upright posts **18** in the usual fashion. Panels **19** comprise hollow extruded aluminum matched modules having a nonslip tread **42**. The panels interlock along mating edges **19***b* and **19***c* respectively and they are interchangeable, except for the panel **19** edge **19***d* (FIGS. 7 and 9) facing the flight of stairs **10** which should be vertical. The panels **19** may be of any desirable length commensurate with the size of landing **12** and their number may be increased to make a full sun deck. They are supported as needed by an open network of stringers **17** strategically placed below the panels.

Panels **19** have an anodic coating much like that applied to steps **14**. Accordingly, their surfaces are scratch-resistant and ice-resistant exactly as described above in connection with steps **14**. Also, like steps **14**, the panels **19** may contain heating elements **50** and insulation **54** to give the panels the same desirable characteristics noted above. And, in like manner, heating elements **50** in the various panels are plugged into their supporting stringers **17**.

Referring now to FIGS. 1 and 5, the posts **22** supporting railing **20** fit into flanged sockets **85** anchored firmly to panels **19** and to those of steps **14** containing reinforcing members **56**. The securement of each socket **85** to the corresponding reinforcing member **56** within a step **14** is accomplished quickly and inexpensively by inserting rivets **86** through holes drilled through the flange of socket **85** and through leg **56***a* of member **56**. (A modified socket **85** may be anchored to leg **56***b* by rivets **57**). Since member **56** is hollow, hollow rivets

can be employed for this purpose. The legs **56***a* and **56***b* of member **56** have sufficient thickness to anchor most railing systems that tie into either the top and/or side of the step. The above-described supporting railing structure is light in weight and will not work loose. Moreover, it can be installed more quickly and cheaply and will last longer than many railing systems used in conventional open-riser stairways.

Referring now to FIG. 10, the plug **52** in each step **14** (and panels **19**) is a generally cylindrical insulating member supporting a pair of clip-like terminals **90** and **92** which resiliently engage over busses **64** and **66** in stringer **16** (and stringers **17**), making good electrical contact therewith. The leads of the heater element **50** are soldered to these terminals. Plug **52** has a reduced diameter neck **94** received in a slightly larger opening **96** in step wall **40**. Neck **94** is itself circumferentially grooved at **98**. A resilient C-shaped clip **100** is snapped in place in groove **98** within step **14** to anchor the plug firmly to wall **40**.

Preferably also a gasket **102** seats in groove **98** to exclude moisture from the interior of step **14**. Also, if needed, another gasket **106** may be included in the countersunk opening **72** in wall **60***a* to ensure that moisture does not enter box girder **60** and short circuit busses **64** and **66** therein.

Electrical connections (not shown) between the various stringers **16** and **17** (FIG. 1) are then made in a conventional way with leads (not shown) from a power source.

As seen from the foregoing, we have devised a stairway comprising an integrated system of lightweight components made of aluminum. These components can be mass-produced with precision in the factory, and then installed quickly and easily by a single relatively unskilled person. Accordingly, manufacturing and installation costs associated with the present stairway are unusually low. Moreover, the use of anodized aluminum for the stairway components gives them a scratch- and mar-resistant finish and also minimizes the accumulation of ice and snow thereon. The anodic coating also greatly increases the efficiency of the heating system incorporated into the stairway when weather conditions demand it. Finally, the configuration of the steps and stringers makes for an unusually strong and sturdy stairway structure of the open-riser type. And, while the stairway is extremely functional, it also presents an unusually good appearance so that it can be used inside as well as outside apartments, offices and other buildings.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described our invention, what we claim as new and desire to secure by Letters Patent is:

**1.** An improved stairway construction comprising
- (A) an elongated hollow tube (**16**) for connection to a stairway landing (**12**), said tube having a pair of opposite side extending flanges;
- (B) one or more shell-like steps (**14**) arranged crosswise on said tube, each said step having a tread surface (**14***a*); and
- (C) means (**78**) for anchoring each of said steps only to said tube flanges.

**2.** An improved stairway construction as defined in claim **1** wherein each said step includes
- (A) a downwardly-dished bottom portion (**32**), said bottom portion having a flat rear wall (**40**) engaging said tube, and
- (B) a cover (**30**), said cover
  - (1) engaging over said bottom portion, and
  - (2) making an acute included angle with said rear wall.

**3.** An improved stairway construction as defined in claim **2** and further including a pitch plate (**79**) secured between said rear wall and said tube for altering the tilt of said tread surface relative to said tube.

**4.** An improved stairway construction as defined in claim **1**
- (A) and further including a landing (**12**), said landing comprising
  - (1) beams (**17**) secured together to form a framing network; and
  - (2) one or more matched panels (**19**) overlying said network; and
- (B) wherein an end of said first-mentioned tube (**16**) is secured to said landing so that each said tread surface is substantially horizontal.

**5.** An improved stairway construction as defined in claim **4** wherein said beams are flanged tubes.

**6.** An improved stairway construction as defined in claim **4** and further including
- (A) heating elements (**50**) inside each of said panels; and
- (B) means (**52**) for electrically connecting said elements to a power source.

**7.** An improved stairway construction as defined in claim **4** and further including a railing (**20, 22**) anchored to said landing and at least one of said steps.

**8.** An integrated open-riser stairway comprising
- (A) an elongated tube (**16**) having a pair of opposite side extending flanges (**62**) adjacent a surface (**60***a*) thereof;
- (B) means defining spaced openings (**72**) in said surface;
- (C) a pair of insulated electrical conductors (**64, 66**) extending along inside said tube;
- (D) a step comprising
  - (1) a hollow shell (**14**) having
    - (a) a flat top wall (**14***a*); and
    - (b) a flat rear wall (**40**) making an acute angle with said top wall;
  - (2) an electrical heating element (**50**) fastened inside said top wall;
  - (3) a connector (**52**) connected to said element and protruding from said shell; and
  - (4) thermal insulating material (**54**) inside said shell below said element;
- (E) said step being positioned so that
  - (1) said rear wall engages said surfaces; and
  - (2) said connector extends through one of said openings and electrically connects to said pair of conductors; and
- (F) a set of fasteners (**78**) extending through said flanges and into said rear wall for anchoring said step to said tube.

**9.** An integrated open-riser stairway as defined in claim **8** wherein
- (A) said conductors comprise a pair of spaced electrical busses protruding up toward said openings; and
- (B) said connector comprises an electrical plug secured in said rear wall, said plug having a pair of contacts (**90, 92**)
  - (1) electrically connected to said heating element; and
  - (2) resiliently engaging said busses.

**10.** An integrated open-riser stairway comprising
- (A) an elongated hollow tube (**16**) having opposite side extending flanges (**62**) adjacent one surface (**60***a*) thereof; and
- (B) one or more shell-like steps (**14**), each step comprising

(1) a relatively flat top portion (30); and
(2) a dished bottom portion (32), said bottom portion having
(a) a relatively flat rear wall (40) engaging said tube surface;
(b) a pair of opposite end walls (36) splaying out from said flanges to the ends of said top portion; and
(c) fasteners (78) extending through said flanges and each said rear wall for anchoring said steps to said tube, said flanges shortening the lever arm between said fastenings and the end of said step on which weight is applied, while lengthening the lever arm between said fastenings and the forces opposing said weight, thereby minimizing the stresses on said fastenings.

11. An integrated open-riser stairway as defined in claim 10 and further including
(A) a landing (12); and
(B) means (82) for securing one end of said stringer to said landing so that each said top portion is substantially horizontal.

12. An integrated open-riser stairway as defined in claim 11 wherein said landing comprises
(A) an open horizontal network of flanged tubes (17); and
(B) one or more panels (19) permanently positioned on said network, each of said panels
(1) consisting of a hollow extrusion, and
(2) having mating edges (19*b*, 19*c*) interlocking with adjacent panels.

13. An integrated open-riser stairway as defined in claim 12 wherein the load bearing elements of said stairway are made of aluminum.

14. An stairway stringer comprising
(A) an elongated tube (16) having a pair of opposite side extending flanges (62) adjacent a surface (60*a*) thereof;
(B) means defining spaced openings (72) in said surface; and
(C) a pair of insulated electrical conductors (64, 66) extending through said tube opposite said openings.

15. An improved stairway construction comprising
(A) an elongated tube (16) for connection to a stairway landing (12), said tube having a pair of opposite side extending flanges (62);
(B) one or more shell-like steps (14) arranged crosswise on said tube, each said step having a tread surface (14*a*);
(C) rivets (78) for anchoring each of said steps to said tube flanges;
(D) a heating element (50) in each said step below said surface;
(E) a pair of electrical conductors (64, 66) extending through said tube; and
(F) means (52) for electrically connecting each said heating element to said conductors.

16. An improved stairway construction as defined in claim 15 and further including heat insulating material (54) contained inside each said step below said heating element.

17. An improved stairway construction comprising
(A) an elongated tube (16) for connection to a stairway landing (12);
(B) one or more shell-like steps (14) arranged crosswise on said tube, each said step having
(1) a downwardly dished bottom portion (32); said bottom portion having a flat rear wall (40) engaging said tube; and
(2) a cover (30), said cover
(a) engaging over said bottom portion;
(b) making an acute included angle with said rear wall;
(c) means (78) for anchoring each of said steps to said tube;
(d) a hollow reinforcing member (56) positioned inside at least one of said steps at one end thereof;
(e) railing supporting means (85) positioned at said end of said step adjacent said reinforcing member; and
(f) means (86) for securing said railing supporting means through said one step to said reinforcing member.

18. An improved stairway construction comprising
(A) an elongated tube (16) for connection to a stairway landing (12);
(B) one or more shell-like steps (14) arranged crosswise on said tube, each said step having an anodized aluminum tread surface (14*a*) impregnated with glycerine;
(C) means (78) for anchoring each of said steps to said tube;
(D) a landing (12), said landing comprising
(1) beams (17) secured together to form a framing network; and
(2) one or more matched panels (19) overlying said network, each of said panels being an aluminum extrusion;
(E) heating means (50) inside each of said panels;
(F) means (52) for electrically connecting said elements to a power source; and
(G) wherein an end of said first-mentioned tube (16) is secured to said landing so that each said tread surface is substantially horizontal.

19. An improved stairway construction as defined in claim 18 wherein
(A) each said heating element is an electrical tape; and
(B) further including heat insulating material (54) containing inside each said panel below said heating element, said insulating material functioning also as a sound dampener to eliminate rings or echoes within each said panel.

20. An improved stairway construction comprising
(A) an elongated tube (16) for connection to a stairway landing (12);
(B) one or more shell-like steps (14) arranged crosswise on said tube, each said step having an anodized tread surface (14*a*);
(C) means (78) for anchoring each of said steps to said tube;
(D) a landing (12), said landing comprising
(1) tubes (17) secured together to form a framing network; and
(2) one or more matched panels (19) overlying said network, each of said panels and tubes being hollow aluminum extrusions; and
(3) wherein an end of said first-mentioned tube (16) is secured to said landing so that each said tread surface is substantially horizontal.

21. An improved step for an open-riser stairway comprising
(A) an open, downwardly-dished aluminum shell (32), said shell having a flat rear wall (40) for engagement with a stringer;
(B) a relatively flat aluminum cover (30) engaging over said shell to close it, said cover
(1) constituting an anodized tread surface of said step; and
(2) making an acute included angle with said rear wall;
(C) an electrical heating element (50) fastened to the inside of said cover just below said tread surface;
(D) a connector (52) protruding from said step for electrically connecting said heating element to a power source; and

(E) a material selected from the group consisting of graphite and glycerine impregnating said tread surface.

**22.** An improved step for an open-riser stairway as defined in claim **21** wherein

(A) said heating element is an electrical tape; and

(B) further including thermal insulating material (**54**) contained inside said step below said heating element.

**23.** An improved step for an open-riser stairway as defined in claim **21** and further including

(A) a hollow triangular reinforcement (**56**) nested inside one end of said step adjacent said cover for anchoring a railing support to said step; and

(B) means (**57**) for fastening said reinforcement to said step.

**24.** An improved step for an open-riser stairway comprising

(A) an open, downwardly-dished shell (**32**), said shell having

(1) a flat rear wall (**40**) for engagement with a stringer; and

(2) relatively flat side walls (**36**) which splay out to the opposite ends of said shell and constitute supporting struts;

(B) a relatively flat cover (**30**) engaging over said shell to close it, said cover

(1) constituting the tread surface of said step;

(2) making an acute included angle with said rear wall; and

(3) having a slight camber; and

(C) wherein



(1) the transverse medial cross section of said step is substantially triangular; and

(2) the longitudinal medial cross section of said step is generally trapezoidal.

**25.** An improved step for an open-riser stairway comprising

(A) an open, downwardly-dished shell (**32**), said shell having a flat rear wall (**40**) for engagement with a stringer;

(B) a relatively flat cover (**30**) engaging over said shell to close it, said cover

(1) constituting the tread surface of said step; and

(2) making an acute included angle with said rear wall

(C) an electrical heating element (**50**) inside said step just below said cover; and

(D) a connector (**52**) protruding from said step for electrically connecting said heating element to a power source.

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