

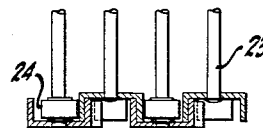
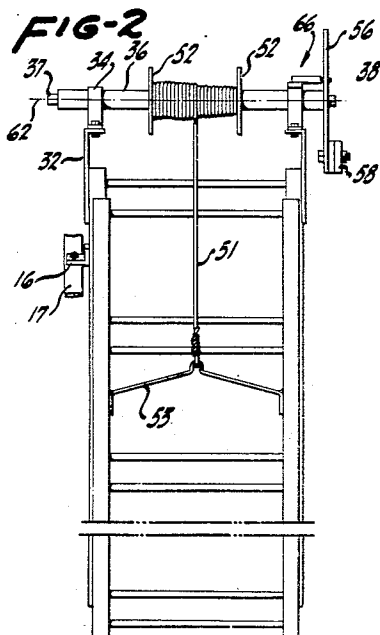
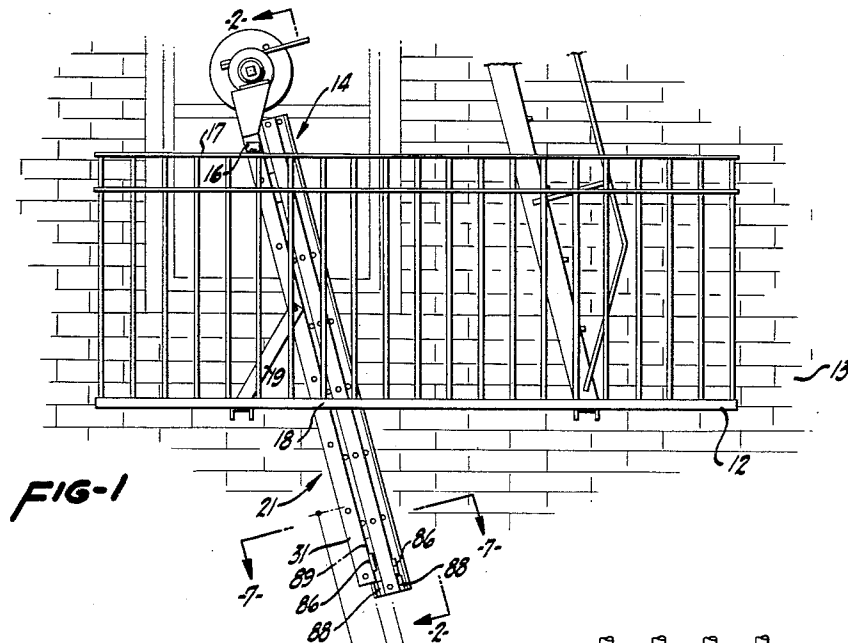
May 27, 1958

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EXTENSIBLE LADDER

2,836,336

Filed June 29, 1955

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

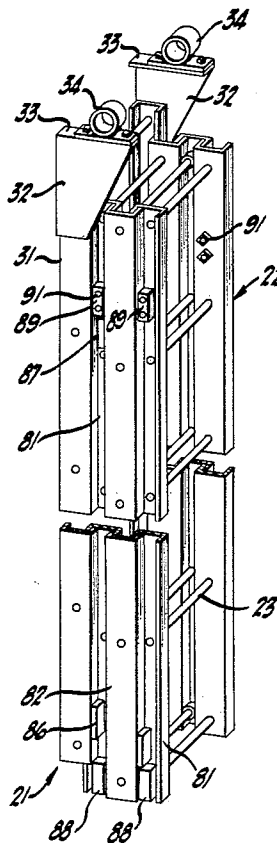


FIG-3

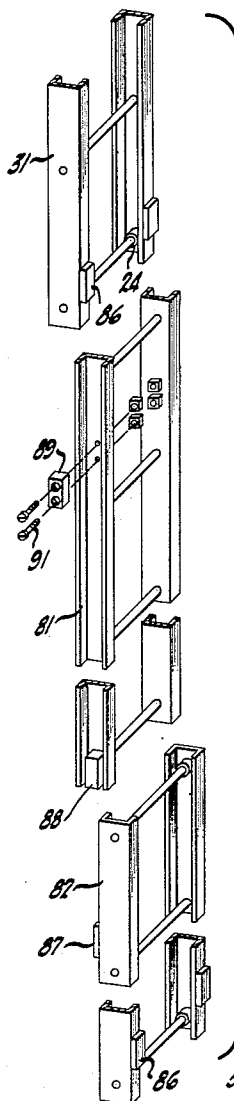


FIG-4

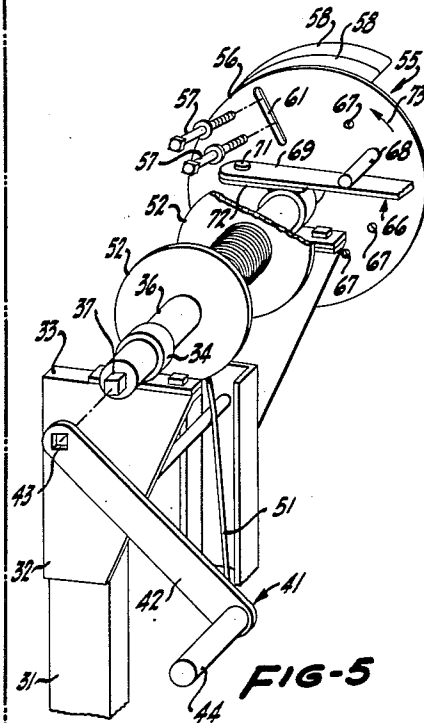


FIG-5

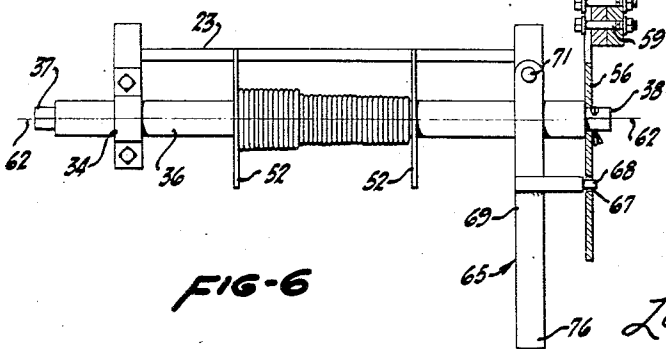


FIG-6

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EXTENSIBLE LADDER

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3 Claims. (Cl. 228—20)

The invention relates to ladders, and, more particularly, to ladders mounted on fire escape balconies and capable of extending downwardly to the ground in telescoping fashion.

Trespassers and other unauthorized persons are prevented from entry onto a building's fire escape system by the simple expedient of elevating the lowermost balcony to a location well above the reach of anyone and even above the reach of the usual ladder. In event of emergency, however, it is highly essential that persons in the building attempting to reach the safety of the ground be furnished safe and reliable access from the balcony to the ground. Ladders of various kinds have long been used for this purpose and, in general, have performed adequately. Quite often, however, rust and corrosion have rendered such ladders inoperative, ladders of the lazy-tong type, for example, having been particularly susceptible to such difficulty. Still other ladders of the downwardly projectable kind frequently tend to pinch or otherwise to harm the person of the user as by a crank handle on the ladder hitting the person as the handle rotates rapidly during the downward movement of the ladder.

Furthermore, many types of fire escape ladders are extensible only in a vertical direction, exemplified by the lazy tong and Jacob's ladder types, and are thus free to sway during use. The average person, and particularly one under distress or condition of panic from fire, finds difficulty in descending these types of ladders.

Still other extensible ladders, when tripped, extend downwardly at a high rate of speed, the sudden checking or halting of the ladder as it strikes the ground or pavement below causing a severe shock to the ladder and balcony parts and setting up undesirable stresses on the entire mechanism.

It is therefore an object of the invention to provide an extensible ladder which is relatively inexpensive to manufacture and install, and yet which possesses a high degree of reliability.

It is another object of the invention to provide an extensible ladder which can by the expedient of adding and adjusting modular length sections, span any vertical distance ordinarily encountered.

It is yet another object of the invention to provide an extensible ladder which can be installed for use in either a vertical or inclined attitude and which, in either of such attitudes, provides a stable and stiff ladder which is easy to descend even under conditions of panic.

It is a further object of the invention to provide an extensible ladder which incorporates an adjustable braking mechanism nicely to check the speed of descent of the ladder sections and which thus circumvents harmful shock as the ladder abuts the ground.

It is a still further object of the invention to provide an extensible ladder which is easily retracted and maintained in predetermined retracted location until tripped by the user.

It is yet a further object of the invention to provide a generally improved extensible ladder.

Other objects, together with the foregoing, are attained in the embodiment described below and shown in the accompanying drawings in which:

Figure 1 is a side elevation of a typical ladder installation, the ladder being shown in fully retracted position, and, in outline, in fully extended position.

Figure 2 is a front elevation to an enlarged scale of the ladder in retracted position, the plane of view being indicated by the line 2—2 in Figure 1, a portion of the showing being broken away to reduce the extent of the figure.

Figure 3 is a perspective of a typical grouping of ladder sections in retracted position.

Figure 4 is an exploded perspective view showing the construction and manner of interengagement of a plurality of ladder sections.

Figure 5 is a perspective of the ladder's cranking, windlass, braking and locking mechanisms.

Figure 6 is a plan of the mechanisms shown in Figure 5, the braking and locking mechanisms being shown in section.

Figure 7 is a section showing the manner of interengagement of the ladder rails and the friction reducing spacers usable in certain types of ladder installations, the plane of section being indicated by the line 7—7 in Figure 1.

While the extensible ladder of my invention is susceptible of numerous physical embodiments, depending upon the particular environmental situation to be met, a considerable number of the herein shown and described embodiments have been made and installed and have performed in an eminently satisfactory fashion.

Mounted on a fire escape balcony 12, affixed to a building wall 13, is an extensible ladder 14 of my invention. The ladder is supported in position as by a laterally disposed mounting bracket 16 bolted on the balcony top rail 17, or by bolting to the balcony bottom rail 18, and is further supported and conveniently held in a tilted or inclined attitude by a suitable bracing member 19, the bottom of the ladder extending downwardly through the customary well (not shown) in the balcony floor grating. Ordinarily the ladder is in a fully retracted position, but, when the occasion arises, a user can by a simple motion cause the ladder quickly to extend, or telescope, or project downwardly to the ground 20 thus enabling the user to escape.

The ladder comprises a plurality of co-operating sections 21. Three types of sections are ordinarily used, each type differing from the other in small but important features later to be described. Each of the types, however, has in common with the others certain structural features including a pair of elongated rails 22, conveniently fabricated from galvanized iron or aluminum channels held in spaced parallel relation by a series of rungs 23.

It is sometimes desirable to provide certain of the rungs, for example the uppermost and lowermost rungs in each section, with bronze or other friction-reducing annular spacing rings 24, or rollers, mounted on the ends of the rungs adjacent the rails. The rings 24 serve not only to space and align the contiguous and overlapping rails, as appears most clearly in Figure 7, but also to assist the sections in sliding relatively to each other.

One distinct type or kind of section is an uppermost or top section 31 surmounted at its upper end by a pair of truncated triangular plates 32, or gussets, mounted on the corresponding top ends of the pair of rails 22 and bent inwardly to form a pair of co-planar mounting plates 33. Bolted to the upper surface of each of the mounting plates 33 is a sleeve journal 34. Each journal is coaxially dis-

posed with respect to the other and serves to support a windlass or winch shaft 36. The windlass shaft 36 is not only rotatably supported by the journals 34 but projects laterally outwardly from each of the journals, terminating at each end in a pair of square lugs 37 and 38, respectively.

The left-hand lug 37, as appears in Figures 2, 5 and 6, is adapted to receive a crank 41, the inner end of the crank arm 42 having a square-shaped aperture 43 to accept the lug 37 and thus to rotate the windlass shaft 36 as the crank handle 44 is revolved. After the ladder is cranked to and locked in fully retracted position the crank 41 is ordinarily removed from the lug 37 and allowed to dangle from the balcony rail bracket 16, or other nearby but out-of-the-way location, at the end of a short length of chain (not shown). With the removal of the crank in this fashion, the person tripping the ladder will not be struck and harmed by the rotating crank as might be the case were the crank allowed to remain on the windlass shaft.

Rotational movement of the windlass shaft 36 is reflected in a translational motion of a cable 51 reaved about the shaft 36 and confined to the central portion thereof by a pair of spaced radially disposed flanges 52 mounted centrally of the shaft. The lowermost or free end of the cable is conveniently affixed to a yoke 53 mounted on the bottom ladder section, as is shown most clearly in Figure 2, or secured to one of the rungs.

Upon tripping the ladder when it is in fully retracted position, the weight of the ladder sections causes the movable or slidable sections to descend, thus causing the cable 51 to pay off from the windlass and the windlass shaft 36 to rotate. Although the ladder sections below the fixed top section 31 initially descend at a fairly low rate of speed, under the gravital force exerted upon them the lower telescoping sections very shortly would assume a high rate of acceleration and, unless retarded or checked, the bottom section would strike the ground with an undesirable shock. I have therefore provided a novel braking mechanism, generally designated by the numeral 55 and comprising an eccentric adjustable weight loading impressed on the windlass shaft 36. A very satisfactory weight loading is achieved by detachably mounting on a circular plate 56 on the lug 38, as by a pair of bolts 57, a pair, conveniently, of segmentally configured blocks 58 each provided with a pair of apertures 59 to receive the bolts. Radial adjustment of the blocks 58 is achieved by provision in the plate 56 of a radial slot 61. The braking mechanism is ordinarily adjusted at the time of installation, experience indicating the number of blocks and initial radial displacement to be used as a first approximation. If the first setting produces inadequate braking, a greater radial throw or an increase in blocks (weight) is indicated. In any event, it is preferable to add blocks rather than to increase radial displacement to a location where the arcuate portions of the blocks extend radially outwardly beyond the periphery of the circular plate 56, since such a projection beyond the plate margin might create a hazard as the plate rotates during descent of the ladder. So nice is the checking, or retarding effort exerted by the braking mechanism that if desired the bottom of the ladder can be caused to touch the ground with only a barely perceptible impact. Since the moment of inertia of the mass of the blocks about the axis 62 of the shaft equals the moment of inertia about a parallel axis through the center of gravity of the weights plus the square of the distance between the two axes times the mass of the blocks, it can be seen that a slight radial adjustment is productive of a significant change in the brake's moment of inertia.

By suitable adjustment of the mass and throw of the blocks any desired translational velocity of the ladder sections is obtainable. In practice, and owing to the exigencies of the situation, the blocks are adjusted so

that the ladder sections will, for average lengths of ladder, fully extend in from 5 to 8 seconds and with a slight degree of impact but which is not harmful to the parts. The braking produces some vibration in the ladder, the vibration shaking loose grit etc. which might have collected during periods of non-use of the ladder and thus permitting the ladder sections to slide over each other more easily even after extended periods of non-use.

While the brake serves its purpose effectively during descent of the ladder its retarding effect is not imparted, to a like degree, during the considerably slower ascent or retraction of the ladder resulting from cranking of the windlass into raised position. The brake, in other words, does not significantly increase the effort required to wind up the ladder.

Upon reaching fully retracted position, the circular brake plate 56 is further utilized so as to co-operate with a ladder locking and tripping mechanism 66. Piercing the plate 56 at equal radii from the shaft axis 62 is a plurality of apertures 67, each adapted to receive a tripping and locking pin 68 projecting laterally from an arm 69 pivotally mounted to swing about a pin 71 secured to a plate 72 mounted on the adjacent one of the journal sleeves 34. The disposition of the arm 69 in relation to the direction of rotation, or tendency to rotate, of the plate 56 in retracted position of the ladder is important. As appears in Figure 5, for example, the cable 51 takes off from the back or rear side of the windlass, the downward force exerted by the weight of the lower ladder sections therefore tending to rotate the shaft 36 and the circular plate 56 in a counter-clockwise direction as indicated by the arrow 73. The force exerted by the walls of the plate apertures 67 on the tripping pin 68 has, therefore, a component acting in a left-hand or rearward direction. This rearwardly acting force multiplied by the moment arm gauged by the distance between the plate 56 and the center of the pivot pin 71 exerts a substantial effort on the lever arm 69, causing it to swing toward the plate 56 and, in effect, tightly forcing or jamming the pin 68 into the plate. As a consequence of this construction, a positive lock is exerted on the plate, a lock which prevents the plate and the windlass from rotating in a ladder extending direction even though the mechanism is subjected to considerable jarring or vibration.

While being extremely effective against accidental dislodgement, the tripping mechanism is quickly and easily brought into operation by voluntary effort of a user. The lever arm 69 is made long enough so that the user's strength exerted against the free end 76 of the lever arm 69 in a left-hand direction, as appears in Figure 6, is effective to dislodge or trip the pin 68 from the aperture 67 and thus to permit the windlass to pay out the cable and allowing the ladder sections to descend.

As heretofore mentioned, it is only the sections other than the fixed top section 31 which extend and retract. The movable ladder sections are somewhat different in construction from the top section 31 and are themselves structurally classifiable into two different types or kinds.

With especial reference to Figures 3 and 4 it can be seen that adjacent to and displaced slightly toward the right from the top section 31 is the first type of movable ladder section, one having its pair of rail channels directed outwardly rather than inwardly as does the top section 31. A ladder section of this kind is termed, for convenience, a faceout section, and is designated by the numeral 81. It is important to note that the adjacent channel legs of the top section 31 and the faceout section 81 are disposed in an overlying or interengaging relation and are adapted to slide with respect to each other.

The second type or kind of movable section comprises a pair of channel rails facing inwardly toward each other. This type is termed a facein section and is designated by the numeral 82. In a fashion comparable to the overlap existing between the channel legs of the top section 31

and the faceout section 81, the adjacent channel legs of the faceout section 81 and the facein section 82 are disposed in an overlying and slidable relation.

It is to be observed that with one top section 31, an extensible ladder of any length can be assembled by utilizing alternating arrangements of faceout and facein sections. Customarily, the sections are manufactured in modular lengths, for example six feet. The balcony height therefore governs how many movable sections are to be utilized in any given installation. The ladder shown in Figure 3, consequently, being four sections in length, would be twenty-four feet long, reduced by the amount of overlap 35, as shown in Figure 1. Usually, the artisan installing the ladder can, by appropriately tilting the ladder cause the bottom of the lowest section lightly to touch the ground in its fully extended position. At other times, the tilt is adjusted to a steeper angle so that the ladder is, in effect, shortened by the distance between adjacent rungs so that two rungs in the bottom and next to bottom section are in registry.

In either event, the ladder is ordinarily assembled by supporting the top section 31 in a horizontal attitude, rear side down, and by sliding into longitudinal interengagement with the top section 31 a faceout section 81, in the fashion indicated most clearly by Figure 4 when the figure is viewed from the left-hand side of the drawing. In the event spacer rings are not used, very satisfactory spacing is attained as a consequence of the diameter adjustment or positioning of the ladder rungs, or by appropriate dimensioning and positioning of a group of limit stop and pickup members mounted on the sections and now to be described.

The first type of stop member is mounted adjacent to but spaced slightly upwardly from the bottom of each section having its channel rails facing inwardly, as exemplified by the top section 31 and the facein sections 82. This first type of stop member is located on the outer surface of the right-hand channel leg, as appears in Figures 3 and 4 and is termed, for convenience, a lower stop plate 86.

A comparable but oppositely facing upper stop plate 87 is mounted on the left-hand channel leg, adjacent the top of the leg, of each of the facein sections 82. The plate 87 is slidable past the plate 86, there being no interference between the plates as one moves past the other as the sections move.

On the outwardly facing surfaces of the channel webs of each of the faceout type of ladder sections 81 is a lower stop block 88, mounted at the bottom of the section, and an upper stop block 89 secured by fastenings 91 at a location above and in abutment with the adjacent upper stop plate when the sections are in retracted position. During assembly, the upper stop blocks 89 are mounted after the various ladder sections are translated into their interengaging relation. Since the upper blocks 89 interfere with the plates 86 in the same channel slot it is apparent that assembly of the faceout sections 81 onto the top section 31 and the facein section 82 could not be effected were the upper stop blocks 89 originally mounted on the sections 81. Reference to Figure 4 from a left-hand direction most clearly illustrates this feature.

With especial reference to Figures 1, 2 and 3, the operation of the blocks becomes apparent. Assuming the locking mechanism to have been tripped by the user to an unlocked position, the weight of all the movable sections of the ladder begins to be felt. The movable sections commence to move downwardly, the cable paying out and rotating the windlass shaft so as to render operative the checking effect of the brake. Since the movable sections translate downwardly as a unit, within a short time the upper block 89 of the adjacent section 81 abuts or strikes against the lower stop plate 86 of the top ladder section 31. This abutment brings the first faceout section 81 to a halt but does not prevent the

further downward movement of the balance of the sections. Shortly, however, the upper stop plate 87 of the facein section 82 strikes against the lower stop block 88 at the bottom of the previously halted section 81 and the section 82 is thereupon brought to a stop. The outboard, or lowest or most forward section, a faceout type of section 8' as shown in Figures 1 and 3, still continues to telescope downwardly, however, until its upper stop block 89 hits against the interferring lower stop plate 86 of the adjacent facein section 82 and its motion thereby is halted. Substantially simultaneously the bottom of the section strikes the ground and the ladder is in fully operative position.

When the emergency has passed, the crank handle is installed on the lug 37 and the cable is wound onto the windlass. The outboard or lowest section commences first to retract, it being secured to the cable. Shortly, the lower block 88 of the outboard section urges upwardly against the adjacent lower plate 86 and raises the facein section 82. This is soon followed by an upward urgency of the upper stop plate 87 of the facein section 82 against the adjacent upper block 89 of the faceout section 81, it being noted that the plates in the same channel do not interfere with each other but that the blocks do interfere with the plates located in the same U-shaped channel.

As winding proceeds, the movable sections are pulled upwardly and in due course reach the position indicated by Figure 3, the movable sections each being in register and located slightly below the top section 31. Shortly, however, as winding continues, the upper surface of the stop block 88 is brought into abutment with the lower surface of the stop plate 86 on the top section 31 and the movable sections are brought to a halt. At this juncture the pin 68 can be swung laterally into one of the apertures 67, a sufficient number of apertures being provided to receive the pin without the necessity of backing off the movable sections more than an inch or two in any case.

It should be noted that the plates and blocks not only serve as spacers and guides keeping the sections in parallel alignment, and as appears most clearly in Figure 3, but they also serve as limit stop members during descent and as pickup members during retraction of the ladder. Furthermore, and as can be observed in Figure 1, the plates and blocks are so proportioned that when the ladder is in fully extended position the adjacent sections are overlapped by an amount greater than the longitudinal distance between rungs and so that the overlapping rungs are in register. Not only is rigidity thereby obtained but the user's foot steps on the registering rungs simultaneously, giving an even more secure footing.

It can therefore be seen that the device of my invention not only provides a rigid telescoping type of ladder eminently useful to persons under conditions of panic, owing to the familiarity of most people with ladders of the rigid type, as distinguished from ladders of the flexible, swaying kind, but it also furnishes a unique and highly useful positive locking mechanism which can be quickly tripped and whose structure is integrated with a simple yet highly efficient ladder brake system.

What is claimed is:

1. An extensible ladder comprising: a top section mounted on a fire escape balcony, said top section including a pair of spaced longitudinal channels facing toward each other, a plurality of transverse rungs extending between said channels, a pair of gusset plates mounted on the upper ends of said channels, a pair of coaxially disposed sleeve bearings on said gusset plates, a shaft journaled in said bearings and terminating at each end in a lug square in section, a circular plate mounted on one of said lugs, said plate having a radially adjustable weight eccentrically mounted thereon, a crank detachably mounted on the other of said lugs adapted to rotate said shaft and said plate, a tripping bar pivotally mounted on one of said sleeve bearings adjacent said plate, said

tripping bar having a tripping pin normally disposed thereon to engage one of a plurality of circumferential apertures in said circular plate and to hold said plate and said shaft in predetermined position, a flexible cable secured at one end to the central portion of said shaft, a pair of cable confining flanges adjacent said sleeve bearings to maintain the windings of said cable in the central portion of said shaft, and a lower stop plate mounted on the outer surface of one leg of each of said channels near the lower end thereof; a lower section comprising a pair of channels, the corresponding legs of each of said lower section channels lying in overlapping and sliding relation with the adjacent legs of each of said top section channels, a pair of lower stop blocks mounted at the lower ends of said channels, a pair of upper stop blocks mounted adjacent the upper ends of said channels, a plurality of transverse rungs extending between said pair of channels, said rungs of said lower section being in register with said rungs of said top section as said lower of said stop plates are in abutment with said lower of said stop blocks, and means for securing the other end of said cable to said lower section, said lower section being movable from a first position wherein said lower stop plate and said lower stop block are in abutment to a second position wherein said lower stop plate and said upper stop block are in abutment, said cable being unwound from said shaft first position to said second position, said shaft concurrently being rotated as said cable unreels therefrom, said lower section being also movable from said second position to said first position as said crank is rotated to wind said cable on said shaft; and means for securing said top section to the fire escape balcony.

2. An extensible ladder comprising: a plurality of ladder sections each including a pair of spaced longitudinal channels and a plurality of spaced transverse rungs extending between said channels, the adjacent legs of each of said channels being disposed in alternately opposed facing relation and in overlapping position for sliding engagement therebetween, each of said sections further including at least one pair of limit stop members projecting transversely from said pair of channels and adapted to abut a corresponding pair of stop members on

the adjacent pair of said channels when adjacent ladder sections are in a first fully-retracted position and in a second fully-extended position relative to each other; a ladder mounting bracket attachable to an elevated balcony structure, said bracket being secured to one of said ladder sections; a windlass rotatably mounted on said bracket, said windlass including a cable fastened to the most distant of said ladder sections from said one of said ladder sections; means for braking said windlass; and means for locking said windlass in fully retracted position of said ladder sections.

3. In an extensible ladder comprising a plurality of overlapping relatively slidable ladder sections provided with limit stops movable into abutment as said sections translate from a fully retracted to a fully extended position and from a fully extended to a fully retracted position, a windlass, and a cable windable about said windlass and secured to one of said ladder sections, the combination of: a circular disk coaxially mounted on said windlass, said disk including a plurality of peripherally disposed apertures and a radially elongated slot; a segmentally configured weight member having an arcuate margin substantially coincidental with the periphery of said disk, said weight member including a pair of radially disposed apertures therein; a pair of detachable fastenings engageable with said slot and said pair of apertures and adapted to mount said weight member at a predetermined radial location on said disk; and a windlass locking mechanism including a pivotally mounted locking lever, a locking pin on said lever and swingable thereby toward and into engagement with one of said plurality of peripheral disk apertures and away from and out of engagement with said disk aperture.

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