# United States Patent [19]

Grider

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[54] BOOM EXTENSION LOCK


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**Related U.S. Application Data**

[63] Continuation of Ser. No. 111,381, Feb. 1, 1971, abandoned.

[52] **U.S. Cl.** ..... **212/55**, 212/144, 287/58 CT

[51] **Int. Cl.** ..... **B66c 23/06**

[58] **Field of Search** ..... 212/55, 144; 52/121; 287/58 CT



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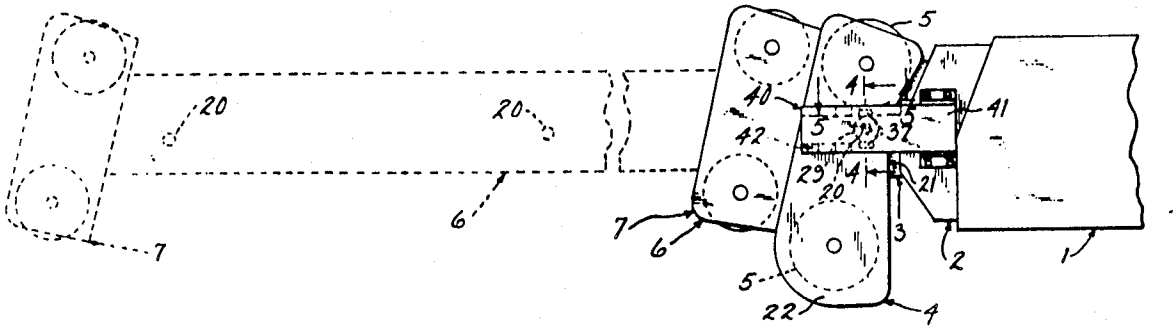
*Attorney*—Allan W. Leiser et al.



[57] **ABSTRACT**

An extensible boom includes main sections and a separately driven extension section which is locked in place by pins on the outer main section. The pins are automatically retracted by means of cam followers actuated by cam tracks on an inner section, and the pins and tracks are near the ends of their sections so that the extension section is operable only when the main sections are substantially retracted. The cam followers operate through override springs to prevent damage, and the pins have enlarged ends which effectively prevent operation of the extension until its drive is actuated.


**8 Claims, 6 Drawing Figures**



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SHEET 1 OF 3

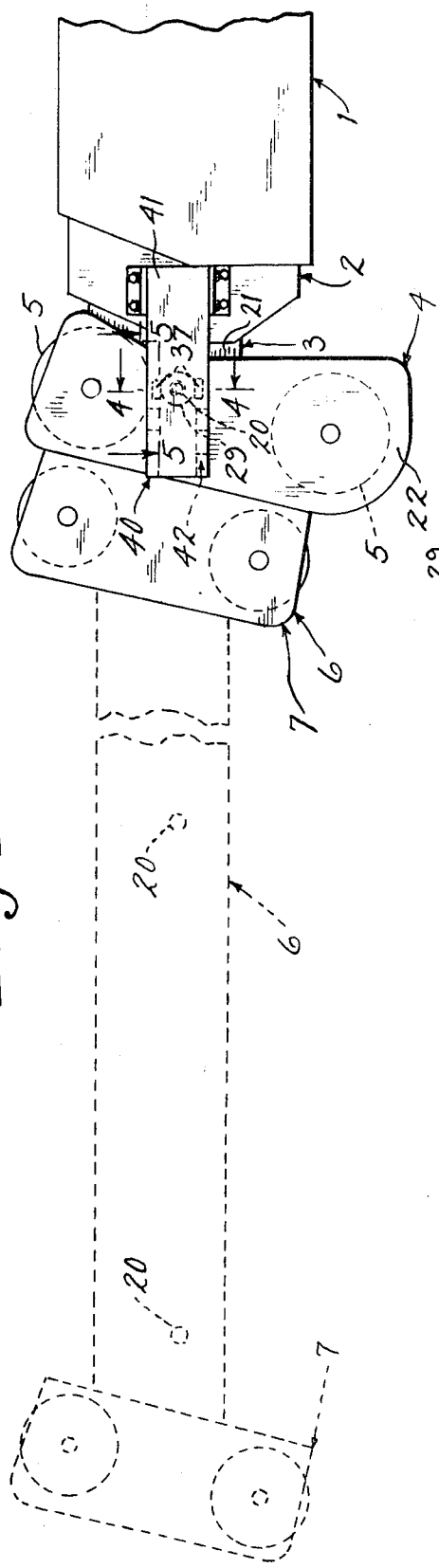


Fig. 1

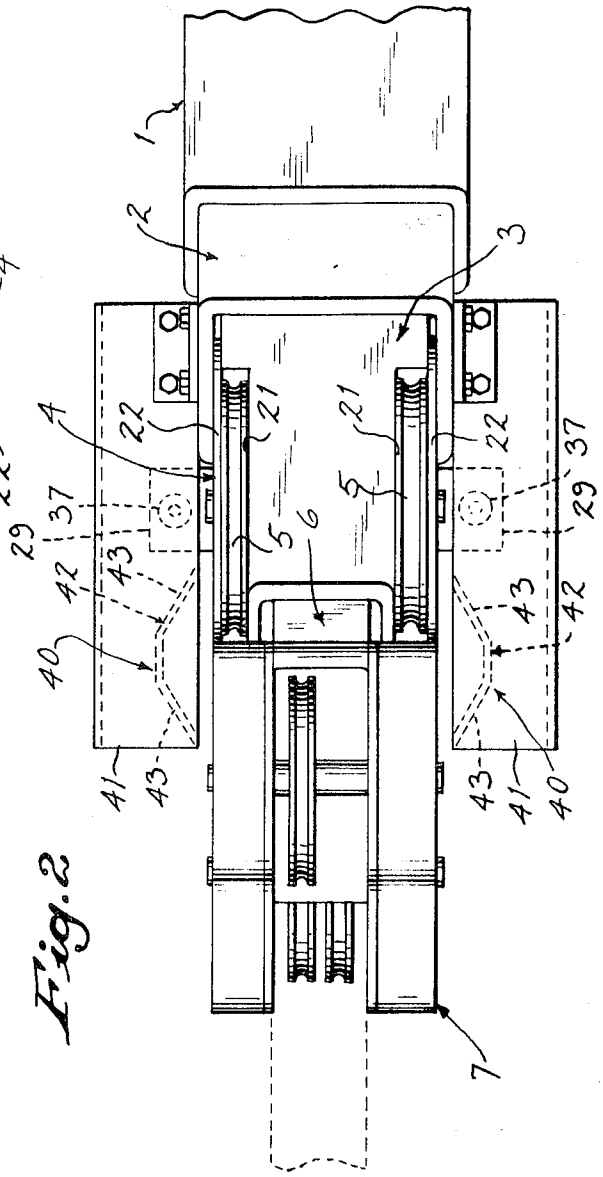


Fig. 2

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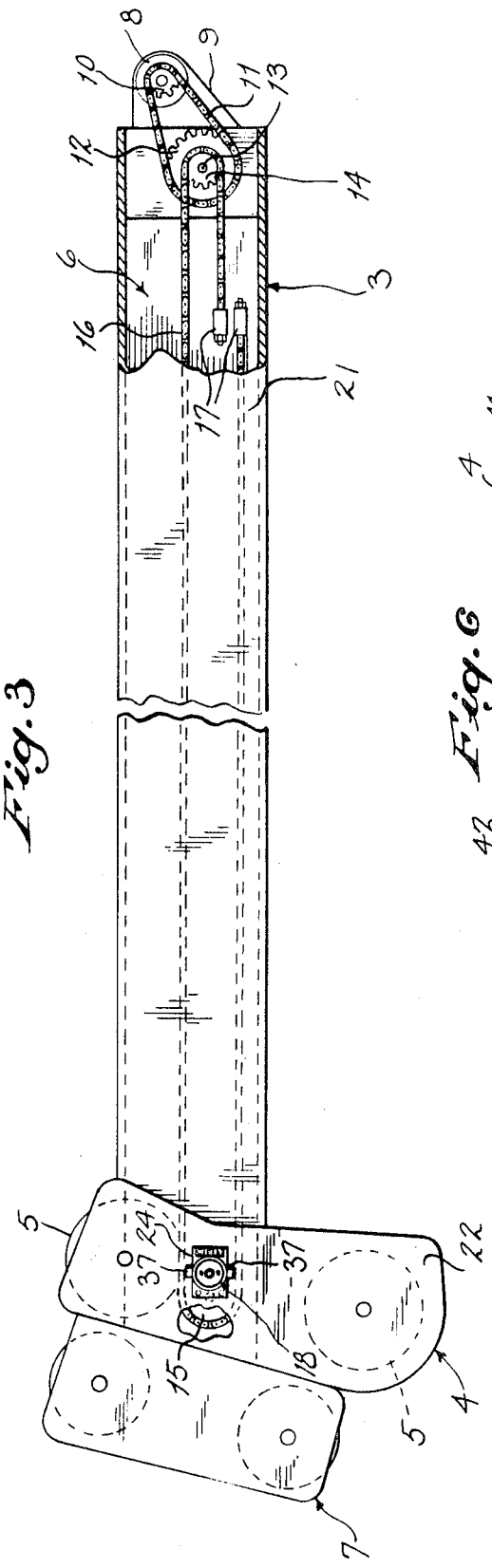


Fig. 3

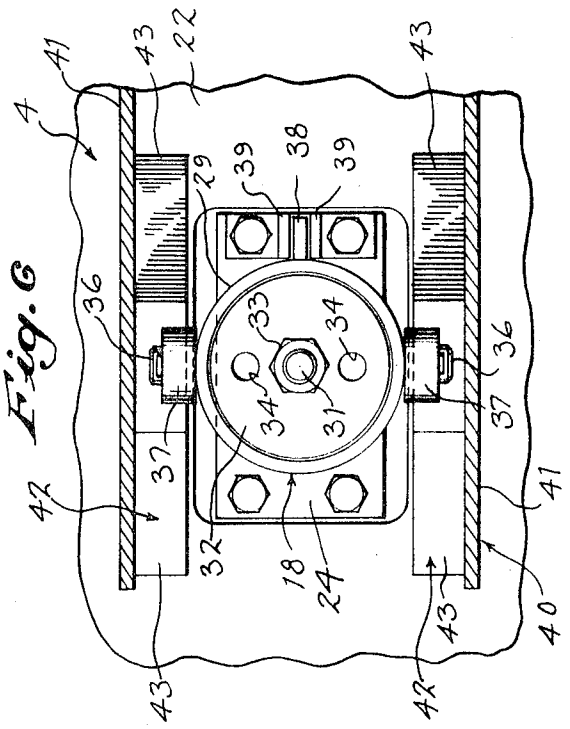


Fig. 6

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Fig. 4

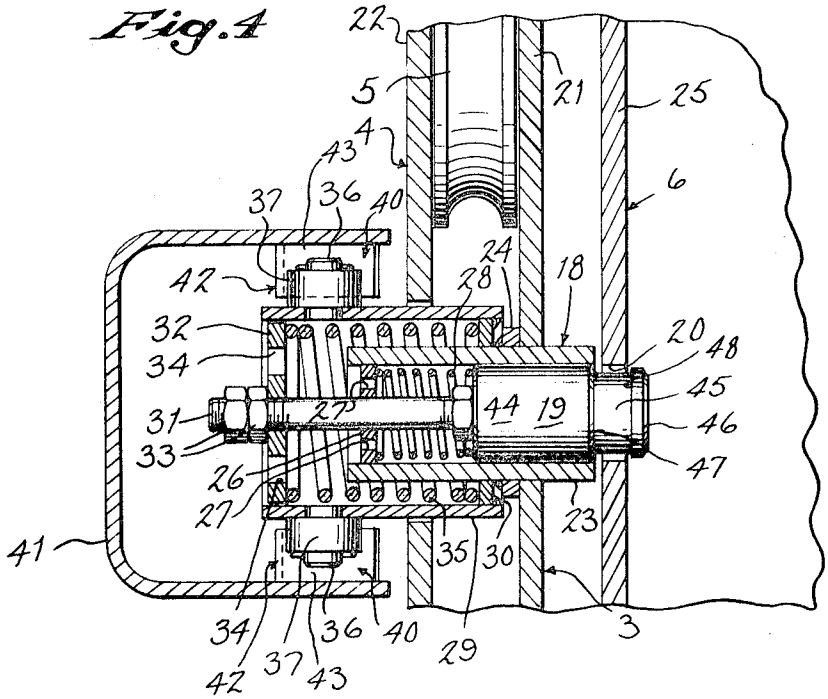
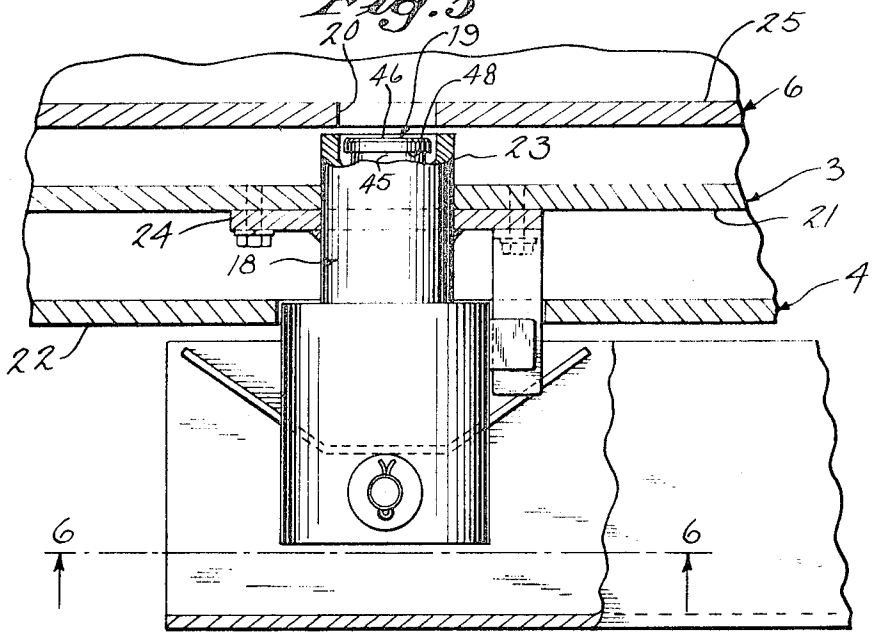



Fig. 5




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# BOOM EXTENSION LOCK

This is a continuation of application Ser. No. 111,381 filed Feb. 1, 1971 and now abandoned.

## BACKGROUND OF THE INVENTION

This invention relates to extensible booms, and particularly to a boom having a light load extension section which is automatically locked and released.

It is common to provide extension sections for extensible booms, such sections being intended for use where extra reach is necessary and only for relatively light loads. Since such sections may be used only sporadically, it is necessary that they be quickly extendable and retractable. It is also necessary to provide some means to lock the extension section securely in place, and it is desirable to provide means to prevent extension when the main boom is extended and loaded. While prior art systems of this general type have been used, they have generally required manual pinning or have otherwise been unsatisfactory.

## SUMMARY OF THE INVENTION

This invention contemplates a separately driven boom extension section which is automatically locked and unlocked in response to extension and retraction of the main sections. The arrangement of the invention is fully automatic, highly effective, safe and durable, and easy for the machine operator to control. At the same time, it is light in weight to increase boom capacity, and is relatively simple and inexpensive to manufacture, assemble and maintain. Other specific features, objects and advantages will become apparent from the description to follow.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial schematic side view, partly broken away and with an alternate position of the extension section shown in broken lines, illustrating a boom constituting a preferred embodiment of the invention,

FIG. 2 is a partial top view of the boom of FIG. 1,

FIG. 3 is a side view, partly broken away, showing the outermost main section and the extension section of the boom of FIG. 1,

FIG. 4 is an enlarged view in cross section through the plane 4—4 shown in FIG. 1, showing the extension section lock means in a locking position,

FIG. 5 is an enlarged view in cross section through the plane 5—5 shown in FIG. 1, but showing the lock means in an inoperative position, and

FIG. 6 is an enlarged view in cross section through the plane 6—6 shown in FIG. 5.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIGS. 1 and 2, the boom shown includes three main sections — an innermost base section 1, an inner extensible section 2 telescopically received in the section 1, and an outer extensible section 3 which is telescopically received in the section 2 and is provided with a regular heavy load tip assembly 4 with laterally opposite sets of hoist sheaves 5. These elements are generally conventional and their basic construction will not be shown or described in detail since the construction of such booms is well known to those skilled in the art. The section 1 will of course be footed on an excavator frame or other support (not shown),



and suitable means (not shown are provided to extend and retract sections 2 and 3 with respect to each other and section 1. It is preferred for this purpose to use any of several known multi-cylinder hydraulic systems which provide for simultaneous proportional extension of sections 2 and 3, but other hydraulic or mechanical drives could be used. The boom sections may be of solid, lattice, or other construction. Although the preferred embodiment includes a fully telescoped, three section main boom, it will become apparent that the invention is adaptable to any boom having at least one outer main section that is extensible and retractable with respect to an inner or base section or element, and is also adaptable to booms with side-by-side as opposed to telescoped sections.

The extension section, which is preferably of solid wall construction, is designated generally by the reference numeral 6, and it is provided with a separate, light load tip assembly 7. The extension section 6 is telescopically received within the section 3 and is movable between the fully retracted position shown in full lines in FIG. 1 and a fully extended position seen in broken lines. As can be seen in FIG. 3, a separate drive means is provided for the section 6. This includes a reversible hydraulic drive motor 8 mounted on a bracket 9 on the inner end of section 3. A drive sprocket 10 on the shaft of the motor 8 is drivingly connected by a chain 11 to a large driven sprocket 12 fixed to the center of a shaft 13 which is rotatably supported by and extends transversely across the inner end of section 3. Keyed to the opposite ends of the shaft 12 just inside the respective side walls of section 3 are two smaller drive sprockets 14, only one of which can be seen in FIG. 3. Idler sprockets 15, again only one of which is seen in FIG. 3, are rotatably supported on and near the outer end of section 3 just inside respective side walls; and drive chains 16, one of which is seen, lead around the sprockets 14 and 15 and have both of their ends 17 fixed by suitable means to the outer side of the adjacent side wall of section 6 near the inner end thereof. Again, FIG. 3 illustrates the drive arrangement on one side only, there being an identical arrangement on the other side. The sprockets 14 and 15 and chains 16 are all disposed in suitable space provided between facing side walls of sections 3 and 6.

Operation of the motor 8 in one or the other direction will of course cause extension or retraction of the section 6. If the sprockets 14 rotate clockwise as seen in FIG. 3, the section 6 will be extended, and counterclockwise rotation will cause retraction. Suitable supply lines and controls (not shown) are of course provided for the motor 8. While the drive arrangement shown is highly desirable, particularly in terms of effectiveness and light weight, other separate drives for the section 6 could be substituted.

Lock pin assemblies carried by section 3 and designated generally by the reference numeral 18, and seen most clearly in FIGS. 4–6, include lock pins 19 which are received in any of a series of longitudinally aligned lock apertures 20 formed in the side walls of the section 6 to lock the section 6 to the section 3 in any of several positions. There are identical, transversely aligned assemblies 18 and sets of aligned apertures 20 on both sides of the boom, but only one side is shown in detail.

Referring particularly to FIG. 2, it can be seen that the outer end of the section 3 is slightly transversely narrower than the remainder thereof, and the reference

numeral 21 designates the side walls of section 3 in this area, the same being of solid construction in the preferred embodiment. The tip assembly 4 includes opposite side plates 22 which are suitably supported on and outwardly spaced from respective walls 21 to provide space for the main hoist sheaves 5, which are necessarily located on the sides of the boom because of the presence of the section 6. Since the lock assemblies are located at the tip 4 in the preferred embodiment, they necessarily extend through the plates 22, but the latter serve no function so far as the invention is concerned.

Referring now to FIGS. 4–6, each lock assembly 18 includes a cylindrical sleeve 23 which is fixed to and extends through a mounting plate 24 bolted to the outside of the associated wall 21. The sleeve 23 extends transversely through the wall 21 to present an open end which faces the associated side wall 25 of the section 4. The outer end of the sleeve 23 is partly closed by a disc 26 fixed therein which defines an inwardly extending shoulder and is preferably provided with air release apertures 27. The pin 19 is reciprocably slidable in the sleeve 23 and its inner end projects inwardly therefrom to be engageable with the apertures 20. A relatively light compression spring 28 is disposed in the sleeve 23 and seated between the shoulder 26 and pin 19 to bias the latter toward an extended position where it is in engagement with an aperture 20 as seen in FIG. 4.

A cylindrical, freely axially movable housing 29 is disposed concentrically about the outer end of the sleeve 23 outside the wall 21, and its inner end is provided with an inwardly extending annular ledge 30, the outer end being open. A stem 31 has its inner end fixed to the pin 19 and extends outwardly through a suitable opening in the disc 26. A circular plate member 32 is held at the outer end of the stem 31 by nuts 33 and defines a spring abutment, the plate 32 preferably being supplied with apertures 34 to allow trapped air to escape. A relatively heavy compression spring 35 is disposed in the housing 29 around the sleeve 23, and is seated between the ledge 30 and abutment 32. As seen in FIG. 4, the spring 35 is at or near its free length and has no effect other than to limit extension of the pin 19, but when the housing 29 is moved outwardly or to the left as seen in FIG. 4 it will be compressed and, being relatively stronger, will override the spring 28 to cause the pin 19 to be retracted.

Stub shafts 36 mounted on opposite sides of the housing 29 rotatably mount rollers 37 which are outside the walls 21 and engageable with a cam track as will be described to serve as cam followers for moving the housing 29 outwardly to retract the pins 19. A key 38 is also attached to the outside of the housing 29, and is inwardly and outwardly movable between fingers 39 fixed to the plate 24, these elements in effect defining a key-slot connection between the housing 29 and wall 21 which allows the former to move axially but prevents rotation to keep the rollers 37 in proper position. As previously indicated, the plates 22 are at the locations of the lock assemblies 18 but do not function in connection with them, the plates 22 simply being provided with suitable openings through which the several described elements extend.

Cam track assemblies designated generally by the reference numeral 40 are fixed to the outer end of the boom section 2 for actuating the lock assemblies 18 as will be described, and again there are identical assemblies on both sides only one of which is shown and described in detail. Each assembly 40 includes a channel-shaped housing 41, the rear end of which is bolted to the outside of an associated side wall of the section 2 near the outer end thereof and which extends forwardly to be over a respective lock assembly 18 when the section 3 is retracted. Facing, oppositely disposed cam tracks 42 are fixed to the inner sides of the side walls of the housing 41 near its forward end, and these are essentially V-shaped to define opposite inclined end portions 43 and a flattened apex 44 which faces outwardly away from the sides of the sections 2 and 3. The tracks 42 are engageable with respective followers 37 to retract the pins 19 as will be described.

As can be seen most clearly in FIGS. 4 and 5, the pins 19 include body portions 44 which fit relatively closely in the sleeves 23, reduced neck portions 45, and enlarged heads 46 which are of slightly less diameter than the bodies 44 and which are adapted to go through the apertures 20 with a relatively close fit. This shaping defines an inwardly facing shoulder 47 which is engageable with the outside of the wall 24 to limit extension of the pin; and also defines an outwardly facing shoulder 48 which is engageable with the inside of the wall 24 when the pin is extended to prevent retraction unless the aperture 20 and pin 19 are in close alignment, for a purpose to be described.

As illustrated by FIG. 1, there are a series of four apertures 20 on each side of the extension section 6, with the apertures 20 on each side being along a line parallel to the boom and being transversely aligned with corresponding apertures on the other side. The innermost apertures 20, which are farthest to the right and behind the lock assembly 18 as seen in FIG. 1, correspond to the fully extended position of the section 6, and it is these apertures 20 that receive the pins 19 when the section 6 is to be locked in extended position. The outermost apertures 20, farthest to the left as seen in FIG. 1, correspond to the fully retracted position of the section 6 and receive the pins 19 when the section 6 is to be locked in retracted position. The apertures 20 which are second from the left as seen in FIG. 1 allow for a partial extension of the section 6 to prevent cable fouling which might otherwise occur when an operator desires to use the main tip 4 while leaving a cable or cables on the extension tip 7. The apertures 20 located second from the right serve as safety apertures in that if the pins 19 fail to engage the innermost apertures 20 for any reason after full extension the section 6 will tend to slide inwardly which will bring the safety apertures 20 into line with the pins 19 and the pins 19 will automatically enter them to stop further slippage.

FIGS. 1 and 2 show the boom sections 1, 2, 3 and 6 (full lines) in fully retracted position. In this position, the cam track housing 41 overhangs the lock assemblies 18, but the cam rollers 37 are behind or to the right of the tracks 42. In this position, the pins 19 are in the innermost apertures 20, as illustrated by FIG. 4, and the extension section 6 is thus locked in retracted position. Having the rollers 37 behind the tracks 42 when all of the sections are fully retracted is important for travel purposes in that the section 6 is locked with the boom at its shortest overall length.

When it is desired to extend the section 6, the section 3 is first extended slightly — in the preferred embodiment there will also be some corresponding extension of the section 2 — which in effect causes the lock assemblies 18 to move forwardly with respect to the cam

tracks 42. In the course of this movement, the rollers 37 will ride up the innermost sloped surfaces 43 and onto the apexes 44 of the tracks 42. The resulting movement of the housings 29 will compress the override springs 35 and cause the pins 19 to be moved out of the apertures 20 against the force of the springs 28, thus freeing the section 6. The drive motor 8 is then actuated to extend the section 6 to its desired position, and the section 3 is extended or retracted slightly to take the rollers 37 off the tracks 42, whereupon the pins 19 will be ready to be moved by the springs 28 into the selected apertures 20. If desired, the further extension or retraction of the section 3 can be accomplished as soon as the section 6 has begun to move, in which case the pins 19 will simply ride along the side walls of the section 6 and automatically drop into the next apertures 20. To retract the section 6, the process is simply reversed. Suitable markers can be provided on the several sections to indicate to the operator when they are at desired intermediate positions. Extension and retraction of the section 6 and locking can be accomplished by the operator without leaving his cab.

Having the pins 19 retractable by means of the override springs 35 provides an important safety feature in the event of blockage of the pins 19 for any reason. In the event of such blockage, the tracks 42 will simply ride past the cams 37 causing compression of the springs 35 without retraction of the pins 19, and upon noticing this the operator can cure whatever problem exists. If there were in effect a direct physical connection between the tracks 42 and pins 19 retraction of the third section when the pins 19 were blocked would result in physical damage to the elements.

The enlarged heads 46, and resulting shoulders 48, on the pins 19 serve, in effect, to prevent extension or retraction of the section 6 unless the motor 8 has been activated. That is, whether the section 6 is extended or retracted there will always be some slippage as the result of gravity which will cause any aperture 20 to move from the precisely aligned position shown in FIG. 4 to a position in which one edge of the aperture is against the neck 45 in which event the shoulder 48 will be against the inside of the wall 25 on one side and prevent retraction from the pin 19. Movement of the rollers 37 over the tracks 42 during such misalignment will simply result in compression of the springs 35. This is important in at least two cases. First, when the section 6 has been extended and the section 3 is retracted for working or prior to retraction of section 6, the pins 19 would ordinarily automatically be retracted, and if the drive motor 8 had not been actuated the section 6 could simply slide inwardly. Similarly, normal extension of the section 3 when the operator desires to use only the main sections would ordinarily retract the pins 19 which could allow the section 6 to fall out. Because of the inherent slippage-caused misalignment, however, the pins 19 can only be brought into perfect alignment with the apertures 20 by slight movement of the section 6, which can only be initiated by actuation of the motor 8. Thus, as a practical matter, the operator is required to actuate the motor 8 before the section 6 can be unlocked.

Although a preferred embodiment of the invention has been shown and described herein, it will be apparent that variations in structure and application are possible without departure from the spirit of the invention. The invention is not, therefore, intended to be limited by the showing herein or in any other manner, except as specifically required by the following claims.

I claim:

1. In an extensible boom including an inner main section and an extensible and retractable outer main section and drive means to extend and retract the outer section with respect to the inner section,

the improvement wherein the boom also includes:

an extension section that is supported by and extensible and retractable with respect to the outer section and provided with at least one transverse lock aperture; separate drive means to extend and retract the extension section, lock means carried by the outer section, said lock means including a lock pin which faces the extension section and is movable between an extended position in which it is received in the lock aperture to lock the extension section in place and a retracted position in which the extension section is freed, bias means to urge the lock pin toward extended position, and a cam follower outside the outer section which is associated with and operable to move the pin to retracted position; and a cam track connected to the inner section of the boom and positioned to engage and operate the cam follower carried by the outer section when the outer section is near its fully retracted position; wherein the extension section is moved relative to said outer section with said separate drive means and said extension section is unlocked from said outer section for such movement by the operation of the cam follower when the outer section is moved relative to the inner section to bring said cam track into engagement therewith.

2. A boom according to claim 1 wherein: the lock means includes a sleeve fixed to and extending transversely through the outer section and having an open inner end facing the extension section and an outer end provided with a shoulder; and the lock pin is reciprocally slidable in the sleeve and has a body portion in the sleeve and a reduced stem which projects outwardly through the outer end of the sleeve and is provided with an abutment at its outer end; and the bias means comprises a relatively light compression spring seated between the pin body and the sleeve shoulder; and there is a freely axially movable housing disposed concentrically around the sleeve which has an open outer end disposed around the stem abutment and an inner end provided with an inwardly turned ledge; and there is a relatively heavier override spring disposed within the housing around the sleeve which is seated between the stem abutment and housing ledge; and the cam follower is mounted on the outside of the housing and is operatively engageable by the cam track to be moved away from the outer section.

3. A boom according to claim 1 wherein the outer and tip sections are capable of relative slippage movement; and lock aperture is in a wall of the extension section; and the pin has an enlarged inner end which passes through the lock aperture with a relatively close fit and is disposed on the inner side of the wall when the pin is extended to define a shoulder which is engageable with the inside of the wall to prevent retraction of the pin.

4. A boom according to claim 1 wherein the lock means and cam track are disposed near the outer ends, respectively, of the outer and inner sections, the cam track thus being operatively engageable with the cam

follower only when the outer section is substantially retracted.

5. A boom according to claim 4 wherein the extension section is provided with at least two aligned lock apertures located near its inner and outer ends to define, respectively, extended and retracted positions of the extension section; and the cam track is adapted to move between the cam follower and the outer section and has a V-configuration defining an apex facing the follower and which is adapted to move the follower laterally away from the outer section, the track being movable past the follower in either direction, the lock pin being retracted when the follower is approximately at the apex of the track; and the elements are positioned such that the track apex is ahead of the follower when the outer section is fully retracted.

6. A boom according to claim 5 wherein: the lock means includes a sleeve fixed to and extending transversely through the outer section and having an open inner end facing the extension section and an outer end provided with a shoulder; and the lock pin is reciprocally slidable in the sleeve and has a body portion in the sleeve and a reduced stem which projects outwardly through the outer end of the sleeve and is provided with an abutment at its outer end; and the bias means comprises a relatively light compression spring seated between the pin body and the sleeve shoulder; and there is a freely axially movable housing disposed concentrically around the sleeve which has an open outer end disposed around the stem abutment and an inner end provided with an inwardly turned ledge; and there is a relatively heavier override spring disposed within the housing around the sleeve which is seated between the stem abutment and housing ledge; and the cam follower is mounted on the outside of the housing and is operatively engageable by the cam track to be moved away from the outer section.

7. A boom according to claim 6 wherein there are two cam followers mounted on opposite sides of the housing and two aligned cam tracks each engageable with a respective follower; and there is a key and slot connection operatively interposed between the housing and the outer section which allows free axial movement of the housing but prevents rotational movement thereof.

8. A boom according to claim 7 wherein the outer and tip sections are capable of relative slippage movement; and lock aperture is in a wall of the extension section; and the pin has an enlarged inner end which passes through the lock aperture with a relatively close fit and is on the inner side of the wall when the pin is extended to define a shoulder which is engageable with the inner side of the wall to prevent retraction of the pin.

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