April 24, 1962 L. M. DAVIS 3,031,029

COLLAPSIBLE LADDER

Filed Aug. 29, 1958 2 Sheets-Sheet 1

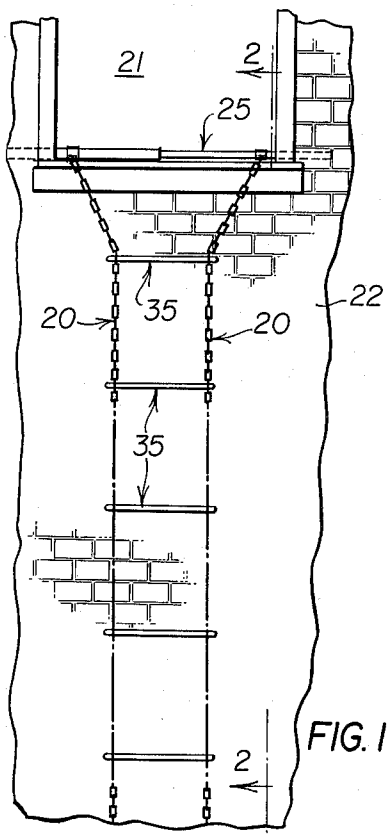

FIG. 1

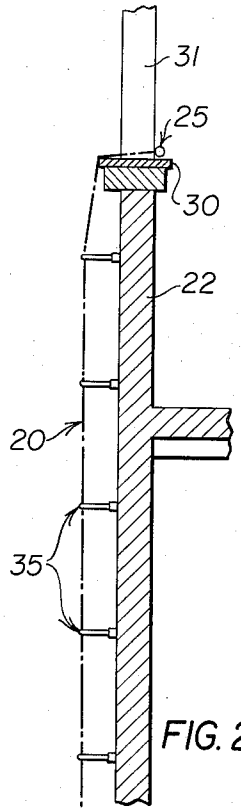

FIG. 2

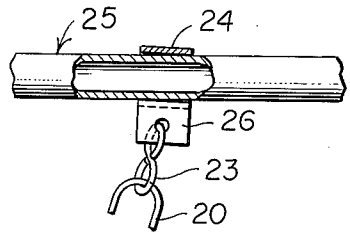

FIG. 3

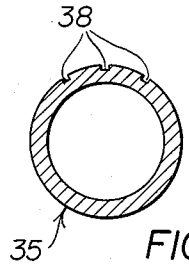

FIG. 5

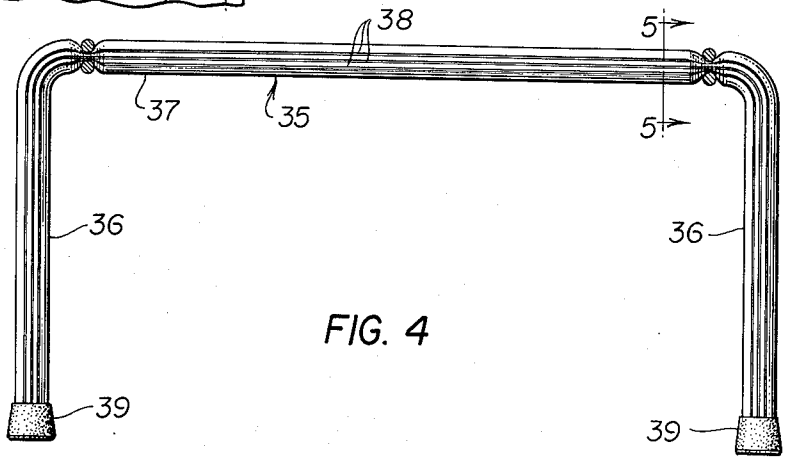

FIG. 4

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COLLAPSIBLE LADDER

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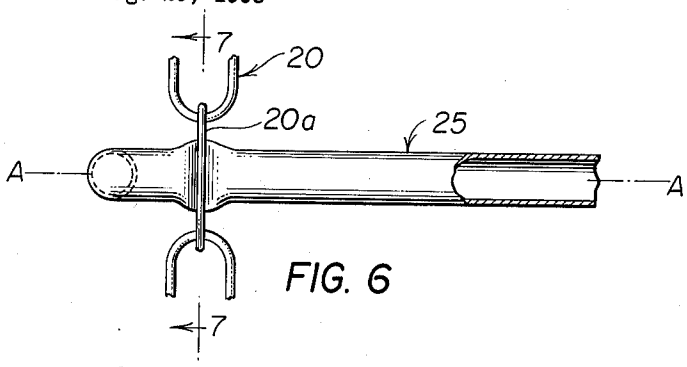

FIG. 6

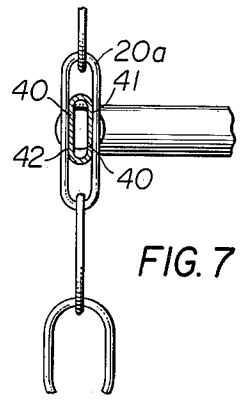

FIG. 7

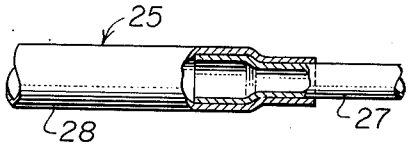

FIG. 8

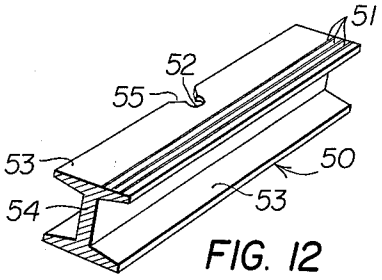

FIG. 12

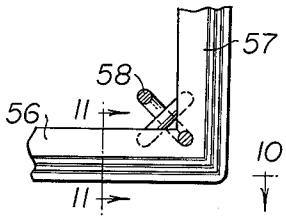

FIG. 10

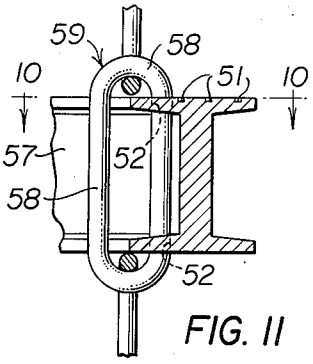

FIG. 11

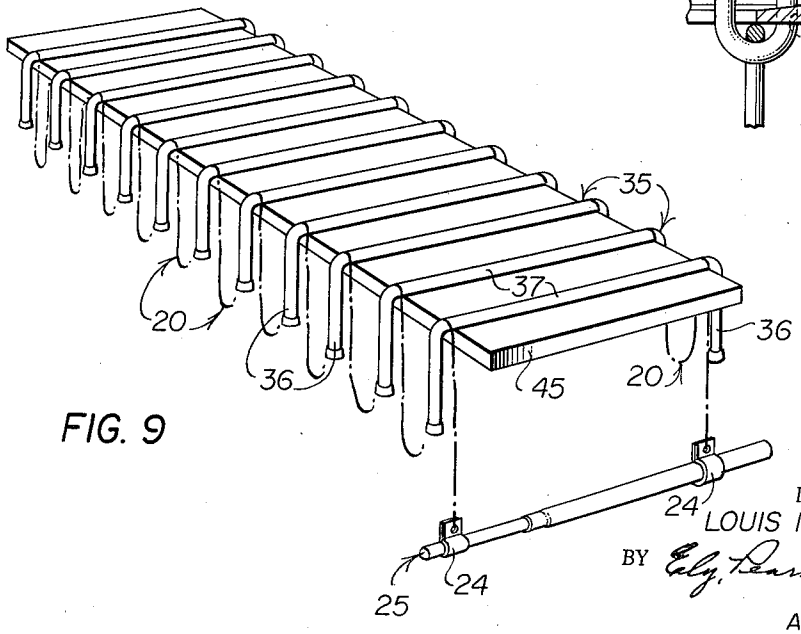

FIG. 9

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COLLAPSIBLE LADDER

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Filed Aug. 29, 1958, Ser. No. 758,081
4 Claims. (Cl. 182—198)

This invention relates to collapsible ladders of the type adapted to be suspended from a window opening or the like. Ladders of this general type are the subject of a number of prior patents, such as U.S. Patents 1,133,722, 1,424,115, 2,202,597, and 2,211,259. The invention relates particularly to improvements in the construction of ladders of this general type and to improvements in the mounting thereof in a window opening and the storing thereof in an orderly arrangement for easy and rapid handling in mounting the ladders for use.

Ladders of the general type to which this invention relates may comprise a pair of normally spaced side chain supports connected by a series of spaced rigid rungs that span the side chains at intervals along their length, the rungs being connected to the side chains so as to restrain the rungs against rotation about their respective axes relative to the side chains at the points of connection of the rungs thereto. The rungs have spaced arms that extend in the same direction from opposite ends thereof to engage an adjacent wall when the ladder is suspended in use from a window opening. These arms hold the side chains and the intermediate portions of the rungs spaced outwardly from the adjacent wall to provide hand room and foot room for a person descending the ladder.

The principal object of the present invention is to improve the construction of ladders of the general type described above so as to render them more economical to manufacture and easier to handle quickly in an emergency, without any sacrifice in the strength and safety of the ladders. Further objects of the invention are to provide an improved and simplified means for mounting such ladders in a window opening and for storing such ladders adjacent a window opening with the parts thereof arranged in an orderly manner to facilitate feeding the ladder out of a window opening and securing the upper end thereof without danger of tangling the side chains and the rungs.

The various features, advantages and details of construction provided by the invention, illustrated by specific embodiments thereof, are described in the following specification and are depicted in the accompanying drawings. In the drawings—

FIG. 1 is a somewhat schematic elevational view of a portion of the side of a building, showing a ladder embodying the invention suspended from a window opening.

FIG. 2 is a somewhat schematic vertical sectional view of the building wall and ladder assembly of FIG. 1, the view being taken as indicated by the line 2—2 in FIG. 1.

FIG. 3 is a fragmentary view on an enlarged scale showing how the side chains of the ladder may be secured to a mounting bar.

FIG. 4 is an enlarged plan view of one of the ladder rungs, one link of each of the two side chain supports being shown in section to illustrate the connection of the rung thereto.

FIG. 5 is a further enlarged sectional view of the rung of FIG. 4, taken as indicated by the line 5—5 in FIG. 4.

FIG. 6 is a fragmentary elevational view showing further details of the connection of the rung of FIG. 4 to the side chain supports.

FIG. 7 is a vertical sectional view of the structure shown in FIG. 6, taken as indicated by the line 7—7 in FIG. 6.

FIG. 8 is a fragmentary side view of the support bar for

mounting the ladder in a window opening, partly broken away to show how a plurality of bar sections are connected in telescopic relationship.

FIG. 9 is a perspective view showing how a ladder embodying the invention may be mounted for storage on an elongated supporting member.

FIG. 10 is a fragmentary plan view of a modified form of ladder rung and connection between the rung and a side chain suport.

FIG. 11 is a vertical sectional view of the modified rung and chain connection of FIG. 10, taken as indicated by the line 11—11 of FIG. 10.

FIG. 12 is a fragmentary perspective view illustrating a step in the formation of the rung of FIGS. 10 and 11 for connection to the side chains.

Referring to the embodiment of the invention shown in FIGS. 1 to 8, inclusive, the ladder may comprise a pair of normally spaced side chain supports 20 which extend generally vertically, in use, from a window opening 21 in a building wall 22. The upper end of each side chain may be secured in the window opening by a bracket including an S-link 23 and a sheet metal collar 24 that is freely slidable on a support bar 25. The collar 24 may comprise a strip of sheet metal that encircles the bar 25, opposite ends of the strip being bent outwardly and disposed together to provide a double thickness flange 26. The S-link 23 may be coupled to the upper end of the side chain 20 and to the flange 26 of the collar 24, as shown in FIG. 3.

The bar 25 is preferably made up of two bar sections 27 and 28, telescoped for extension from a shortened condition to a length greater than a window opening with which it is to be associated. The telescopic connection between the two bar sections is shown in FIG. 8 with the sections extended to their maximum combined length.

As shown in FIGS. 1 and 2, the side chains 20 extend generally horizontally through the window opening 21 from the inside thereof, and over a window sill 30, so as to hang generally vertically therefrom along the wall 22. The bar 25 is extended so that its opposite ends project outwardly well beyond the sides of the window opening and bear against inside surfaces of side members 31 of the window casing. Before the ladder is fed out of the window to hang downwardly therefrom, the bar is preferably placed in position, and the collars 24 are slid outwardly along the bar to positions close to the sides of the window casing 31. The ladder may then be fed out of the window, and the weight of the ladder hanging on the collars 24 will tend to twist them slightly, as shown in FIG. 3, and cause them to grip the bar sufficiently to resist sliding inwardly toward each other. In this way, the beam loads applied to the bar are concentrated close to the points where the bar is supported against the window casing, thus minimizing the tendency of the bar to bend when a load is applied to the ladder.

The side chains 20 of the ladder are connected by rigid rungs 35 which, in this embodiment of the invention, are preferably made of lightweight tubing, such as aluminum tubing or the like. Such tubing may be extruded in long lengths of uniform cross section and cut to shorter lengths, each shorter length being bent into the U-shaped configurations shown in FIG. 4 to provide rungs having spaced terminal arms 36 extending in the same transverse direction adjacent opposite ends of an intermediate rung portion 37. Conveniently, such tubing may be extruded with a plurality of spaced, longitudinally extending grooves 38 therein to provide surface irregularities forming a skid resistant tread surface on the rungs. Suitably, rubber caps 39 or the like may be mounted over the ends of the terminal arms 36 to cover any rough edges and provide cushions for engaging the wall 22.

As shown in the drawings, the side chains **20** are formed of simple welded links that are interconnected in series in a conventional manner, and the outside diameter of the tubing of which the rungs **35** are constructed is selected so that it will freely pass through any of the general links with a relatively close sliding fit. Obviously, other types of chains having link loops to receive the rungs may be similarly employed.

Each rung is passed through corresponding links of the two side chains, and these links are slid to positions on the intermediate rung portion **37** adjacent the bends at opposite ends thereof. Thereupon, the two links **20***a* are squeezed in any suitable manner to distort and partially collapse them to a more elongated configuration, while also distorting and partially collapsing the rung **35**. This produces flattened portions **40** on opposite sides of the rung (FIG. 7) while indenting the rung, as best shown in FIGS. 4 and 6, and opposite sides of the distorted chain link are clampingly seated in these indentations and engage the flattened portions of the rung over a substantial distance, whereby non-integral, oppositely facing surface portions of the rung, for example at points **41** and **42**, respectively engage oppositely facing surface portions of the link to resist rotation of the rung about its axis (designated A—A in FIG. 6) relative to the link.

When the weight of a person is carried on any rung of the ladder, the entire length of the side chains from the upper ends thereof down to and including the rung to which such weight is applied are placed under sufficient tension so that they behave essentially as rigid bars. Thus, the links **20***a* to which the rung carrying load is connected resist being twisted about the axis of the rung, and the interlocking conformations of these links and the rung hold the rung against rotation about its axis so that the terminal arms of the rung are firmly held in horizontal positions with their free ends in engagement with the surface of the building wall **22**. Similarly, each rung above the one on which the load of a person is carried is firmly held in a corresponding position. Thus, the entire ladder from the rung on which the person is standing up to the upper end thereof is rigidified and held firmly in position with the terminal arms of the rungs engaging the building wall and holding the intermediate portions **37** of the rungs spaced outwardly from the wall to provide ample clearance for hand room and foot room.

In actual practice, the weight of the side chains and interconnecting rungs of the ladder will be found sufficient so that each of the rungs is held firmly in position, as shown in FIG. 2, from the top of the ladder to a point close to the bottom thereof, even before the weight of a person is applied to the ladder. Thus, there is little or no likelihood that any one of the rungs more than a step or two above the bottom end of the ladder will tend to rotate with loss of the spacing function of its terminal arms. In any event, even the lowermost rung of the ladder will hang with its intermediate portion **37** similarly spaced from the wall of the building by reason of the fact that the side chains hang substantially vertically from their points of attachment to the next higher rung.

The general characteristics of ladders of the type to which the invention pertains are well known and need not be further described. As indicated above herein, the invention is directed to novel features of construction of such ladders which enable them to be economically mass produced without sacrifice of strength and safety, rather than to the broadly old ladder principles involved and general mode of operation thereof.

The ladders of the invention will commonly be stored in a convenient location adjacent a window from which they are intended to be suspended in use so as to be conveniently accessible in the event of an emergency. In order to avoid tangling of the side chain and rung elements of a ladder of this character, it is important that the elements of the ladder be stored in an orderly arrangement which will facilitate easy and rapid securement of the upper end of the ladder and feeding of the ladder out of the window opening. This may be done by distributing the rungs of the ladder in their normal order in closely spaced relationship along the length of an elongated support **45**, which may be a simple board or plank of appropriate dimensions, as shown in FIG. 9. The intermediate portions **37** of the rungs are arranged parallel to each other and rest upon the support transversely thereof, and the terminal arms **36** of the rungs hang downwardly on opposite sides of the support. Each side chain portion connecting a pair of adjacent rungs may also hang downwardly at one side of the support along a catenary curve. In this manner, all of the elements of the ladder may be arranged in an orderly manner with the side chain portions that connect adjacent rungs hanging downwardly therebetween on opposite sides of the support along a series of such catenary curves. The upper ends of the side chains may also hang downwardly on opposite sides of the support adjacent one end thereof with the bar **25** telescoped to its shortest condition and held in the collars **24**. The support **45** may be enclosed in a bench, window seat, piece of furniture, or the like, in any desired manner so as to be out of sight and to remain in its desired orderly storage arrangement.

When it is desired to mount the ladder in position for use, the bar **25** may first be extended as required to safely engage the inner surfaces of the window casing on opposite sides of the window opening and may be be held in the position shown in FIGS. 1 and 2 with one hand while sequentially feeding the ladder rungs out of the window with the other hand, beginning with the uppermost rungs, until the entire ladder has been fed out of the window and has dropped into position as shown in FIGS. 1 and 2, ready for use. In this manner, tangling of the elements of the ladder is easily avoided, and it may be handled without the necessity for lifting more than a small portion thereof at any time.

A modification of the invention employing a different structural form of rung and a different kind of connection between the rungs and the side chains is illustrated in FIGS. 10 and 11. In this case, each rung is made from a bar **50** of I-beam configuration in transverse section, which may also be economically extruded from lightweight metals, such as aluminum, with non-skid tread surfaces formed by longitudinally extending grooves **51** in one surface of the bars. An appropriate short length of a bar of this cross-sectional configuration may be drilled to provide a pair of aligned apertures **52** through upper and lower flanges **53** of the bar on one side of the web **54** thereof at the locations along the bar where it is to be bent to form the terminal arms thereof. Notches **55** may then be cut into the two flanges with 90° apex angles located, as shown in FIG. 12, whereby the bar may be bent, as shown in FIG. 10, to form a terminal arm **56** extending at right angles to the intermediate portion **57** of the rung. Before making the bend, a link **58** of a side chain **59** to be connected to the rung at this end thereof is positioned with one side of the link **58** in both of the apertures **52**, whereby bending of the bar closes the notches **55** and encircles the side of the link so as to interlock the link and the finished rung, as shown in FIGS. 10 and 11. Obviously, bars of channel shape or the like may be used in the same manner in place of bars of I-beam form.

This latter form of mechanical interlocking of the rungs with connected links of the side chains provides resistance to rotation of the rung about its axis in essentially the same manner as the interlocking conformations shown in FIGS. 4–7. In both forms of the invention, each rung is clampingly connected to a link of each side chain by interlocking conformations thereon comprising

surface portions of the rung engaging oppositely facing, non-integral surface portions of the links at points thereon that are spaced a substantial distance along the link. In both forms of the invention, at least a portion of the rung passes through the link so as to provide a positively interlocked support for the rung which does not depend upon friction to hold the rung in place.

As will be apparent from the foregoing description of the invention, a collapsible ladder design is provided which may be fabricated from standard chains and elongated bars of standard cross-sectional configuration capable of being produced by simple rolling or extrusion operations. As will also be apparent, the rungs may be formed from appropriate bar stock by simple fabricating operations and may be connected to the side chains by equally simple fabricating operations, without the necessity for welding, bolting, or riveting the rungs to the chains or providing complicated chain gripping brackets on the rungs. As a result, fabrication of the parts of the ladder and their assembly can be performed with simple, conventional, metal fabricating and forming apparatus at a high rate of speed in mass production operations with a low manufacturing cost enabling the product to be sold at an attractive price.

While the invention has been disclosed here with reference to certain specific structural details of selected forms of the invention, it will be readily apparent to those skilled in the art that various modifications of such details may be made while employing the principles of the invention within the scope of the appended claims.

Having described my invention, I claim:

1. In a collapsible ladder comprising a pair of normally spaced single-coursed side chain supports connected by rigid metal rungs that span the side chains at intervals along their length and are connected thereto, the rungs having spaced arms extending transversely adjacent opposite ends thereof to engage an adjacent wall, when the ladder is suspended in use from a window opening, for holding the side chains and chain-spanning portions of the rungs spaced outwardly from the wall; the improvement wherein each side chain comprises a series of interconnected links, and each rung comprises an elongated bar of substantially uniform cross section over its length, said bar having its opposite end portions bent to extend in the same transverse direction with respect to a straight intermediate portion thereof, and each rung is clampingly connected to a link of each side chain against rotation relative thereto by interlocking conformations thereon comprising surface portions of the rung directly engaging oppositely facing portions of the link at points thereon that are spaced a substantial distance along the link, said surface portions of the rung being non-integral with said oppositely facing portions of the link, at least a portion of the rung passing through the link, the uniform cross-section of the rung obtaining on the portions of the rung extending from both sides of the link.

2. In a collapsible ladder, the improvement of claim 1 wherein each rung is surrounded by each link to which it is connected and is substantially circular in cross section over its length except for being distorted into an oblate configuration where it passes through the link to provide flattened side portions of the rung, and each link connected to a rung is distorted relative to its next adjacent links, into clamping engagement with the flattened portions of the rung surrounded thereby.

3. In a collapsible ladder, the improvement of claim 1 wherein each rung is surrounded by each link to which it is connected and is distorted where it passes through the link to provide indentations on opposite sides of the rung and each link connected to a rung is distorted, relative to its next adjacent links, into clamped seating engagement with the rung in the adjacent indentations on opposite sides of the rung.

4. In a collapsible ladder, the improvement of claim 1 wherein each rung, in transverse cross section, comprises a web portion and correspondingly directed top and bottom flanges, the connection between the rung and each link being at the juncture of the intermediate portion of the rung and a transversely extending end portion thereof, the interlocking conformations of the rung comprising aligned apertures through said top and bottom flanges receiving and encircling one side of the connected link in rigidly interengaging relationship therewith.

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