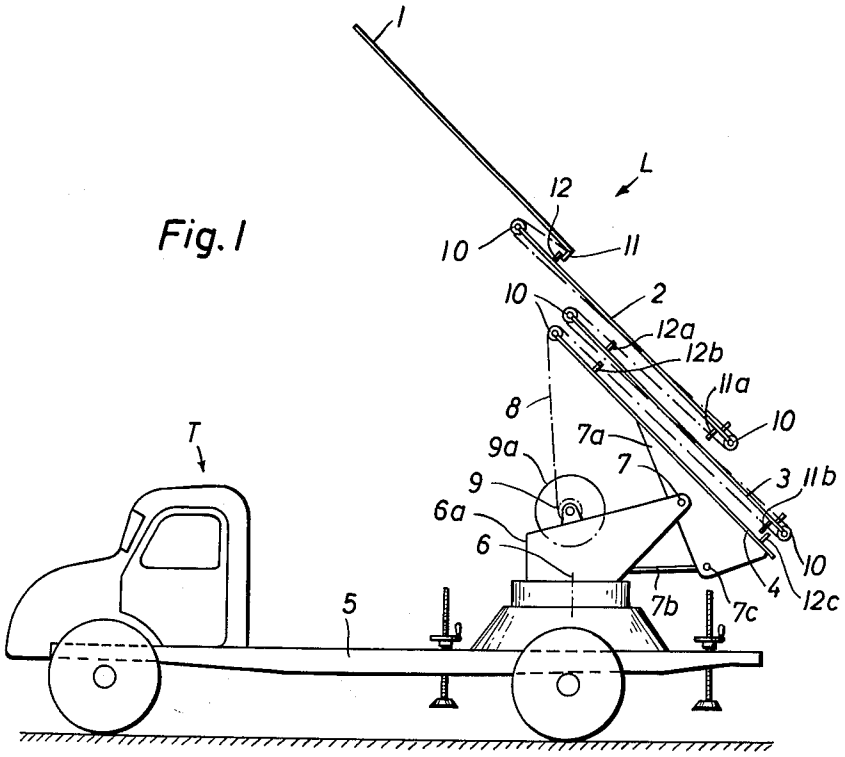
May 7, 1963 H. MÖLLER 3,088,543

EXTENSIBLE MULTI-SECTION SUPPORTING STRUCTURES

Filed July 20, 1960 5 Sheets-Sheet 1

Fig. 1



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EXTENSIBLE MULTI-SECTION SUPPORTING STRUCTURES

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Fig. 2

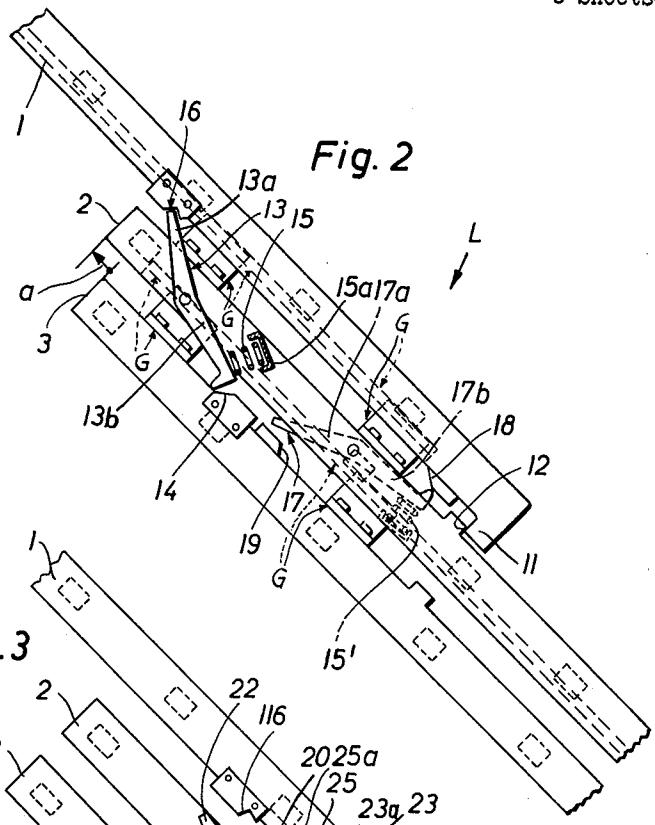
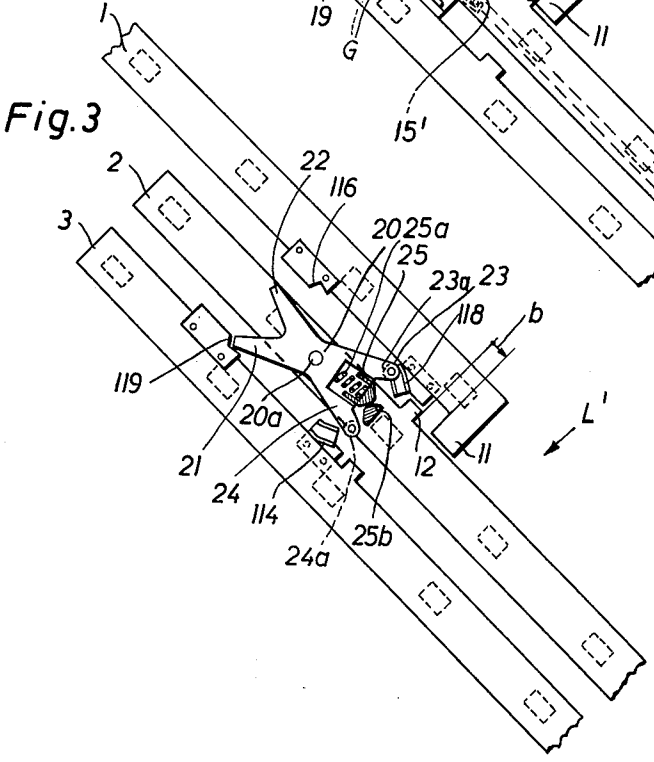


Fig. 3



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EXTENSIBLE MULTI-SECTION SUPPORTING STRUCTURES

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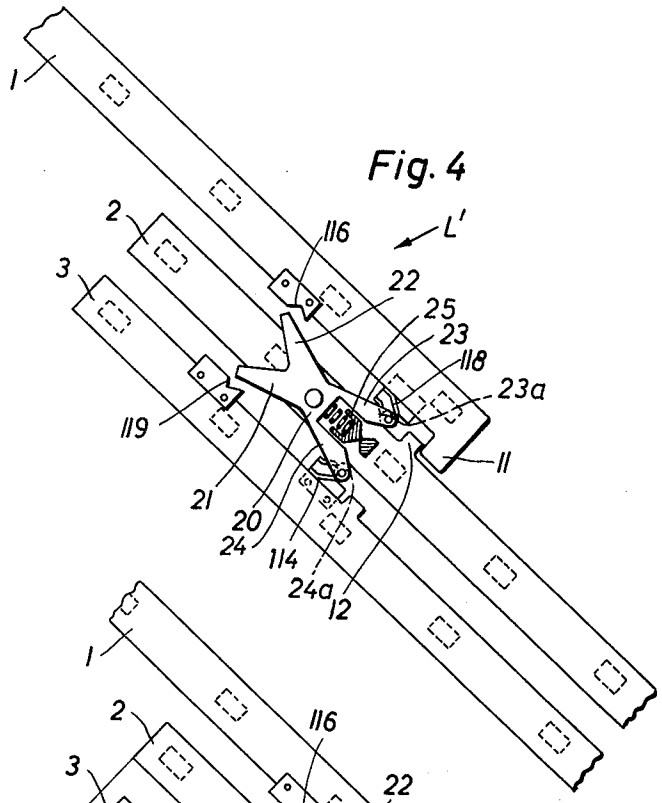


Fig. 4

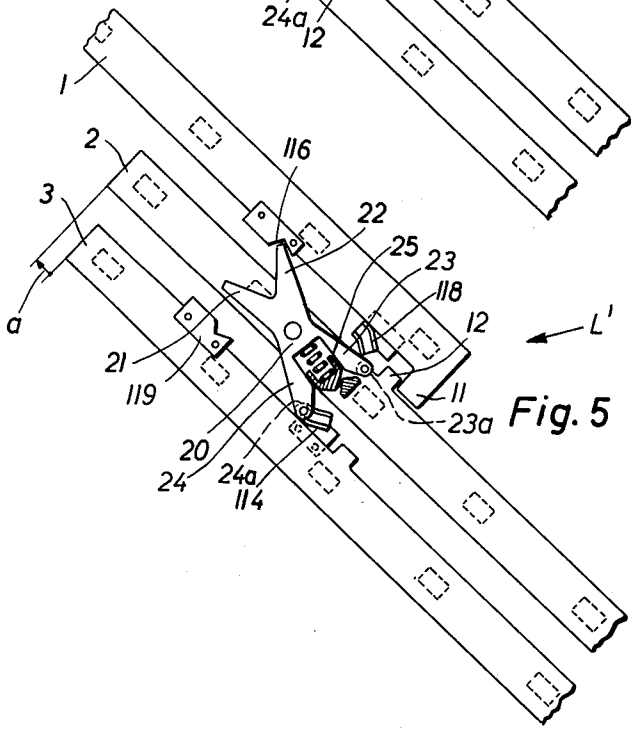


Fig. 5

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EXTENSIBLE MULTI-SECTION SUPPORTING STRUCTURES

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Fig. 6

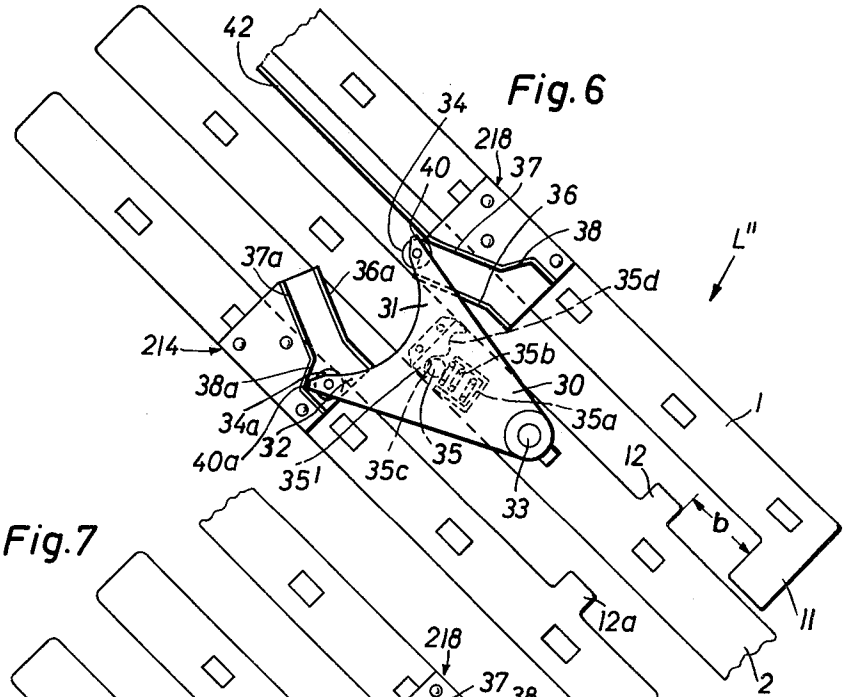


Fig. 7

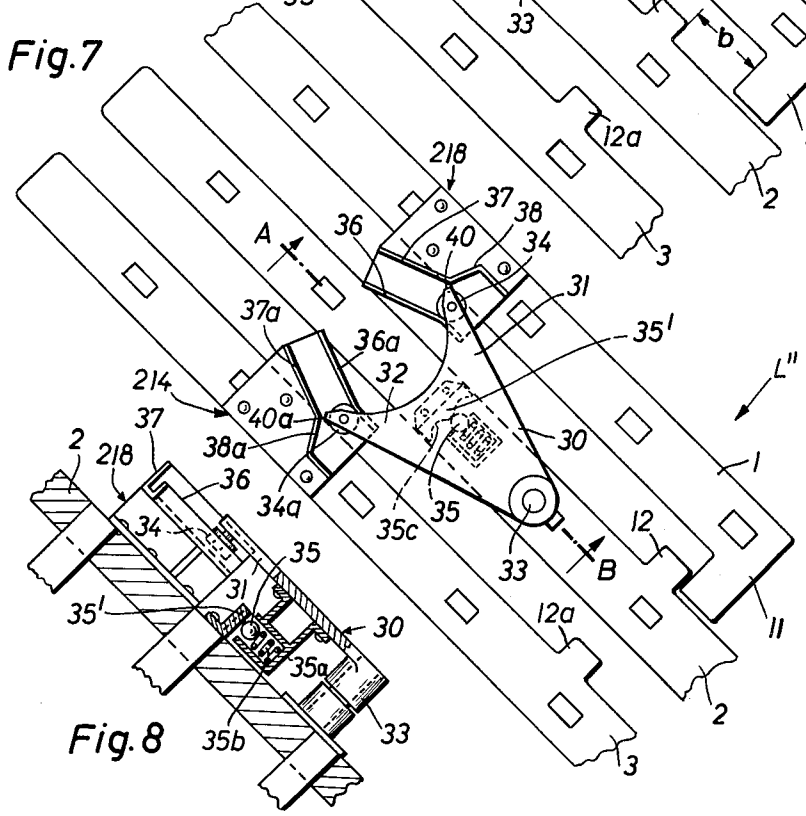


Fig. 8

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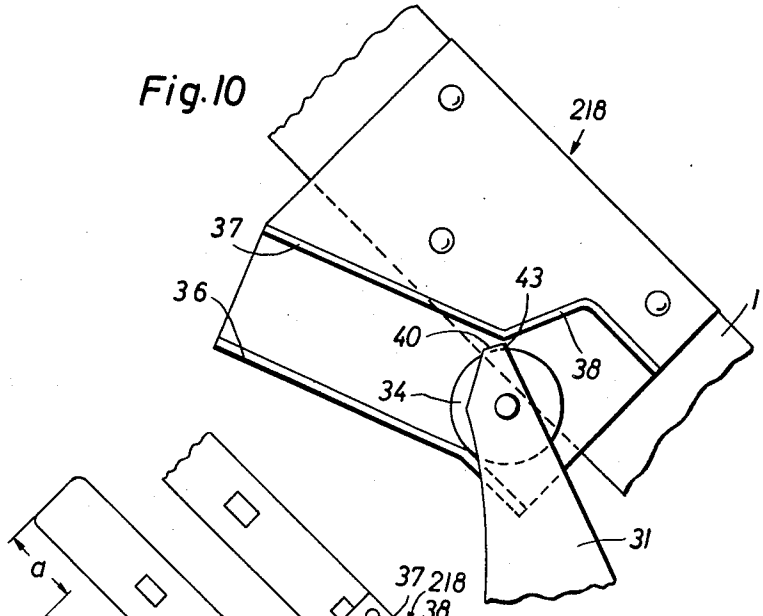
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EXTENSIBLE MULTI-SECTION SUPPORTING STRUCTURES

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Fig. 10



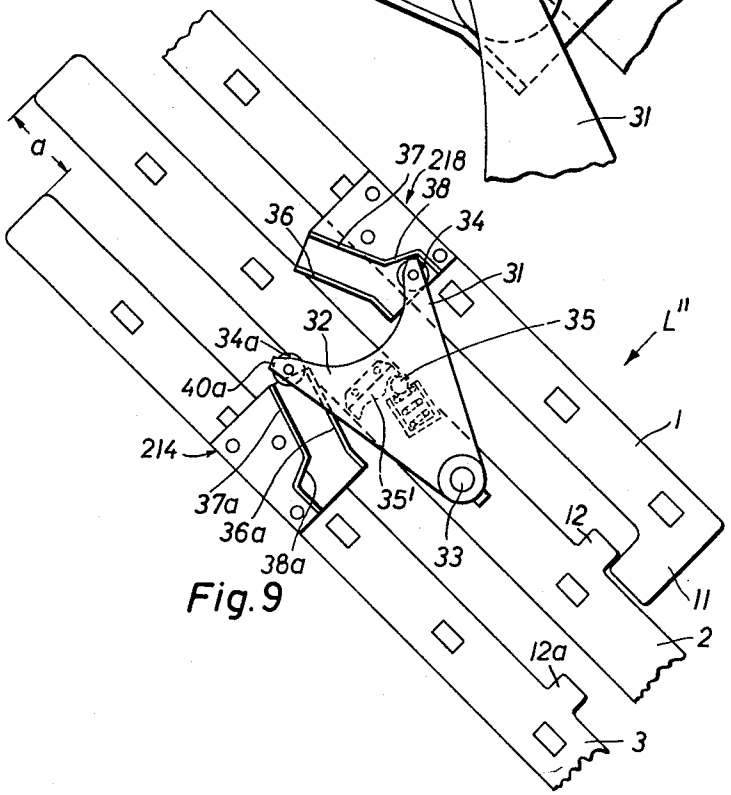


Fig. 9

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United States Patent Office

3,088,543

Patented May 7, 1963

3,088,543

EXTENSIBLE MULTI-SECTION SUPPORTING STRUCTURES

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Filed July 20, 1960, Ser. No. 44,212
Claims priority, application Germany Apr. 16, 1960
15 Claims. (Cl. 182—211)

The present invention relates to extensible multi-section supporting structures, such as extension ladders, radio and television towers, supports and scaffolds for use in construction and repair work at variable elevations above the ground, and the like. More particularly, the invention relates to an extensible and collapsible supporting structure consisting of at least three sections which is especially suited for use as a fireman's ladder.

An important object of the invention is to provide an extensible and retractible multi-section supporting structure which is constructed and assembled in such a way that the extension and retraction of its sections always take place in a predetermined sequence.

Another important object of the invention is to provide a supporting structure of the just outlined characteristics which is more reliable and hence safer in use than the supporting structures of presently known design.

A further object of the invention is to provide an extension ladder which is constructed and assembled in such a way that the uppermost section cannot be retracted before the retraction of the section therebelow is completed, and so forth, and in which the sections located at a higher level must move to a fully extended position before the sections therebelow may be moved to their respective extended positions.

An additional object of the invention is to provide an extensible and retractible multi-section supporting structure, such as an extension ladder, in which a single controlling means may determine the sequence of movements performed by two or more sections.

Still another object of the invention is to provide an arrangement for controlling the sequence of movements of sections in a multi-section supporting structure which may be readily installed in many multi-section supporting structures of presently known design.

An additional object of the invention is to provide an arrangment of the just outlined characteristics which occupies little space, which adds little to the overall weight of a multi-section supporting structure, and which may be operated with great safety and for extended periods of time without requiring any or by requiring very little attention.

With the above objects in view, the invention resides in the provision of an extensible multisection structure which comprises essentially a first, a second and a third or median section with the median section located between the first and second sections, means for slidably guiding the first section longitudinally of the median section and for slidably guiding the median section longitudinally of the second section so that the first section may be moved between an extended position in which its rear end is adjacent to the forward end of the median section and a retracted position in which the forward ends of the first and median sections are adjacent to each other, as well that the median section may be moved between an extended and a retracted position in which its rear and forward end is respectively adjacent to the forward end of the second section. In accordance with the present invention, the median section carries one or two rockable levers including two locking arms the first of which may engage with a suitable detent means provided at the rear end of the first section when the latter

is moved to its extended position and the second of which may engage with a second detent means provided at the forward end of the second section when the median section is moved to its retracted position. In other words, the first locking arm and the first detent means can prevent a displacement of the median section with respect to the first section or vice versa, while the second locking arm and the second detent means may prevent any displacement of the median section with respect to the second section. The improved arrangement further comprises first and second operating means, preferably formed as cam means mounted at the forward end of the second section and at the rear end of the first section, respectively, for selectively disengaging the locking arms from the associated detent means. Thus, when the first section is moved to its fully extended position, the second cam means which is mounted at the rear end of the first section disengage the second locking arm from the detent means on the second section so that the median section is movable with the first section with respect to the second section. On the other hand, when the median section is moved to its fully retracted position the first cam means which is mounted at the forward end of the second section will disengage the first locking arm from the detent means on the first section so that the latter may be moved with respect to the median section.

The locking arms may form integral parts of two distinct levers both rockably mounted at the forward end of the median section, or the two locking arms may constitute two arms of a four-armed lever whose other two arms are engageable with the respective cam means to rock the four-armed lever in clockwise or anticlockwise direction. Alternately, the first detent means may be integrally formed with the second cam, and the second detent means may form an integral part of the first cam. In such instances, the arrangement may utilize a two-armed bell crank lever whose locking arms then alternately perform two different functions, namely, one of the arms may rock the other arm upon engagement with one of the cams so that the other arm moves into locking engagement with the detent means of the other cam, and the other arm may rock the one arm upon engagement with the other cam so that the one arm moves into locking engagement with the detent means of the one cam.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following detailed description of certain specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a schematic side elevational view of a truck-mounted extension ladder embodying one form of the invention;

FIG. 2 is an enlarged fragmentary side elevational view of three sections forming part of the extension ladder shown in FIG. 1, with the first or upper section in fully extended position;

FIG. 3 is a similar fragmentary side elevational view of three sections forming part of a modified supporting structure in which a single four-armed lever controls the movements of two sections, the upper section being shown close to its fully extended position;

FIG. 4 is a similar side elevational view of the modified supporting structure with the upper section shown in fully extended position;

FIG. 5 is a further side elevational view of the modified supporting structure with the uppermost section in fully extended position and with the median section in partially extended position;

FIG. 6 is a fragmentary side elevational view of three

sections forming part of a different supporting structure in which a two-armed bell crank lever controls the extension and retraction of the two upper sections, the uppermost section being shown close to its fully extended position;

FIG. 7 is a view similar to the view of FIG. 6, showing the uppermost section in fully extended position;

FIG. 8 is a central section through the median section taken along the line A—B of FIG. 7, as seen in the direction of arrows;

FIG. 9 is a view similar to the views of FIGS. 6 and 7 with the uppermost section in fully extended position and with the median section in partly extended position; and

FIG. 10 is an enlarged fragmentary detail view of the structure shown in FIGS. 6, 7 and 9.

Referring now in greater detail to the illustrated embodiments, and first to FIG. 1, there is shown a multi-section supporting structure in the form of an extension ladder L which is mounted on the platform 5 of a fireman's truck T in such manner that it may be rotated about a vertical axis 6 as well as about a horizontal pivot axis 7. The extension ladder L consists of four sections 1, 2, 3, 4 the latter of which is fixed to a carriage 7*a* pivotally connected at 7 to a rotary turret 6*a* whose axis of rotation coincides with the vertical axis 6. The carriage 7*a* is pivotable about the horizontal axis 7 by a fluid operated piston-cylinder assembly comprising a piston rod 7*b* which is articulately connected to the carriage by a pivot axle 7*c* and is mounted at that side of the turret 6*a* which is turned away from the side facing the observer of FIG. 1. The turret 6*a* also supports a winch assembly 9*a* whose drum 9 serves as an anchoring means for one end of the cable or rope 8, this cable being led about suitable pulleys 10 mounted at the forward end of the lowermost section 4 and at the forward and rear ends of the intermediate sections 3 and 2. The other end of the cable 8 is anchored at the rear end of the uppermost section 1. The piston rod 7*b* of the piston-cylinder assembly is adapted to tilt the carriage 7*a* with the extension ladder L in a vertical plane so that the sections 1–4 may be pivoted between a horizontal idle position and a nearly or fully vertical operative position. A rotation of the turret 6*a* will cause angular displacements of the extension ladder about the vertical axis 6. The means for guiding the extending and retracting movements of the sections 1–3 with respect to each other and with respect to the fixed section 4 have been omitted in FIG. 1 for the sake of clarity. Such guide means are shown in FIG. 2.

In accordance with my invention, and as will be fully explained in connection with FIGS. 2–10, the construction of the extension ladder L is such that, when the winch 9*a* is rotated in a direction to wind the cable 8 onto the drum 9, the uppermost section 1 will be moved upwardly and along the adjacent section 2 until a stop member 11 at the rear end of the section 1 comes into abutment with a counterstop 12 located at the forward end of the section 2 therebelow, whereupon the section 2 will travel forwardly and upwardly until the stop 11*a* at its rear end comes into abutment with the counterstop 12*a* at the forward end of the section 3. Upon further rotation of the winch drum 9 in a direction to wind the cable 8 thereon, the section 3 will slide along the fixed lowermost section 4 until the stop 11*b* at the rear end of the section 3 comes into abutment with the counterstop 12*b* at the forward end of the lowermost section 4. On the other hand, when the drum 9 is rotated in a direction to pay out the cable 8, the section 3 will return to the position of FIG. 1 in advance of the section 2, followed by the section 2, and finally by the section 1, i.e. the uppermost section 1 is the first to move to an extended position but the last to return to its retracted position. In such manner, the center of gravity of the extension ladder L is always rather close to the ground because the

sections 1–3 will be held in a position above the turret 6*a* excepting when the ladder L is completely extended. Moreover, since the sections 1–3 are moved seriatim rather than simultaneously, the ladder may be extended or shortened through very short distances, i.e. through distances equal to the spacing between the adjacent rungs of a single section. In many presently known extension ladders whose sections move simultaneously to an extended or retracted position, it is necessary that each section be moved through a distance equal to the spacing between two adjacent rungs if the operator desires to move only one section through such a distance.

It will be noted that FIG. 1 shows the extension ladder L in a position in which the uppermost section 1 is in fully and the next section 2 in partially extended position. The section 3 is shown in its idle or retracted position in which the stop 11*b* abuts against the rear counterstop 12*c* of the fixed section 4.

Referring now to FIG. 2, there is shown the uppermost part of the extension ladder L with the upper or first section 1 in fully extended position and with the median or third section 2 only slightly displaced from its completely retracted position. This ladder embodies a novel arrangement which holds the median section 2 against movement with respect to the lower or second section 3 before the upper section 1 reaches its fully extended position, and for holding the upper section 1 against movement into retracted position before the median section 2 reaches such retracted position. The means for guiding the sections 1, 2, 3 with respect to each other is indicated by the reference character G.

As shown in FIG. 2, the rear stop 11 of the upper section 1 abuts against the counterstop 12 at the forward end of the median section 2. The reference character *a* indicates a short distance by which the median section 2 is moved from its fully retracted position. The section 2 rockably supports a first two-armed lever 13 whose forward or locking arm 13*a* abuts against the suitably inclined stop face of a first detent member 16 fixed to and adjacent to the rear end of the upper section 1 so that the locking arm 13*a* locks the upper section 1 to the median section 2. The lever 13 is under the bias of a resilient element here shown as a helical spring 15 whose ends bear against the rear or rocking arm 13*b* of the lever 13 and against a cup 15*a* fixed to the side wall of the median section 2. Thus, the spring 15 tends to turn the lever 13 in clockwise direction whereby the nose of the rocking arm 13*b* abuts against the adjacent face of a first cam 14 which is fixed to the forward end of the lower section 3. The configuration of the cam 14 is such that it pivots the lever 13 against the bias of the spring 15 when the median section 2 is moved to its fully retracted position but that it permits the spring 15 to pivot the lever 13 into the position of FIG. 2 as soon as the median section is slightly moved in forward direction toward its extended position (distance *a*).

A second two-armed lever 17, similar to the lever 13, is rockably mounted preferably at the other lateral side of the median section 2, its purpose being to prevent the section 2 from moving from its retracted position before the stop 11 engages with the counterstop 12. To that end, the lower sections 3 carries a second detent member 19 formed with a suitably inclined stop face which normally engages with the free end of the forward or locking arm 17*a* forming part of the lever 17 and thereby prevents the median section 2 from moving in forward direction. The lever 17 is under the bias of a helical spring 15′ supported by the median section 2 and acting in such a way that the lever 17 tends to turn in anticlockwise direction whereby the nose of its rear or rocking arm 17*b* slides along the inclined face of a second cam 18 whenever the upper section 1 moves to the position of FIG. 2 so as to pivot the lever 17 in clockwise direction and to remove the second locking arm

17*a* from engagement with the stop face of the second detent means **19**. It will be seen that the second cam **18** is fixed to the rear end portion of the upper section **1** so that it turns the lever **17** in clockwise direction shortly before the stop **11** comes into abutment with the counterstop **12** to thereby release the median section **2** and to permit a movement of this median section in forward direction, i.e. upwardly and to the left of FIG. 2.

In the position of FIG. 2, the upper section **1** is locked against movement with respect to the median section **2**, i.e. against movement into a retracted position, because the median section is not completely retracted. However, as soon as the section **2** moves to its fully retracted position (downwardly and to the right of FIG. 1) so that its forward end becomes aligned with the forward end of the lower section **3**, the upper section **1** is automatically released for movement to its retracted position because the lever **13** is then rocked in anticlockwise direction by the inclined surface of the cam **14** which acts upon the rocking arm **13***b*, and the first locking arm **13***a* moves away from the stop face of the first detent means **16**. Also, as the upper section **1** begins to return to its retracted position with respect to the median section **2**, the second cam **18** releases the rocking arm **17***b* so that the spring **15'** is free to rock the lever **17** in anticlockwise direction and to thereby move the second locking arm **17***a* into engagement with the stop face of the second detent means **19** which locks the median section **2** to the lower section **3** until such time when the stop **11** again comes into abutment with the counterstop **12**.

An important advantage of the controlling arrangement described in connection with FIG. 2 is that, in contrast to the known constructions which utilize a cable and pulleys for extending or retracting the aligned sections of an extensible multi-section supporting structure, the sequence in which the sections of the ladder L may be moved with respect to each other is determined in advance and is maintained in a fully automatic way during the extension or collapse of the supporting structure. In other words, the median section **2** cannot be moved to its extended position before the upper section **1**, and the upper section cannot return to its retracted position before the median section. In prior constructions, the sequence of movement of the sections to extended position is determined solely by the fact that the weight of the upper section is less than the combined weight of two uppermost sections, that the combined weight of two uppermost sections is less than the combined weight of three uppermost sections, and so forth. This weight difference is also a determining factor as regards the sequence in which the sections of prior art supporting structures return to their retracted positions, i.e. the combined weight of all movable sections will cause them to move in unison in such a way that the lowermost movable section returns to its retracted position whenever the winch pays out the cable, whereupon the next lowermost section returns to its retracted position together with all sections thereabove, and so forth. In such prior constructions, excessive friction between certain sections or the deformation of a given section could prevent the sections from performing movements to retracted or extended position in a desired sequence which could result in accidents if an improperly extended or collapsed supporting structure is put to use. It can be said that the improved supporting structure of the present invention not only relies on the weight of individual sections and on the combined weight of two or more sections to insure a retraction and extension in a given sequence, but that the invention also provides means insuring that the given sequence cannot be altered as a result of inaccuracies in the manufacture of component parts, deformation of one or more sections or of the guide means therefor, temperature changes, or any other factors which could eventually hinder the force of gravity from controlling the extension and retraction of sections in a desired sequence.

The modified ladder L' of FIGS. 3 to 5 is controlled by a four-armed lever **20** which is pivoted to a side wall and is located at the forward end of the median section **2**, as at **20***a*, and whose arms perform all the functions of the two-armed levers **13** and **17** of FIG. 2. The lever **20** comprises two locking arms **21**, **22** and two rocking or adjusting arms **23**, **24**. The first opposing pair of arms **22**, **24** performs the function of the arms **13***a*, **13***b*, and the second pair of opposing arms **21**, **23** performs the function of the arms **17***a*, **17***b* respectively. A pointed retaining member **25** which is slidably mounted in the body of the lever **20** and is permanently biased by a helical spring **25***a* cooperates with a pointed retaining cam **25***b* fixed to the median section **2** to yieldably hold the lever **20** in one of its two extreme positions shown in FIGS. 3 and 5. In the position of FIG. 3, the tip of the second locking arm **21** engages with the stop face of a second detent member **119** mounted at the forward end of the lower section **3** while the first locking arm **22** is spaced from the stop face of a first detent member **116** located at the rear end of the upper section **1**. Consequently, the upper section is free to move in either direction with respect to the median section **2** therebelow. A follower roller **23***a* mounted at the free end of the second rocking arm **23** is received in an inclined channel formed by a cam **118** which is secured to the rear end of the upper section **1** while a similar follower roller **24***a* on the rocking arm **24** is removed from the guide channel of a cam **114** carried by and located at the forward end of the lower section **3**. The purpose of the retaining assembly **25**, **25***a*, **25***b* is to prevent unintentional rocking movements of the lever **20** about the pivot **20***a*. Of course, such unintentional rocking movement could be prevented by extending the guide channels of the cams **114**, **118** all the way along the sections **2**, **1**, respectively which, however, would increase the weight and the initial cost of the extension ladder L'.

FIG. 3 shows the sections **1**, **2**, **3** in a position in which the median section **2** is fully retracted and the stop **11** at the rear end of the upper section is spaced by a distance *b* from the counterstop **12**. In other words, the upper section **1** is very close to its fully extended position. The follower roller **23***a* is located at the outermost end of the inclined guide channel in the second cam **118** and holds the second locking arm **21** in abutment with the stop face of the second detent member **119**, i.e. the median section **2** is securely locked against displacement with respect to the lower section **3**. The position of the lever **20** remains unchanged if the upper section **1** is moved to its retracted position because, though the follower roller **23***a* will move from engagement with the second cam **118**, the retaining means **25**, **25***a*, **25***b* will prevent the lever from being rocked in clockwise direction excepting when an external force applied to the lever **20** overcomes the bias of the spring **25***a* and permits the retaining member **25** to travel along the inclined surface and over the tip of the fixed retaining cam **25***b* to the position of FIG. 5. Such external force is supplied by the follower roller **23***a* when the upper section **1** moves from the position of FIG. 3 to the position of FIG. 4, i.e. when the distance *b* is reduced to zero and the stop **11** engages with the counterstop **12**, because the roller **23***a* travels in the inwardly inclined guide channel of the second cam **118** and forcibly turns the lever **20** in clockwise direction so that the tip of the retaining member **25** engages with the tip of the retaining cam **25***b*. At the same time, the roller **24***a* of the first rocking arm **24** enters the inner end of the guide channel in the first cam **114** and, as the second locking arm **21** is already moved away from the second detent member **119**, the median section **2** is now free to move to its extended position. A short displacement of the median section with respect to the lower section **3** (see the distance *a* in FIG. 5) is sufficient to bring about a further rocking movement of the lever **20** in clockwise direction so as to move the first locking arm **22** into abutment with

the stop face of the first detent member 116 and to lock the upper section to the median section. Such rocking of the lever 20 is brought about by the follower 24*a* which travels toward the outer end of the inclined channel in the first cam 114 and permits the spring 25*a* to expand whereby the retaining cam 25*b* holds the retaining member 25 in the new position of FIG. 5.

The operation of the lever 20 is reversed when the median section 2 is returned from the position of FIG. 5 into the position of FIG. 4. The first cam 114 and the follower roller 24*a* will rock the lever 20 in anticlockwise direction to remove the first locking arm 22 from engagement with the first detent member 116 so that the upper section 1 is free to return to its retracted position. Such movement of the section 1 (to the position of FIG. 3) brings the roller 23*a* into engagement with the second cam 118 and results in anticlockwise rotation of the lever 20 so that the second locking arm 21 engages with the second detent member 119 and locks the median section 2 to the lower section 3. In other words, during an extension of the ladder L', the lever 20 will operate in such a way as to lock the moving sections to each other and to consecutively release the moving sections from the stationary sections therebelow. During the retraction of ladder sections, the lever 20 will lock the fully retracted sections to each other and will consecutively release the extended sections from the fully retracted sections.

Of course, the follower rollers 23*a*, 24*a* may be replaced by non-rotatable pins or other projections as long as such projections may be properly guided in the channels of cams 118 and 114.

Referring now to FIGS. 6 to 10, there is shown a modified multi-section supporting structure in the form of an extension ladder L'' whose sections are controlled by a bell crank lever 30 which is rockable about a pivot member 33 fixed to and located in the proximity of the forward end of the median section 2. The locking arms 31, 32 of the lever 30 carry rocking members in the form of follower rollers 34, 34*a*, respectively. The roller 34 is adapted to cooperate with the inclined walls 36, 37 of a guide channel defined by a cam 213 fixed to the rear end of the upper section 1. A similar cam 214 is fixed to the forward end of the section 3 and defines an inclined guide channel bounded by inclined walls 36*a*, 37*a* for the follower roller 34*a* The wall 37 is formed with a differently inclined extension 38 which constitutes a first detent means in that it may engage with a locking face 40 at the forward end of the first locking arm 31 to prevent a displacement of the upper section 1 with respect to the median section 2 when the bell crank lever 30 assumes the position of FIG. 9 in which the stop 11 abuts against the counterstop 12. A similar second detent means is formed by the extension 38*a* of the wall 37*a*. This second detent means 38*a* is adapted to engage with the locking face 40*a* at the forward end of the second locking arm 32 and to thereby lock the median section 2 to the lower section 3 in the position of FIG. 6, i.e. when the upper section 1 is free to move with respect to the median section.

FIG. 6 illustrates the extension ladder L'' in a position in which the stop 11 is spaced by a distance *b* from the counterstop 12, i.e. the upper section 1 is close to its fully extended position. The rocking follower roller 34 is located at the innermost end of the channel between the cam walls 36 and 37, and the stop face 40 is not engaged by the first detent means 38. Consequently, the upper section 1 is free to move in either direction with respect to the median section 2 which latter is locked to the lower section 3 by the engagement of the face 40*a* on the second locking arm 32 with the second detent means 38*a*. The bell crank lever 30 is yieldably held in such position by a spherical retaining member 35 which is guided by a bracket 35*a* secured to the central portion of the lever 30. The retaining member 35 is under the bias of a helical spring 35*b* which permanently urges the member 35 into one of two concave seats 35*c*, 35*d* formed in a second bracket 35' secured to the median section 2. In FIG. 6, the retaining member 35 is received in the left-hand seat 35*c* of the bracket 35'.

The retaining assembly 35, 35*a*, 35*b*, 35' may be replaced by an extension 42 of the wall 37 which serves as a guide for the rocking roller 34 when the upper section 1 moves to its retracted position to thereby prevent clockwise angular displacement of the bell crank lever 30. A similar extension (not shown) may be provided for the wall 37*a* to hold the lever 30 in the position of FIG. 9.

FIG. 7 shows the upper section 1 in fully extended position. The retaining member 35 bears against a ridge between the seats 35*c*, 35*d* to thereby maintain both stop faces 40, 40*a* out of engagement with the respective first and second detent means 38, 38*a*. Thus, in the position of FIG. 7, the upper section 1 is free to return to its retracted position and the median section 2 is free to move toward its extended position. During a movement of the upper section 1 from the position of FIG. 6 into the position of FIG. 7, the rocking roller 34 travels along the inclined cam wall 36 and rocks the lever 30 in clockwise direction by forcibly removing the retaining member 35 from the seat 35*c*. Such clockwise rocking of the lever 30 causes the stop face 40*a* to move away from the second detent means 38*a* simultaneously with the entry of the rocking follower roller 34*a* into the channel defined by the cam walls 36*a*, 37*a*. Thus, the locking engagement of the median section 2 with the lower section 3 is terminated, and the median section is now free to move to the position of FIG. 9. During a displacement of the median section 2 with respect to the lower section 3 (see the distance *a* indicated in FIG. 9), the rocking follower roller 34*a* travels along the inclined cam wall 37*a* and turns the lever 30 in clockwise direction to thereby move the stop face 40 into abutment with the first detent means 38. The retaining member 35 is now received in the seat 35*d* and yieldably holds the lever 30 in its new position. The median section 2 is free to continue its travel to an extended position because the roller 34*a* has reached the innermost end of the cam wall 37*a* and is separated from the first cam 214. During such forward movement of the median section the latter is locked to the upper section 1 because the stop face 40 of the first locking arm 31 remains in abutment with the first detent means 38.

FIG. 10 shows that the stop face 40 of the first locking arm 31 is formed with a sharp edge 43 which is immediately adjacent to the meeting edge between the wall 37 and the first detent means or extension 38 when the lever 30 assumes the position of FIG. 7. Consequently, even a very small clockwise angular displacement of the lever 30 will bring about a locking engagement between the stop face 40 and the first detent means 38 or, inversely, a very small anticlockwise angular displacement of the lever 30 will result in a disengagement of the median section 2 from the upper section 1. It will be understood that the stop face 40*a* on the second locking lever 32 is provided with a similar sharp edge which is immediately adjacent to the meeting edge between the wall 37*a* and the second detent means or extension 38*a* when the lever 30 assumes the intermediate position of FIG. 7. Such construction of locking arms 31, 32 insures that the lever 30 will react immediately, i.e. with much greater accuracy than if the locking action were brought about by an engagement of rocking rollers 34, 34*a* with the detent means 38, 38*a*, respectively. In the position of FIG. 7, the rollers 34, 34*a* are slightly spaced from the walls 37, 38 and 37*a*, 38*a*, respectively.

Of course, if the ladder L'' comprises additional median or intermediate sections, it will be provided with two or more levers 30. In such instances, i.e. if the lower section 3 is movable with respect to a fourth section therebelow, a second bell crank lever will be mounted on the section 3 preferably at the opposite side from the lever

30, i.e. the second lever will be secured to the rear side wall of the section 3 and will cooperate with cams on the section 2 and on a fourth section beneath the section 3. This is also applicable to the embodiment of FIGS. 3–5 where a second four-armed lever 20 will be secured to the forward end of the section 3 if the latter is movable with respect to a fourth section therebelow. In the embodiment of FIGS. 1 and 2, the section 3 carries two levers corresponding to the levers 13, 17 which engage with cams on the sections 2 and 4, respectively.

If desired the cams 14—18, 114—118 and 214—218 may be replaced by suitable hydraulic or electric operating means adapted to rock the locking arms from and into engagement with the respective detent means.

It is equally possible to duplicate the arrangement shown in FIGS. 2, 3 or 6 even if the supporting structure comprises only three sections. In such instances, the second lever or levers will add further to the safety of the supporting structure because the lever or levers located at one side of the median section may control the movements of the sections 1 and 2 if the lever or levers at the other side of the median section would become damaged, deformed or otherwise prevented from operating in the above described manner.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising first and second locking means rockably mounted at the forward end of said third section, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with said first locking means when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, and said second detent means engaging with said second locking means when the third section is moved to its retracted position, and first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means rocking the first locking means from engagement with said first detent means when said third section is moved to its retracted position, and said second cam means rocking the second locking means from engagement with said second detent means when the first section is moved to its extended position.

2. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising a lever having a first and a second locking arm and rockably mounted at the forward end of said third section, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with said first arm when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position to lock the first section to said third section, and said second detent means engaging with said second arm when the third section is moved to its retracted position to lock the third section to said second section, and first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means rocking the first arm from engagement with said first detent means when said third section is moved to its retracted position to release said first section from said third section, and said second cam means rocking the second lever from engagement with said second detent means when the first section is moved to its extended position to release said third section from said second section.

3. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising a four armed lever having a first and a second locking arm and a first and a second rocking arm, said lever rockably mounted at the forward end of said third section, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with said first locking arm when the first section is moved to its extending position and said third section is at least slightly displaced from its retracted position to lock the first section to said third section, and said second detent means engaging with said second locking arm when the third section is moved to its retracted position to lock the third section to said second section, and first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means engaging with said first rocking arm to rock the first locking arm from engagement with said first detent means when the third section is moved to its retracted position to thereby release said first section from said third section, and said second cam means engaging with said second rocking arm to rock the second locking arm from engagement with said second detent means when the first section is moved to its extended position to thereby release said third section from said second section.

4. In an extensible supportnig ladder, in combination, a first, a superimposed second and a superimposed third

ladder section, each section having a forward end and a rear end and said third section located between said first and second section; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising a first and a second two armed lever each rockably mounted at the forward end of said third section and each having a locking arm and a rocking arm, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with the locking arm of said first lever to lock said first section to said third section when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, and said second detent means engaging with the locking arm of said second lever to lock said third section to said second section when the third section is moved to its retracted position, and first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means engaging with the rocking arm of said first lever to rock the locking arm of the first lever from engagement with said first detent means when said third section is moved to its retracted position whereby the first section is released from said third section, and said second cam means engaging with the rocking arm of said second lever to rock the locking arm of said second lever from engagement with said second detent means when said first section is moved to its extended position whereby the third section is released from said second section.

5. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising a first and a second two armed lever each rockably mounted at the forward end of said third section and each having a locking arm and a rocking arm, first and second detent means respectively mounted at the rear end of said first section and at the forward of said second section, said first detent means engaging with the locking arm of said first lever to lock said first section to said third section when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, and said second detent means engaging with the locking arm of said second lever to lock said third section to said second section when the third section is moved to its retracted position, first and second resilient means mounted on said third section for respectively biasing said first and second locking arms into engagement with said first and second detent means, and first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means engaging with the rocking arm of said first lever to rock the locking arm of the first lever from engagement with said first detent means against the bias of said first resilient means when said third section is moved to its retracted position whereby the first section is released from said third section, and said second cam means engaging with the rocking arm of said second lever to rock the locking arm of said second lever from engagement with said second detent means against the bias of said second resilient means when said first section is moved to its extended position whereby the third section is released from said second section.

6. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising a bell crank lever having a first and a second locking arm and rockably mounted at the forward end of said third section, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with said first locking arm when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, and said second detent means engaging with said second locking arm when the third section is moved to its retracted position, and first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means engaging with said second locking arm for rocking the first locking arm from engagement with said first detent means when said third section is moved to its retracted position, and said second cam means engaging with said first locking arm for rocking the second locking arm from engagement with said second detent means when said first section is moved to its extended position.

7. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising a bell crank lever having a first and a second locking arm and rockably mounted at the forward end of said third section, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with said first locking arm when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, and said second detent means engaging with said second locking arm when the third section is moved to its retracted position, and first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means integral with said second detent means and engag-

ing with said second locking arm for rocking the first locking arm from engagement with said first detent means when said third section is moved to its retracted position, and said second cam means integral with said first detent means and engaging with said first locking arm for rocking the second locking arm from engagement with said second detent means when said first section is moved to its extended position.

8. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising a bell crank lever having a first and a second locking arm and rockably mounted at the forward end of said third section, first and second follower means connected with said first and second locking arm, respectively, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with said first locking arm when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, and said second detent means engaging with said second locking arm when the third section is moved to its retracted position, and first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means engaging with said second follower means for rocking the first locking arm from engagement with said first detent means when said third section is moved to its retracted position, and said second cam means engaging with said first follower means for rocking the second locking arm from engagement with said second detent means when said first section is moved to its extended position.

9. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising a bell crank lever having a first and a second locking arm and rockably mounted at the forward end of said third section, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with said first locking arm when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, and said second detent means engaging with said second locking arm when the third section is moved to its retracted position, first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means engaging with said second locking arm for rocking the first locking arm from engagement with said first detent means when said third section is moved to its retracted position, and said second cam means engaging with said first locking arm for rocking the second locking arm from engagement with said second detent means when said first section is moved to its extended position, and retaining means mounted on said third section and on said lever, said retaining means comprising resilient means for biasing said first locking arm into engagement with said first detent means when said first section is moved to its extended position and for biasing said second locking arm into engagement with said second detent means when said third section is moved to its retracted position.

10. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising a lever having a first and a second locking arm and rockably mounted at the forward end of said third section, each said arm having a locking face formed with a sharp edge, a first and a second follower connected with said first and second arm, respectively, a first and a second cam respectively connected to the forward end of said second section and to the rear end of said first section, each said cam comprising an inclined wall for engaging with said first and second follower, respectively, and detent means for the respective locking arm, said detent means constituting extensions of said inclined walls, the detent means of said first cam engageable with the second locking arm when the third section is moved to its retracted position and the detent means of said second cam engageable with said first locking arm when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, the inclined wall of said first cam engaging with said second follower for rocking said first arm from engagement with the detent means of said second cam when the third section is moved to its retracted position, and the inclined wall of said second cam engaging with said first follower for rocking said second arm from engagement with the detent means of said first cam when the first section is moved to its extended position, said lever assuming an intermediate position when the first section is moved to its extended position and the third section is moved to its retracted position in which intermediate position the edges of said end faces are immediately adjacent to the detent means of the respective cams whereby a slight displacement of said first section from its extended position will move the second arm into engagement with the detent means of said first cam, and a slight displacement of the third section from its retracted position will move the first arm into engagement with the detent means of said second cam.

11. In an extensible supporting ladder, in combination, a first ladder section having a forward end and a rear end; a superimposed second ladder section having a forward end; a superimposed median ladder section having a forward end and a rear end, said median section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first section longitudinally of said median section

between an extended position in which the rear end of said first section is adjacent to the forward end of said median section and a retracted position in which the forward end of said first section is adjacent to the forward end of said median section, and for slidably guiding said median section longitudinally of said second section between an extended position in which the rear end of said median section is adjacent to the forward end of said second section and a retracted position in which the forward end of said median section is adjacent to the forward end of said second section; and means for controlling the sequence of movements of said first section with respect to said median section and of said median section with respect to said second section, said controlling means comprising first and second locking means rockably mounted on and adjacent to the forward end of said median section, first detent means mounted on and adjacent to the rear end of said first section for engaging with said first locking means when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, second detent means mounted on and adjacent to the forward end of said second section for engaging with said second locking means when the median section is moved to its retracted position, first cam means mounted on and adjacent to the forward end of said second section for rocking the first locking means from engagement with said first detent means when said median section is moved to its retracted position, and second cam means mounted on and adjacent to the rear end of said first section for rocking said second locking means from engagement with said second detent means when the first section is moved to its extended position whereby the median section is movable with respect to said second section when the first section is moved to its extended position and the first section is movable to its retracted position when the median section is moved to its retracted position.

12. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising a lever having a first and a second locking arm and rockably mounted at the forward end of said third section, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with said first arm when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position to lock the first section to said third section, and said second detent means engaging with said second arm when the third section is moved to its retracted position to lock the third section to said second section, first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means rocking the first arm from engagement with said first detent means when said third section is moved to its retracted position to release said first section from said third section, and said second cam means rocking the second lever from engagement with said second detent means when the first section is moved to its extended position to release said third section from said second section, and retaining means mounted on said third section and on said lever, said retaining means comprising resilient means for biasing said first locking arm into engagement with said first detent means when said first section is moved to its extended position and for biasing said second locking arm into engagement with said second detent means when the third section is moved to its retracted position.

13. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; means for respectively moving said first and third sections with respect to said third and second sections, said moving means comprising pulley means mounted at the forward ends of said second and third sections and at the rear end of said third section, and cable means having an end anchored at the rear end of said first section and extending about the pulley means located at the forward and rear ends of said third section and at the forward end of said second section in that order; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising first and second locking means rockably mounted at the forward end of said third section, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with said first locking means when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, and said second detent means engaging with said second locking means when the third section is moved to its retracted position, and first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means rocking the first locking means from engagement with said first detent means when said third section is moved to its retracted position, and said second cam means rocking the second locking means from engagement with said second detent means when the first section is moved to its extended position.

14. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; and means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising first and second locking means mounted at the forward end of said third section, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said first detent means engaging with said first locking means when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, and said second detent means en-

gaging with said second locking means when the third section is moved to its retracted position, and first and second operating means for disengaging said first locking means from said first detent means when said third section is moved to its retracted position and for disengaging said second locking means from said second detent means when said first section is moved to its extended position.

15. In an extensible supporting ladder, in combination, a first, a superimposed second and a superimposed third ladder section, each section having a forward end and a rear end and said third section located between said first and second sections, each of said sections having two spaced side walls and transversely extending rungs therebetween; means for slidably guiding said first and third sections between an extended position in which the rear ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections, and a retracted position in which the forward ends of said first and third sections are respectively adjacent to the forward ends of said third and second sections; means for controlling the sequence of movements of said first and third sections with respect to said third and second sections, respectively, said controlling means comprising first and second locking means rockably mounted at the forward end of said third section, first and second detent means respectively mounted at the rear end of said first section and at the forward end of said second section, said

first detent means engaging with said first locking means when the first section is moved to its extended position and said third section is at least slightly displaced from its retracted position, and said second detent means engaging with said second locking means when the third section is moved to its retracted position, and first and second cam means respectively mounted at the forward end of said second section and at the rear end of said first section, said first cam means rocking the first locking means from engagement with said first detent means when said third section is moved to its retracted position, and said second cam means rocking the second locking means from engagement with said second detent means when the first section is moved to its extended position; first and second stop means respectively provided at the rear ends of said first and third sections; and first and second counterstop means respectively provided at the forward ends of said third and second sections, said first and second stop means respectively abutting against said first and second counterstop means when said first and third sections are moved to their respective fully extended positions.

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