

July 14, 1959

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2,894,670

SELF-LEVELING LADDER ATTACHMENT

Filed May 13, 1958

2 Sheets-Sheet 1

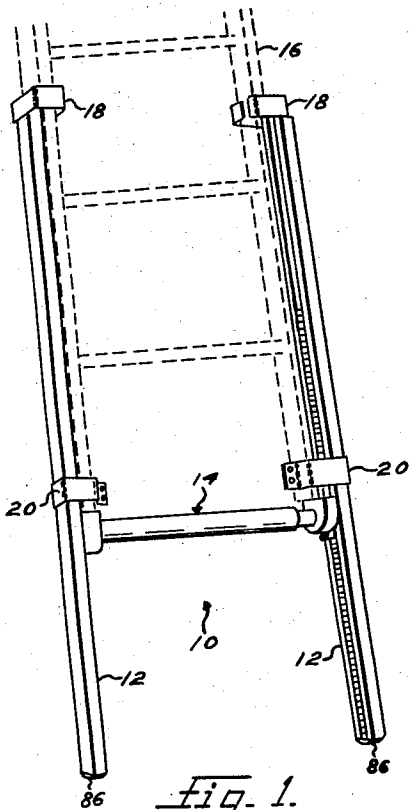
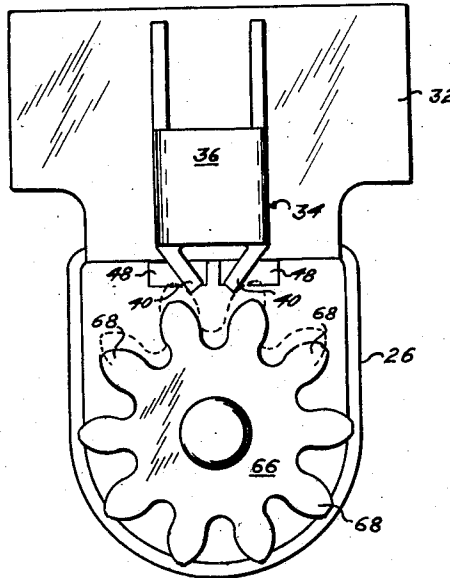


Fig. 2.

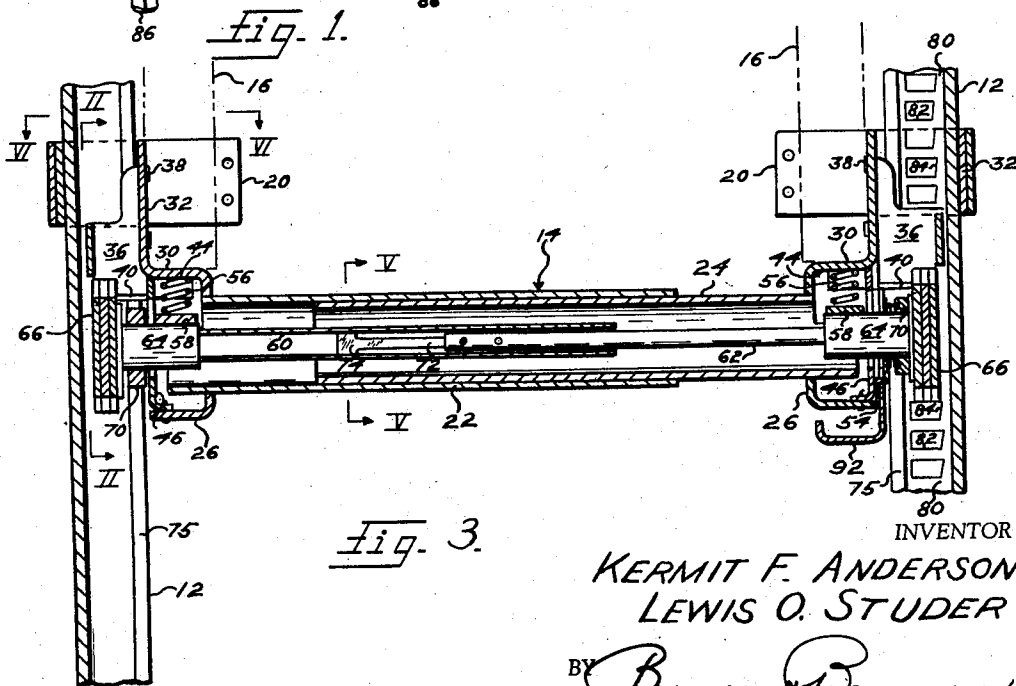


Fig. 3.

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SELF-LEVELING LADDER ATTACHMENT

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Application May 13, 1958, Serial No. 735,036

11 Claims. (Cl. 228—63)

The invention relates to ladder leveling devices and particularly pertains to an automatic self leveling ladder attachment which adjusts itself and locks under the weight of the operator.

The problem arising from supporting ladders upon non-level support surfaces wherein the supports for the legs are not in the same horizontal plane are well known, and several types of devices have been proposed to compensate for this condition. Such devices include adjustable extensions affixed to each ladder leg, arcuate adjustable supports and self leveling extensions wherein frictional locking engagement of the extension with the ladder is produced by the weight of the operator upon the ladder. Such aforementioned devices have not provided the answer to the problem as manually adjustable leg extensions and arcuate supports require time consuming adjustment at each location of the ladder and self locking leveling devices of known character do not lock with such positive action as to prevent malfunctions and consequently do not provide the assurance of safety necessary when using a ladder.

It is thus an object of the invention to provide an automatic self leveling ladder attachment which automatically adapts immediately to leg support surfaces of different heights and locks with a positive action.

A further object of the invention is to provide a self leveling ladder attachment wherein locking of the leg supports is provided by a gear simultaneously engaging a rack and fixed abutment.

Another object of the invention is to provide a light weight, self leveling ladder attachment which may be affixed to a wide variety of conventional ladders without modification to the ladder and which conforms in shape and size to the general configuration of the ladder.

A further object of the invention is to provide a self leveling ladder attachment which is self locking and releasing and will adapt itself to the supporting surface merely by placing the ladder on the surface and which is released from a locked position by removal of the operator's weight from the ladder.

Yet another object of the invention is to provide a self leveling ladder attachment in which the self leveling feature may be selectively engaged and disengaged as desired.

These and other objects of the invention will become apparent when viewed with respect to the following description and accompanying drawings wherein.

Fig. 1 is a perspective view of the complete ladder attachment as affixed to a ladder,

Fig. 2 is an elevational view of the gear and gear lock, the solid lines representing the gear in the unlocked position and the dotted lines illustrating the locked gear position, taken along the line II—II of Fig. 3,

Fig. 3 is a cross sectional elevational view of the operating mechanism of the invention,

Fig. 4 is an exploded view of the components associated with each leg member of the ladder attachment illustrating the self leveling lock-out plate,

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Fig. 5 is a cross section taken along the lines V—V of Fig. 3, and

Fig. 6 is a cross sectional plan view taken along the line VI—VI of Fig. 3.

As shown in Fig. 1 the ladder attachment 10 of the invention consists basically of a pair of vertical track or leg members 12 interconnected by a rung 14. The attachment 10 is adapted to be affixed to the lower end of a conventional ladder 16 and each leg 12 is provided with upper and lower brackets 18 and 20, respectively, for this purpose. The upper bracket 18 is affixed to the top of legs 12 and is of substantially rectangular configuration whereby the leg of the ladder is enclosed within the bracket in sliding connection, the inner side of the bracket 18 being open in the central portion to provide clearance for the rungs of the ladder 16 during relative movement. Brackets 18 are preferably adjustable in size whereby a close, yet easily slidable, connection with a variety of different sized ladders may be achieved.

The brackets 20 are affixed to the ladder and function as guides and supports for the legs 12 during relative movement of the legs and the ladder. As shown in Fig. 3 the rung 14 consists of cylindrical telescoping members including the outer tube 22 and the inner tube 24 which are provided with housings 26 affixed to the open ends thereof. The tubes 22 and 24 project into the interior of the housings 26 and are notched at the ends at 25 providing a support shelf for plate 58 as will be later explained. The housings 26 are cup shaped, being open at 28, and each is formed with a planar upper surface 30 on which the ends of the ladder legs rest. The housings 26 are also formed with an upward projecting portion 32 which is formed into a rectangular configuration of the proper size to slidably receive the leg members 12. The lower brackets 20 are affixed to the portion 32 whereby the ladder leg is firmly held adjacent the portion 32 and in contact with surface 30.

A gear lock element 34 is affixed to the housing 26 and consist of a formed member having a U-shaped body 36 from which project studs 38 which extend through holes in portion 32 and are swaged over to affix the gear lock to the portion 32. The gear locks 34 are also provided with a pair of gear engaging teeth 40 which converge toward each other and terminate in spaced relation to each other. A projection 42 extends from each tooth 40 into the interior of housing 26 contiguous with the interior of the upper wall 44 to provide additional strength to the gear lock structure.

The opening 28 of the housing is enclosed by a plate 46 having a pair of recesses 48 to provide clearance for the gear lock teeth 40 and a central oval opening 50. The opening 50 is formed with inwardly projecting side guide lips 52 and the lower edge of the opening 50 is formed with an outwardly extending tongue 54 whose purpose will be later described. Screw fasteners are used to affix the plate 46 within opening 28 of the housing whereby the plate is flush with the open edge of the housing. The above described components are best shown in Fig. 4 and except for the tongue 54 both of the housings 28, gear locks 34 and plates 46 are identical, the tongue being formed in only the plate 46 which is adjacent the lock-out device as later described.

A helical compression spring 56 is located within the housing 26 and abuts the upper wall 44 between the projections 42 at one end and is affixed to a plate 58 at the lower end, upwardly extending fingers are provided on plate 58 to project into the interior of spring 56 maintaining alignment of the spring and the plate. The plate 58 bears on the gear supporting members as illustrated in Fig. 3. One of the gear supporting members takes the form of a tube 60 of square cross section and

the other gear support comprises a cylindrical rod 62 adapted to telescope within tube 60. The free ends of tube 60 and rod 62 are affixed to cylindrical hubs 64 and a gear 66 having sprocket like teeth 68.

The gears 66 are preferably prefabricated of three or more steel stampings, each layer being case hardened, whereby a very strong, economical gear is produced. An annular guide roller 70 is journaled on the hub 64 to help maintain engagement of the gears with the rack as will be later apparent.

The tube 60 and the rod 62 project through the outer tube 22 and inner tube 24, respectively, and are assembled such that the hubs 64 extend through the opening 50 into the interior of housing 26 and are contacted on the upper surface by the plate 58. As thus assembled, the gears 66 will be located directly below the gear locks 34 and biased away from the gear lock by the springs 56 until the plate 58 rests upon the notched ends 25.

To provide self leveling the gears 66 are coupled together for simultaneous rotation and thus means are provided to couple the tube 60 and rod 62 comprising a leaf 72 of spring steel that is affixed to rod 62 and extends axially as an extension of the rod. The leaf 72 is of the same or less diameter as the rod through most of its length, however, it is of greater width at the end 74. The end 74 is of a width substantially equal to the hypotenuse of the inner square of the tube 60, Fig. 5, thus keying the rod 62 to the tube 60. The leaf 72 is of substantial strength and will twist only under certain conditions which will be later defined.

The track or leg members 12 are preferably formed of aluminum extrusions and are of rectangular cross section having one of the sides partially open at 75 throughout the length of the leg. As seen in Fig. 6 the legs 12 are formed with guide ribs 76 which contact the inner surface of the housing portion 32, it being understood that the legs 12 axially slide within portion 32. Interiorly, the legs 12 are formed with axial ribs 78 a pair of which are formed in spaced relation on opposite sides of the legs in opposed relation. The ribs 78 serve to support a rack 80 within the leg and locate the rack for engagement with the gear 66. The rack 80 is formed of stamped flat stock with a series of evenly spaced holes 82 to receive the gear teeth. It will be noted in Fig. 3 that the holes are not truly rectangular in that the side 84 is formed at a slight angle off of perpendicularity with the top and bottom edges of the holes to provide additional clearance for the gear teeth when the attachment is used with spread bottom ladders. The lower ends of legs 12 are enclosed by a foot 86 of substantially the same size as the leg whereby conventional safety feet of most designs may be affixed to the legs 12 over the feet 86 if desired.

The components are assembled as in Fig. 3 wherein the gears 66 are located within the confines of the legs 12 and the teeth 68 of the gear engage the holes 82 of the racks. Each of the legs 12 is provided with a rack, however the racks are located on different sides of the legs whereby the right gear 66 engages the rack on the far side of the gear, as viewed in Fig. 3, and the left gear engages the rack on the side toward the viewer. The resultant effect being that since the gears 66 are coupled together, pushing one of the legs 12 upwardly produces an equal downward movement of the other leg 12. As noted in Fig. 6 the rollers 70 will be located within the opening 75 of the legs 12 and will bear on the edge 88 of the leg to resist any tendency of the gear teeth to disengage the rack 80.

In operation the ladder attachment 10 is affixed to a conventional ladder as in Fig. 1 wherein the ends of the ladder legs rest on the surface 30 of the housings 26 and are held in place by the lower brackets 20. The ladder may now be lifted and placed in the desired location. Should the surface supporting the ladder and attachment be such that one of the feet 86 of the legs 12

engages the terrain, floor, etc. on which the ladder is to be supported before the other foot 86 due to an uneven support surface the leg 12 engaging the floor first will be moved upwardly due to the weight of the ladder and the other leg 12 will be driven downward due to the rack and gear coupling interconnecting the gears 66. Downward movement of the leg continues until the moving leg engages the support surface at which time the ladder will be vertically supported assuming the ladder is lowered in a vertical position. It will be appreciated that upon both legs 12 contacting the supporting surface any weight applied to the ladder will tend to make one gear 66 rotate in one direction and the other gear 66 rotate in the opposite direction and as the gears are coupled together gear rotation due to weight applied to the ladder is prevented.

The gears 66 are now in the position as shown in the solid lines of Fig. 2 e.g. weight of the ladder is being transmitted through springs 56 to the rod 62 and tube 60, the gears 66 and the racks 80. Upon the operator placing his weight upon the rung 14, which consists of the inner and outer tubes or any rung of the ladder, the springs 56 will be overcome and compressed which moves the teeth 40 of the gear lock into engagement with the teeth 68 of the gears 66 thereby locking the gears against rotation and the weight of the ladder and operator is directly imposed by the gear lock 34 to the gears 66 and upon the racks 80 thus locking the legs 12 in the self leveled position. The teeth 40 of the gear lock are shaped such that the gear teeth 68 may engage the gear lock either by trapping a gear tooth between the teeth 40 of the gear lock or the teeth 40 may wedge themselves between two adjacent gear teeth 68, as in Fig. 2, to lock the gears against rotation. Either type of engagement is positive in its operation and slippage or malfunction practically impossible.

It will be understood that the springs 56 may compress sufficiently under the weight of a heavy or extension ladder to engage the gear locks with the gears before the operator's weight is applied to the rungs. The operation is the same as above, e.g. the ladder is lowered to the supporting surface or terrain during the self-leveling phase and once the legs 12 are properly located to adapt themselves to the supporting terrain and the ladder is vertical, the operator releases the ladder such that the full weight thereof is supported by the attachment 10 which will lock the gears 66.

Should the occasion arise where the tips of the gear teeth 68 are engaged by the tips of one of the lock teeth 40 and upon weight being applied to the ladder the gear tooth of one gear 66 moved to the position wherein the gear tooth is between lock teeth 40 while the tooth of the other gear 66 moved in the opposite direction whereby the lock teeth 40 are wedged between two gear teeth a twisting torque will be applied to the means interconnecting the two gears and it is for this occasion that the leaf 72 is employed. Should a twisting torque be imposed on the rod 62 and tube 60 the twist will occur in the portion of leaf 72 having the narrow width and subsequent damage to the tube or rod is prevented.

Means are provided for rendering the self aligning mechanism inoperative which may be desirable under certain conditions, for instance when the ladder is being transported, and includes a lockout plate 90 having a handle or operating portion 92. The plate 90 is located adjacent the enclosure plate 46 and need be used in conjunction with only one of the gears 66, however a lock plate for each gear may be used if desired. The lock plate is provided with an opening 94 through which the hub 64 projects and a cut out 96 intersects the opening to provide clearance for the tongue 54, a larger clearance recess 98 is formed in the upper edge of the plate 90 to prevent interference with the gear lock 34 and a slot 100 is formed in the plate below the cut out 96 of complementary cross section to the tongue 54. A spring

102 and washer 104 are interposed between roller 70 and the lock-out plate 90 to bias the lock-out plate toward the enclosure plate 46.

In normal operation, the lock-out plate will be in the position where the tongue 54 is within opening 94 and cut out 96 and during locking of the gears the plate 90 will not interfere with the relative movement of the gear lock and gear as the opening 94 is substantially longer than the hub 64. To lock out the self aligning action the handle 92 is moved toward the spring 102, compressing the spring and clearing the end of the tongue 54, the plate 90 is then moved upward until the lower edges of opening 94 contact the hub 64, further upward movement compresses the adjacent spring 56 and moves the adjacent gear 66 into engagement with the gear lock 34. The handle 92 is then moved toward the center of the ladder which inserts the tongue 54 within slot 100 maintaining engagement of the gear lock and gear and "locking" the ladder attachment whereby rotation of the gears 66 is prevented although no weight is imposed on the ladder 16. The ladder may now be transported or used as a conventional ladder without self leveling operation. To release the lock-out means the handle 92 is merely moved toward the spring 102 disengaging the tongue 54 and slot 100 at which time the spring 56 will push the hub downward disengaging the gear and gear lock re-establishing the automatic operation of the ladder attachment. It will be appreciated that initial compression of spring 56 to engage the gear and gear lock permitting the slot 100 to engage tongue 54 may also be achieved by the weight of the ladder 16, if sufficiently heavy, or by the operator placing enough weight on the ladder to compress the springs 56.

The attachment 10 is easily affixed to most conventional ladders in that the brackets 18 and 20 are adjustable to properly engage various sized ladder legs and as tubes 22-24 and tube 60-rod 62 are telescoped together the ladder attachment is readily varied in width as desired. The attachment may be affixed to either wood or metal ladders by merely conforming brackets 18 and 20 to the ladder leg cross section, cylindrical or other type legs may be accommodated. As some ladder legs diverge at the bottom of the ladder the attachment construction permits the legs 12 to accommodate this feature and by making the holes 82 within rack 80 wider than the gear 66 and angling side 84 proper gear and rack engagement is provided with this type of ladder. In the conventional model the distance from the supporting surface to the rung 14, Fig. 1, is approximately 14 inches, however, as the leg members 12 move in opposite directions during leveling, compensation for support surfaces having a vertical differential of approximately 28 inches may be provided. Of course greater adjustability may be achieved depending on the dimensions of the attachment. The attachment is preferably constructed of aluminum except for those parts requiring high strength such as gears 66, racks 80, tube 60, rod 62, leaf 72 etc. and weighs only eight pounds thereby adding little weight to the ladder.

It will thus be appreciated that the ladder attachment of the invention provides automatic self leveling for safe, sure support of a ladder regardless of terrain or floor conditions and that the locking of the legs 12 is positive and automatic and requires no attention on the part of the operator. The principles of the invention may be incorporated in embodiments other than those illustrated and described and it is intended that the invention be limited only by the scope of the following claims.

We claim:

1. In combination with a ladder having substantially vertical rung supporting members a self leveling attachment adapted to be affixed to the ladder, said attachment including, a leg member affixed to each of the vertical ladder members for axially slidable movement relative thereto, a rack member carried by each of said leg

members, a gear engaging each of said rack members, means rotatably mounting said gears to the ladder, drive means interconnecting said gears, a gear lock affixed to the ladder adjacent each of said gears, said means mounting said gears to the ladder permitting relative engaging movement between said gears and gear locks upon application of a predetermined weight to the ladder.

2. In combination with a ladder having substantially vertical rung supporting members a self leveling attachment adapted to be affixed to the ladder, said attachment including, a leg member affixed to each of the vertical ladder members for axial slidable movement relative thereto, a rack member formed in each of said leg members, a gear rotatably supported by the ladder meshing with each of said rack members, drive means interconnecting said gears for simultaneous rotation in the same direction, said gears engaging said racks on opposite sides of the gears whereby movement of one of said leg means in one direction produces an opposite movement of the other leg means, a gear lock supported by the ladder adjacent each of said gears and means supporting said gears relative to said gear locks whereby application of a predetermined weight to the ladder lockingly engages said gears and gear locks.

3. In a self leveling ladder having substantially vertical rung supporting members, leg members slidably supported by said rung supporting members for relative parallel axial movement thereto, gear racks affixed to said leg members, gears meshing with each of said racks, means supporting said gears on said rung supporting members for relative rotative, transverse movement thereto, drive means interconnecting said gears, said gears engaging said racks on opposite sides of said gears whereby movement of said leg members in one direction produces movement of the other leg member in the opposite direction, gear locks supported by and fixed relative to said rung supporting members adjacent said gears and means biasing said gears away from said gear locks whereby placing said leg members on a supporting surface permits said leg members to automatically level themselves and application of a weight on said rung supporting members sufficient to overcome said biasing means lockingly engages said gear locks with said gears.

4. In a self leveling ladder as in claim 3 wherein said biasing means comprises a spring interposed between said gear locks and said drive means.

5. In a self leveling ladder as in claim 3 wherein tubular telescoping members extend between said rung supporting members and said drive means is enclosed within said tubular members.

6. In a self leveling ladder as in claim 3 wherein said drive means comprises relative telescoping shaft means affixed to each of said gears and torsion deflectable means drivingly interconnect said shaft means.

7. In a self leveling ladder as in claim 6 wherein said shaft means comprises a rod affixed to one of said gears inserted within a non-circular tube affixed to the other gear and said deflectable means comprises a leaf spring affixed to said rod closely engaging the opposed axially extending bends of said non-circular tube.

8. In combination with a ladder having substantially vertical rung supporting members a self leveling attachment adapted to be affixed to the ladder, a leg member affixed to each of the vertical ladder members for axially slidable movement relative thereto, a rack member carried by each of said leg members, a gear engaging each of said rack members, means rotatably mounting said gears to the ladder, drive means interconnecting said gears, a gear lock affixed to the ladder adjacent each of said gears, said means mounting said gears to the ladder permitting relative engaging movement between said gears and gear locks upon application of a predetermined weight to the ladder, and self leveling lock-out means adapted to selectively maintain engagement of at least

one of said gears and gear locks upon removal of the predetermined weight from the ladder.

9. In a self leveling ladder attachment, support structure adapted to be affixed to the ladder, parallel spaced leg means guided within said support structure for slidable movement relative thereto, self leveling drive means rotatably mounted in said support means and transversely displaceable thereto interposed between said leg means, positive drive means affixed to each of said leg means in opposite driving relation with said self leveling drive means whereby axial sliding movement of one leg in a given direction with respect to said support means axially moves the other leg in the opposite direction and locking means fixed to said support means for engagement with said self leveling drive means preventing rotation thereof upon relative transverse displacement of said self leveling drive means and said locking means.

10. In a ladder attachment as in claim 9 wherein spring means are interposed between said support means and said self leveling drive means biasing said drive means away from said locking means.

11. In a self leveling ladder attachment, support struc-

ture adapted to be affixed to the ladder, parallel spaced leg members guided within said support structure for slidable movement relative thereto, tooth engaging means carried by each of said leg members, gear means rotatably and transversely displaceably supported on said support structure meshing with said tooth engaging means, drive means interconnecting said gear means whereby movement in a given direction by one of said leg members with respect to said support structure moves the other leg member in the opposite direction and lock means mounted on said support structure adjacent said gear means for locking engagement with said gear means upon relative transverse displacement of said gear means and said support structure.

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