April 7, 1959 L. S. GLESSNER 2,880,920

EXTENSION LADDER

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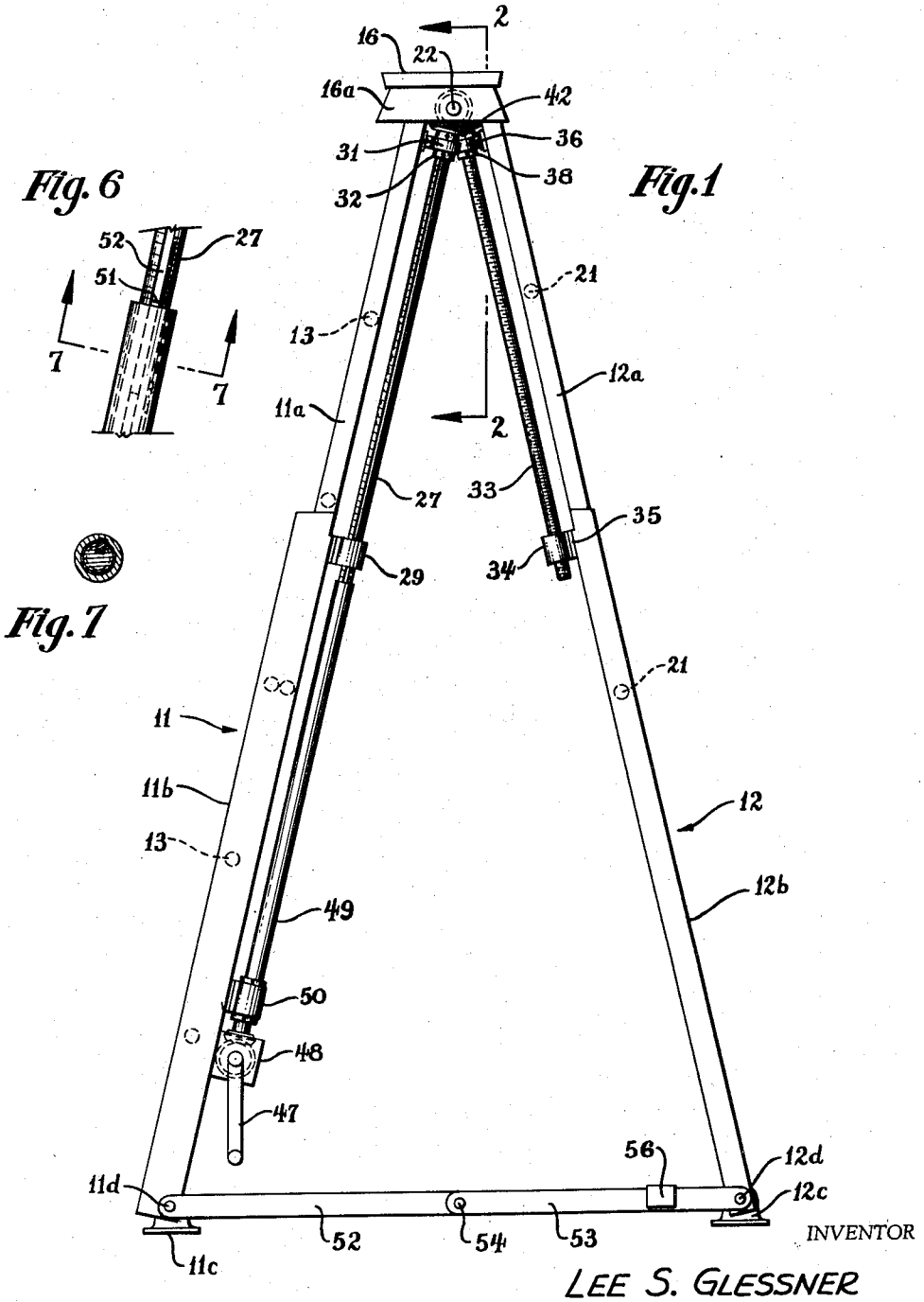


Fig. 1

Fig. 6

Fig. 7

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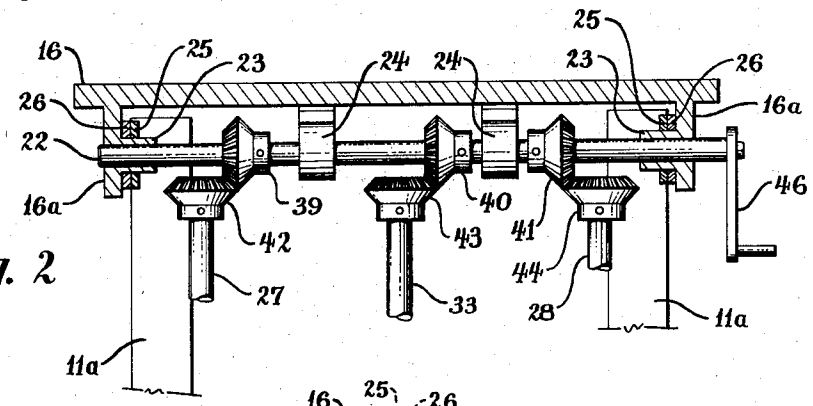


Fig. 2

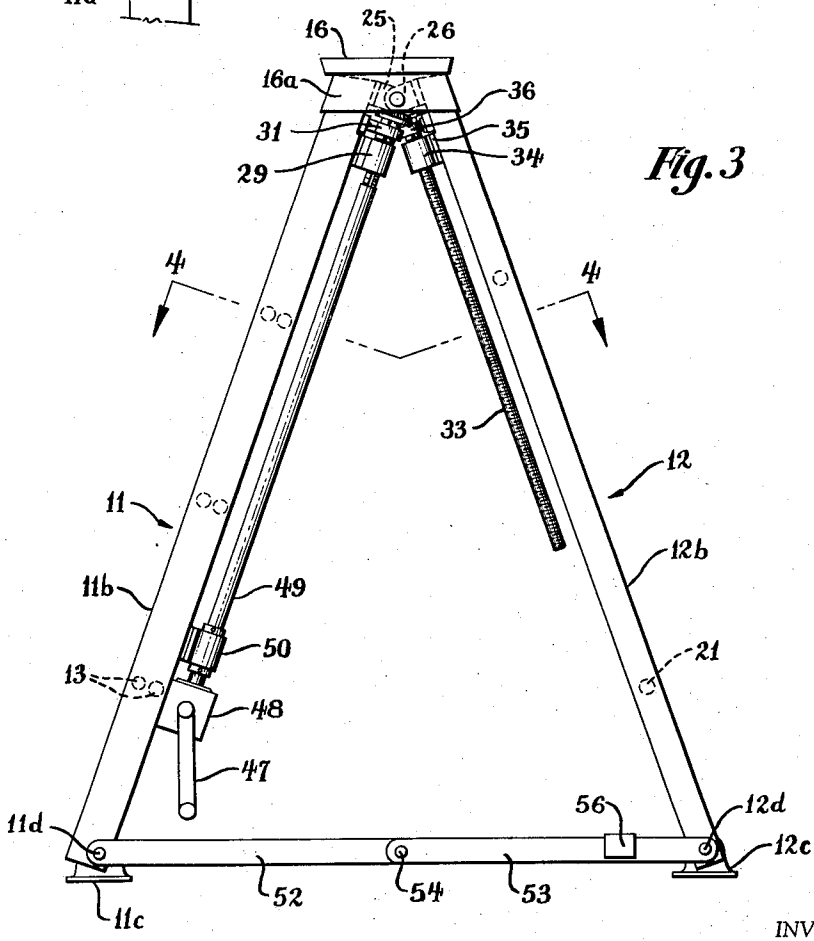


Fig. 3

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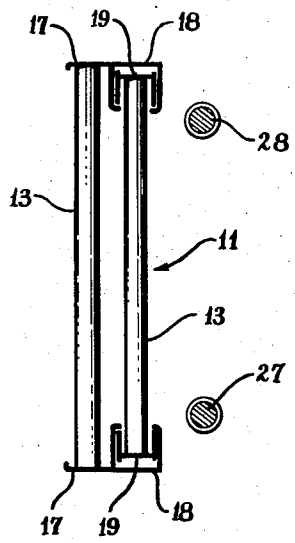
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EXTENSION LADDER

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Fig. 4



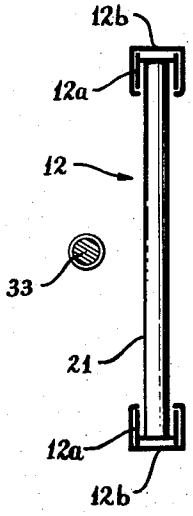
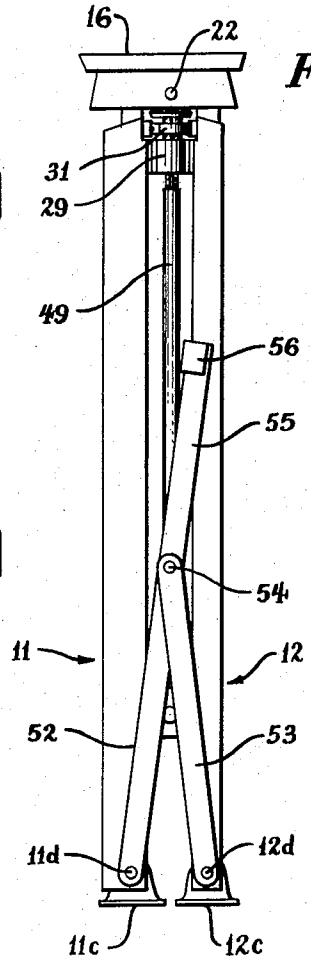


Fig. 5



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EXTENSION LADDER

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9 Claims. (Cl. 228—21)

This invention relates to a screw actuated extensible stepladder.

While it has heretofore been known to actuate extensible ladders by screw mechanisms, such mechanisms have not heretofore been applicable to use in stepladders of the type here involved, wherein the ladder is supported by an angularly disposed prop member, the two being pivotally connected at their upper ends for relative angular folding movement. The production of an extensible stepladder of this type obviously involves the overcoming of several difficult problems. For instance, in order to maintain equilibrium of the ladder, it is essential that both the ladder and its prop member be extended equally and simultaneously, so that suitable mechanisms must be associated with both the ladder and its said prop, and operated in coordinated relation. Moreover, the mechanism, in its entirety, must be so arranged that it will remain operable during the relative angular movement of the members that will occur as an inherent incident of their extension or retraction. The mechanism preferably should not interfere with the folding of the prop member against the ladder, as for transport.

Additionally, it will be desirable to link together the lower ends of the ladder member and its prop member to prevent inadvertent spreading of these lower ends with consequent collapse of the ladder while in use. This, too, is complicated by the necessity for avoiding interference by the connecting link with the aforementioned angular movement between the ladder and the prop incident to their extension. The present invention has been conceived with the foregoing problems in mind and includes a novel arrangement of parts which successfully overcomes all of the foregoing obstacles in a novel, efficient and simple manner.

To this end the invention broadly comprises the provision of the ladder and its prop in the form of a pair of individually extensible bipartite members, each comprising upper and lower slidably interconnected sections. The upper sections of these members are pivotally interconnected for angular movement about a common rotatable pivot shaft which is connected through suitable gearing with jack screws on the respective members, the screws extending radially to the said shaft and so geared thereto as to be swingable therearound without interfering with the geared connection between the shaft and each of said screws. Each jack screw is rotatably journalled and axially fixed on the upper section of its respective member and has a threaded connection with means fixed on the lower relatively slidably interconnected section of its respective member. Accordingly, rotation of either said screw will transmit equal simultaneous rotation to the other said screw or screws with resultant simultaneous extension or retraction of their respective members.

It will be apparent that such simultaneous extension or contraction of the pivotally interconnected members of the ladder while their lower ends are in fixedly spaced ground engaging relation, will result in a progressively

changing angular relationship between the members. This will be readily permitted by the mechanism aforementioned.

It will be further apparent that a drive may be imparted to the threaded jack screws through any one of said screws whereby said drive will be transmitted by the said pivot shaft to the other said screws.

Moreover, it will be readily apparent that by the application of a suitable hand crank or other actuating means to the said pivot shaft, a workman, while standing on the upper portion of the ladder, may readily adjust its height without necessity for descending the ladder.

In order to permit the aforementioned angular movement between the ladder members while maintaining their lower ends against spreading and in fixedly spaced relationship, I provide a link pivotally connected between the lower ends of the said members. Moreover, and as a further improvement on this particular feature, the lower ends of the respective members may be provided with ground engaging feet pivotally connected to the lower ends of the members coincidentally with the pivotal connections of said link.

The invention, in the presently preferred form, is illustrated in the accompanying drawings, in which

Fig. 1 represents a side elevation of a stepladder in accordance with the invention with the ladder in partially raised or extended position;

Fig. 2 is a cross section on the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 1 but with the ladder in its fully lowered or retracted position;

Fig. 4 is a cross section on the line 4—4 of Fig. 3;

Fig. 5 is a side elevation of the ladder as it appears when in folded condition ready for transport;

Fig. 6 is a fragmentary side elevation of one of the jack screw assemblies; and

Fig. 7 is a sectional view on the line 7—7 of Fig. 6.

Referring now in detail to the accompanying drawings, the ladder comprises a pair of individually extensible bipartite members, including the ladder member designated **11** in its entirety and a prop member designated **12** in its entirety. The bipartite ladder member **11** comprises upper and lower slidably interconnected sections **11*a*** and **11*b*** and the prop member similarly comprises upper and lower slidably interconnected sections **12*a*** and **12*b***. It will be seen that the two sections **11*a*** and **11*b*** of the ladder member are both provided with usual vertically spaced rungs **13** and the upper end of the ladder, in accordance with more or less usual practice, terminates in a rigidly attached step or platform **16**.

Referring particularly to Fig. 4, it will be seen that the lower section **11*b*** of the ladder comprises vertical side rails **17** extending parallel to each other in a common plane, together with channelled guides **18—18** in a plane parallel and rigidly connected to rails **17**. The guides **18—18** slidably receive the vertical side rails **19** of the upper ladder section **11*a***.

The prop member **12** comprises simply the parallel channelled guides **12*b*** of the lower section for sliding reception of the side rails **12*a*** of the upper section, the ladder side rails being interconnected in parallel relationship by suitably disposed cross braces **21**.

For the purpose of pivotally interconnecting the upper ends of the two extensible members **11** and **12**, a horizontal cross shaft **22** is rotatably journalled in bearings **23** respectively supported from the opposite depending side portions **16*a*** of the platform **16**. Also, if desired, intermediate bearings **24** for the shaft **22** may depend from and be secured to the under surface of the platform **16** as will be best seen in Fig. 2.

The upper ends of the side rails **12*a*** of the upper support section carry brackets or bearings **26** which are rotat-

ably journalled about the bearing members **23** concentrically with the shaft **22**, to provide a pivotal connection between the members **11** and **12** about the horizontal axes defined by the shaft **22**.

For the purpose of simultaneously raising or lowering the respective extensible members **11** and **12**, suitable operatively interconnected jack screws are provided. A pair of such screws **27** and **28** is carried by the upper section **11***a* of the ladder, such screws being supported on ladder section **11***a* for free rotation but in fixed axial positions. Inasmuch as both of these screws are mounted in identical fashion it will suffice to describe in detail the means exemplified for so supporting but one of them, namely, the screw **27**.

It will be seen that the screw **27** is threaded through a cooperating threaded member in the form of a nut **29** fixed on its corresponding side rail **11***b* of the lower ladder section and extends thence upwardly parallel to the ladder to have its upper end terminating in a bearing portion which is freely rotatably supported in bearing **31** fixed on the corresponding side rail **11***a* of the upper ladder section. A radial thrust collar **32** fixed on the threaded shaft **27** beneath the bearing **31** rotatably abuts against the said bearing to prevent axial displacement of the threaded screw shaft **27**. Thus, it will be seen that by rotation of the screw **27** it will be caused to move axially due to its cooperation with the fixed nut **29** on the lower ladder section and will thereby transmit movement through the bearing **31** to the upper ladder section including the side rails **11***a*. Thus, extension or contraction of the ladder member by relative movement of its aforesaid two sections may be accomplished incident to rotation of the screw **27**. It will be noted that the screw **27** is mounted as aforementioned adjacent and parallel to one of the side rails **11***a* of the upper ladder member while the screw **28** is mounted in similar manner adjacent the other side rail **11***a* of the upper ladder member and cooperates with a similar nut **29** fixed on the corresponding side rail **11***b* of the lower ladder section.

The slidably interconnected prop sections **12***a* and **12***b* are actuated by a similar jack screw arrangement to that aforementioned. Same includes the threaded screw shaft **33**, the lower end of which is threadedly received in a nut or other threaded means **34** fixedly supported on a cross bar **35** midway between the two side rails **12***b* of the lower prop section. The upper end of the screw **33** is rotatably supported through a bearing **36** fixedly carried by cross bar **37** midway between the side rails **12***a* adjacent the upper end thereof. A radial thrust collar **38** fixed on the shaft **33** rotatably abuts against the under surface of the bearing **36** to prevent axial displacement of the shaft **33** relative to the bearing **36** and upper prop section **12***a*. It will be seen that the disposition of the several screws **27**, **28** and **33** is such that all extend radially to the axis of the shaft **22** and are swingable with their respective members **11** and **12** about the axis of said shaft.

In order to interconnect the said screws **27**, **28** and **33** for simultaneous coordinated actuation, there are provided suitably disposed gear means exemplified by the bevel gears **39**, **40** and **41**, respectively, keyed on the shaft **22**. These gears **39**, **40** and **41**, respectively, mesh with bevel gears **42**, **43** and **44** keyed or otherwise fixed on the upper ends of the jack screws **27**, **33** and **28** respectively. It will thus be seen that the several jack screws are all interconnected through the aforesaid shaft **22** and gearing in such manner that rotation of any one of said screws or said shaft will result in simultaneous equal rotation of all of the screws or screw shafts. Thus, if the threads on the respective screws are of equal pitch, as will be the case in the preferred embodiment, the ladder member and the prop member will be caused to extend or contract simultaneously and to equal extents. Incidentally, in the particular arrangement illustrated, it will be noted that the gearing is so disposed that the two shafts **27** and **33** will rotate in an opposite direction from the shaft **28**. Therefore, the shafts **27** and **33** in the specific arrangement illustrated must be of opposite thread than the shaft **28**. However, this is by no means essential considering the invention from its broader aspects.

With the foregoing interconnection between the several threaded shafts **27**, **28**, **33** and the cross shaft **22**, it will be readily apparent that any one of them may be rotated by suitable means and from various convenient locations in order to raise and lower the ladder as desired. For instance, the ladder may be readily raised and lowered by an operator mounted on the upper portion of the ladder by means of a hand crank **46** keyed on the outer end of the shaft **22**. This is of considerable advantage inasmuch as it will enable a workman to adjust the height of the ladder without dismounting therefrom.

Also, in order to adapt the ladder for easy raising and lowering at a location adjacent its base, suitable means may be provided for imparting rotation from any one of the said jack screws. One suitable form of such means is shown as comprising a hand crank **47** rotatably supported by a gear box **48** fixed on one of the side rails of the lower ladder section **11***b*. The arrangement is such that the crank transmits rotation to gearing within the gear box **48** and such gear box in turn is operatively connected to and rotates a tubular shaft or sleeve **49** which is rotatably supported in a bearing **50** on one of the side rails **11***b*. The upper end of the tubular sleeve **49** freely slidably receives the jack screw **27** but is slidably keyed thereto as at **51**, the key **51** working in a keyway **52** in the screw **27** to impart rotation to the screw **27** while permitting a relative telescoping action between the screw and its cooperating sleeve **49**. Such rotation of the screw **27** as transmitted from the crank through the sleeve **49** will result in similar rotation of the shaft **22** and the remaining jack screws **28** and **33** with resultant raising or lowering of the ladder in its entirety.

By comparison of Figs. 1 and 3 of the drawings it will be readily apparent that raising or lowering of the ladder will result in angular movement between the members **11** and **12**, it being apparent, for instance, that the angle between these members is less when the ladder is raised, as in Fig. 1, than when it is lowered, as in Fig. 3. In order to faciltate such angular movement while affording a steady support for the base of the ladder, the respective lower ends of the members **11***b*, **11***b*, and **12***b*, **12***b* may be provided with supporting feet **11***c* and **12***c*, respectively, which are pivotally connected as at **11***d* and **12***d* to the respective side rails **11***b*, **12***b* for movement about axes parallel to the shaft **22**.

Moreover, it will be desirable to provide some linkage or interconnecting means between the lower ends of the ladder members **11** and **12** which will prevent inadvertent spreading apart of the lower ends of these members with resultant collapse of the ladder, while avoiding interference with the angular movement above mentioned between the members **11** and **12**. To this end the preferred form of linkage consists of a toggle linkage, the two links **52** and **53** of which have their relatively remote ends pivotally connected to the lower ends of the members **11** and **12** coincident with the pivotal axes **11***d* and **12***d*, respectively. The toggle linkage may be of a more or less conventional type employed in step-ladder structures wherein the two links **52** and **53** are pivotally interconnected at **54** to form the knee of the toggle and the link **52** has an end portion **55** extending across the medial pivot **54** and carrying a hook or stop member **56** for engaging the upper edge of the link **53** as the said links are brought downwardly into alignment to spread the ladder members **11** and **12** apart to place the ladder in use. However, by displacing the knee of the toggle linkage upwardly the hook or lock **56** will be disengaged and the ladder members **11** may be folded together about the axis of the shaft **22** as shown in Fig. 5 for transport or for storage, all in usual manner.

In this application I have shown and described only the preferred embodiment of the invention simply by way of illustration of the preferred mode of carrying out the invention. However, I recognize that my invention is capable of other and different embodiments and that its several details may be modified in various ways, all without departing from my invention as defined in the accompanying claims. Accordingly, the drawings and description herein are to be construed as merely illustrative in nature and not as restrictive.

Having thus described my invention, I claim:

1. An extensible stepladder comprising an extensible ladder member and an extensible prop member, said ladder member and said prop member each comprising upper and lower linearly slidably interconnected sections, a horizontal shaft rotatably supported at the upper end of one of said upper sections, the other upper section being pivotally connected at its upper end to said first upper section for swinging movement about the axis of said shaft, a jack screw rotatably journalled and axially fixed on each said upper section, intermeshing gearing on said shaft and each of said screws operative to cause rotation together of said shaft and said screws, a nut fixed on each said lower section in threaded engagement with a screw of its respective upper section to cause simultaneous relative sliding movement between the sections of said members incident to rotation of said screws, and means for rotating said shaft.

2. The combination of claim 1, wherein said shaft rotating means comprises a sleeve slidably receiving and keyed to one of said jack screws, means supporting said sleeve for rotation and against axial movement on the lower section of its respective member, and means associated with said sleeve for manually rotating same.

3. The combination of claim 2, in which said rotating means comprises a hand crank rotatable on said last mentioned lower section, and gear means for transmitting rotation from the crank to said sleeve.

4. The combination of claim 1, wherein said rotating means comprises a hand crank fixed on said shaft.

5. An extensible stepladder comprising a pair of individually extensible bipartite members, each comprising upper and lower slidably interconnected sections, a rotatable pivot shaft pivotally connecting said upper sections for relatively swinging movement, a threaded jack screw shaft rotatably journalled and axially fixed on each said upper section radially to the axis of said pivot shaft, intermeshing gearing on said pivot shaft and each of said jack screw shafts for causing simultaneous rotation of said shafts in any of the relative angular positions of said upper sections, threaded means fixed on each of said lower sections, each said means operatively engaging a jack screw shaft of its respective member to extend or retract said member incident to rotation of said shafts, and means associated with one of said shafts for rotating same.

6. The combination of claim 5 including supporting feet pivotally mounted at the lower ends of the respective lower sections, for movement about axes parallel to said pivot shaft.

7. The combination of claim 6, including a link extending between and interconnecting the lower ends of the said lower sections against relative spreading, said link being pivotally interconnected to the respective lower ends coincidentally with the pivotal mountings of the respective supporting feet, to avoid interference with relative angular movement between the members incident to the extension and retraction.

8. The combination of claim 7 in which said link comprises a foldable toggle linkage.

9. An extension ladder comprising relatively linearly slidably associated upper and lower ladder sections, inter engaging threaded means carried by the respective sections for relative rotation about an axis parallel to the relative sliding movement of said sections, said threaded means being axially immovable on their respective sections, and means on one member for rotating its respective threaded means to extend and retract the respective sections, in combination with a cross-shaft rotatably journalled on said upper section, an extensible prop having an upper prop section swingably supported on said shaft, and a lower prop section slidably supported on said upper prop section, interengaging threaded means respectively carried by the last mentioned prop sections for extending and retracting said prop, and gear means on said shaft and on the said threaded means of each of said upper sections interconnecting said shaft and said last mentioned threaded means for rotation together.

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