Dec. 19, 1967 W. M. GUINN 3,359,559

IMPULSE-TYPE TELESCOPING ANTENNA

Filed Nov. 29, 1963 2 Sheets-Sheet 1

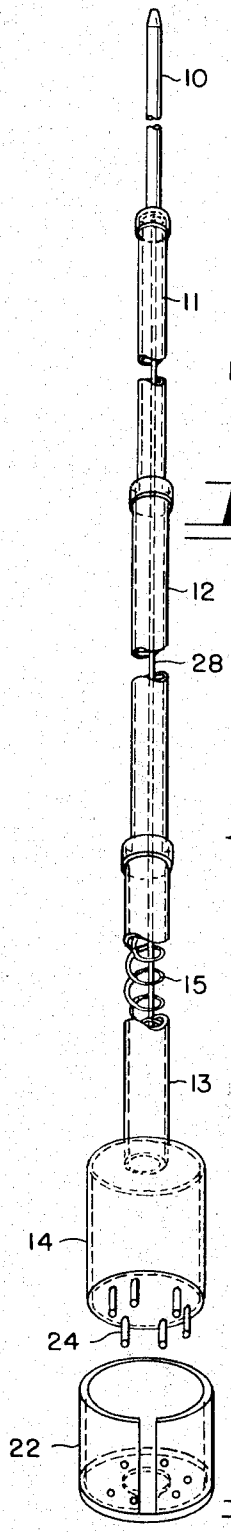


Fig 4

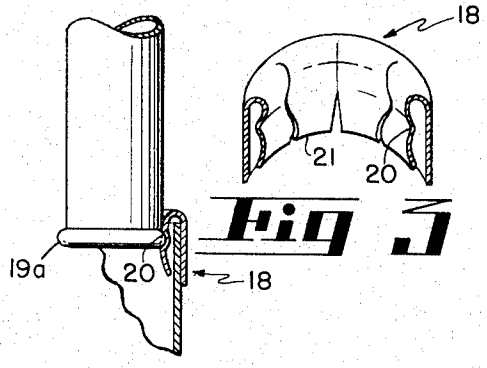


Fig 3

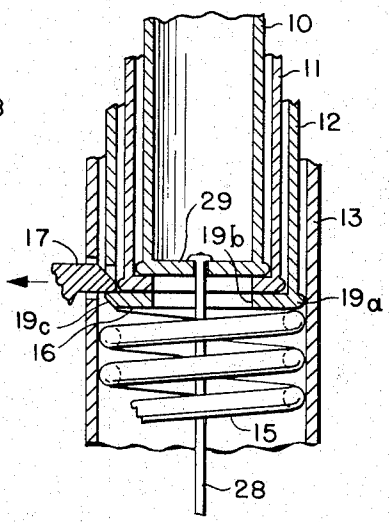
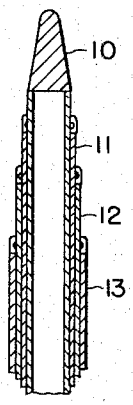


Fig 2



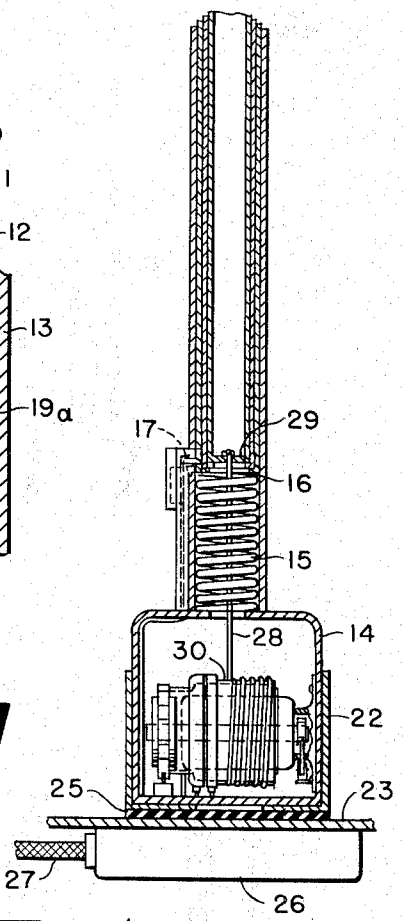


Fig 1

Fig 5

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IMPULSE-TYPE TELESCOPING ANTENNA

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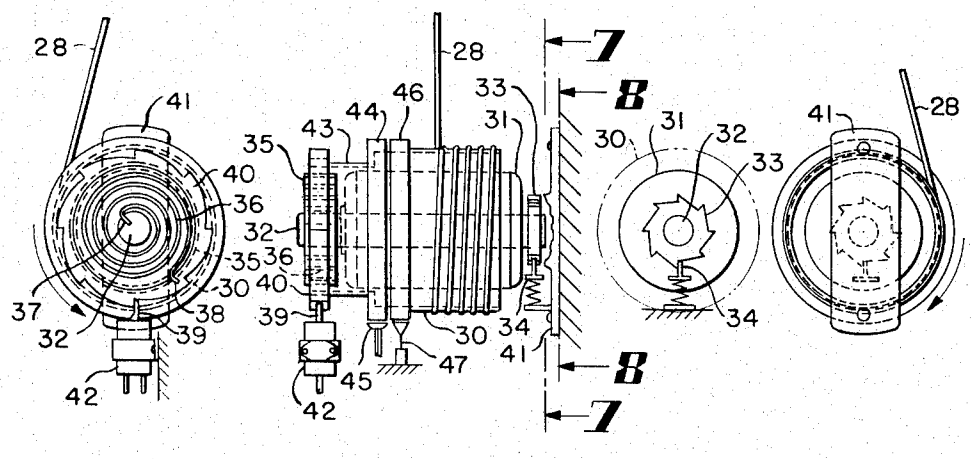


Fig 9 Fig 6 Fig 7 Fig 8

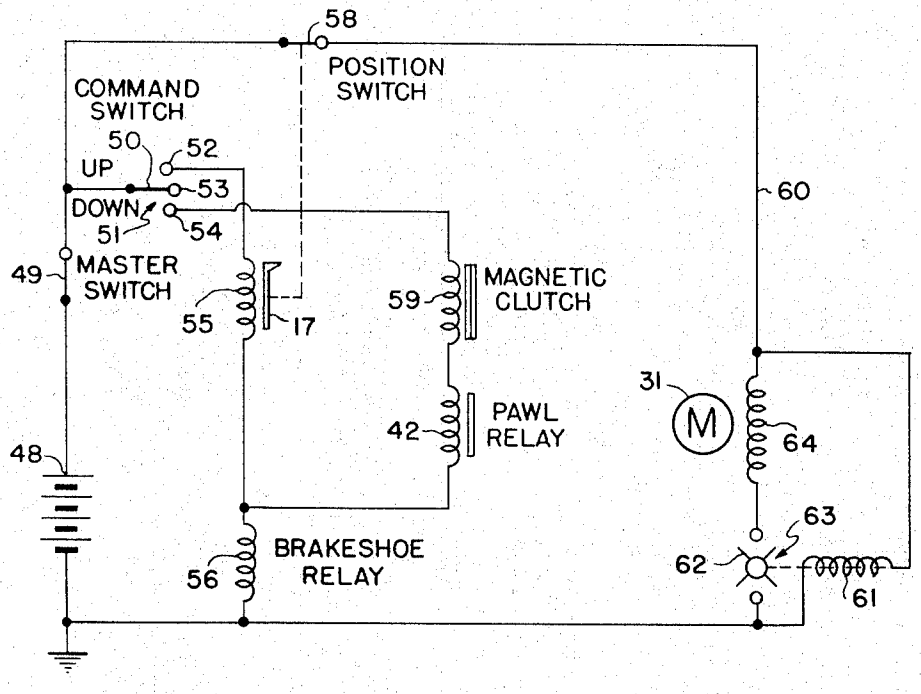


Fig 10

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United States Patent Office 3,359,559 Patented Dec. 19, 1967

3,359,559

IMPULSE-TYPE TELESCOPING ANTENNA

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Filed Nov. 29, 1963, Ser. No. 326,660
11 Claims. (Cl. 343—901)

ABSTRACT OF THE DISCLOSURE

The disclosed apparatus includes a telescoping antenna. The various sections of the antenna are projected into an extended position by a compressible coil spring and retracted by means of an overpowering spiral spring. The spiral spring, which is energized by an electric motor, serves to energize the coil spring during antenna retraction.

The present invention relates to impulse-type telescoping devices, and particularly to telescoping antennas which may be rapidly extended and retracted by triggered means.

A broad object of the invention is to provide a telescoping device, the sections of which may be extended or retracted at high speeds in response to either manual or automatic control.

A specific object of the invention is to provide a vehicular antenna which may be rapidly retracted to prevent damage to the antenna when the vehicle encounters overhead obstructions, and rapidly re-erected to minimize loss of signal intelligence.

A further object is to provide an antenna of the type described which may be quickly mounted on or demounted from the frame of a vehicle.

For a better understanding of the invention, together with other objects, advantages, and capabilities thereof, reference is made to the accompanying drawings, in which:

FIG. 1 is an elevational view, partially in cross section, of a vehicular antenna in accordance with the invention, this view showing the antenna in its retracted state;

FIG. 2 is an enlarged view of a portion of FIG. 1, showing in detail the bases of the antenna sections and their relation to each other in the retracted state;

FIGS. 3 and 4 show the means by which the sections of the antenna are locked together in the erected state, FIG. 3 being a perspective view, partially cut away, of the spring-fingered collar secured to the upper extremity of an antenna section, and FIG. 4 being an elevational view showing how the base of the section of next smaller diameter mates with this collar;

FIG. 5 is a perspective view of the erected antenna, with the individual antenna sections partially broken away;

FIG. 6 is an enlarged view of the antenna mechanism housed within the base block of FIG. 1;

FIG. 7 is a cross-sectional view taken along the line 7—7 of FIG. 6 and looking in the direction of the arrows;

FIG. 8 is a sectional view taken along the line 8—8 of FIG. 6 and looking in the direction of the arrows;

FIG. 9 is an elevational view looking toward the left side of FIG. 6; and

FIG. 10 is a circuit schematic showing the electrical components for the erection and retraction of the antenna.

The invention described visualizes an antenna comprising four tubular telescoping sections, the antenna having a length of approximately twelve feet in the erected state and slightly less than four feet when retracted.

Referring to FIGS. 1 and 2, the physical construction

of the telescoped sections and their relation to each other will first be described in detail.

The tubular sections **10–13** are preferably fabricated of fiberglass and conductively coated to function as the radiator element. The innermost section **10** may or may not be solid or closed at its upper end, as the particular application indicates. The outer or largest diameter section **13** is securely fastened to a soft iron block **14** forming a base for the antenna. Located within the outer tubular section **13** is a helical spring **15** compressed between the upper surface of base block **14** and the base **16** of tubular section **12** adjacent section **13**. Spring **15** is preferably of beryllium copper composition, for both a non-magnetic long life spring element and a low resistance electrical conductor.

In the retracted state illustrated in FIGS. 1 and 2, the spring **15** is maximally compressed, and the inner sections **10** and **11** are resting loosely within section **12**. A hold-down latch **17** restrains the base **16** of section **12**, and hence the spring **15**. When the hold-down latch **17** is triggered to release the base **16**, the spring **15** applies a sudden impulse to the three inner sections **10, 11, 12**, and they are impelled upwardly until captured by locking devices incorporated in the mating ends of the sections. It might be said that the antenna is "shot" erected. Preferably the spring rises in contact with the base of section **12** to its full extent, although a shorter spring would suffice for the motive power in most cases.

The upper end of each section, except the innermost section **10**, is provided with a split collar **18** having annularly spaced spring fingers **21** formed with an annular depression **20** (FIG. 3). This collar, secured directly to the upper end of the section, is coated with a conducting material so that the mated sections serve as a continuous electrical radiator. The bases of the intermediate sections **11** and **12** are formed with a slightly thickened rim portion having shoulders **19*a*** and **19*b***, as shown in FIGS. 2 and 4. While the base of section **10** is here shown as closed, it might alternatively be open-ended and provided with a shoulder **19*b*** as are the other movable sections of the antenna.

When the sections are propelled upwardly, the shoulder **19*a*** at the base of each section is captured by and mates within the depression **20** in the spring fingers of collar **18** of the section beneath it (FIG. 4). The fingers **21** (FIG. 3) are formed and biased in such manner as to support a downward force of several times that required to mate the sections in the forward, or upward, direction.

The antenna as erected is shown in FIG. 5, the ends of the fully extended sections being mated and the spring **15** being under minimum tension. This figure also illustrates how the antenna may be readily mounted or demounted, the base **14** of the antenna being constructed for rapid insertion in or withdrawal from a magnetic socket **22** provided on the frame **23** of the vehicle, the socket maintaining the antenna in its mounted position. Electrical leads **24** project through the base of socket **22**, an insulating disk **25**, and the vehicle frame **23** to provide circuit connections for the various elements located within block **14** to electrical components located within a housing **26** beneath the frame of the vehicle (FIG. 1). A conductor **27** leads to a source of power supply (not shown).

Referring again to FIGS. 1 and 2, it will be seen that a line **28** extends from the base **29** of the innermost tubular section **10** to a reel **30** on which line **28** is wound. Retracting the antenna sections with minimum "down" time is accomplished by "reeling in" line **28** on the reel **30** with a force sufficient to overcome the locking action of the spring-fingered collars mating the sections and to compress spring **15**. That is to say, as the base **29** of

section **10** is pulled downwardly, the shoulder **19***a* of its rim portion strikes the shoulder **19***b* of section **11** immediately beneath it, breaking its connection with the spring-fingered collar of section **12**. The rim portion of section **11**, driven by the downward force of base **29**, in turn strikes the rim portion at the base of section **12**, breaking its connection with the collar **18** of section **13** and impelling section **12** downwardly with sufficient force to compress spring **15**, spring **15** inherently acting as a shock absorber.

As seen in FIG. 2, the shoulder **19***a* of section **12** is beveled at **19***c* to complement the sloping face portion of latch **17**. Latch **17** is spring-biased inwardly so that, in its normal position (i.e., when it is not held in a vertical position by engagement with base **16**), it is inclined slightly to the right of the position shown in FIG. 2.

When the downwardly propelled sections approach the fully retracted state, the portion **19***c* of base **16** slides over the sloping face portion of latch **17**, forcing the latch outwardly (to the left, FIG. 2) until base **16** slips beneath the latch, whereupon the spring bias of latch **17** forces it inwardly to capture and restrain base **16** and hence maintain spring **15** under maximum compression until an "up" command is given.

Each step of the sequence just described takes place in a fraction of a second, the entire "down" time for the particular antenna shown being on the order of milliseconds.

The apparatus for driving the reel **30** to retract the antenna sections is shown in FIGS. 6–9. Referring first to FIG. 6, there is shown an electric motor **31** for driving a shaft **32**. One end of shaft **32** is provided with a ratchet **33** which rides freely over a stationary pawl **34** in one direction (clockwise, as illustrated in FIG. 7) but is restrained by pawl **34** from turning in the opposite direction.

At the opposite end of shaft **32** is mounted a cylinder **35** housing a spiral spring **36**, one end of which is fixed to shaft **30** and the other end of which is connected to the cylinder housing **35** (as indicated at **37** and **38**, respectively, FIG. 9). Except when a command is given to retract the antenna sections, cylinder **35** is held stationary by a pawl **39** engaging a ratchet **40** fixed on the outer periphery of cylinder **35**. When the motor **31** is energized, shaft **32** turns in a clockwise direction (FIGS. 7 and 8), tightening spring **36**, one end of which is attached thereto, to the limit of its tension, whereupon motor **31** stalls and is de-energized. Pawl **34** prevents counterclockwise rotation of shaft **32**, pawl **39** prevents clockwise rotation of cylinder **35**, and spring **36** remains at maximum tension until the "down" command is given.

In FIG. 9, which is a view looking toward the left side of FIG. 6 and therefore opposite in a rotational sense to FIGS. 7 and 8, there are shown: a motor mounting plate **41** (see also FIGS. 6 and 8); the spiral spring **36**; the shaft **32** to which one end of spring **36** is attached at **37**, and the cylinder **35** to which the other end of the spring is attached at **38**; the ratchet **40** and the pawl **39**, together with a relay **42** for withdrawing pawl **39** when the "down" command is given.

As seen in FIG. 6, the cylinder **35** is connected to, or integral with, a hollow cylindrical housing **43** into which one end of motor **31** projects, the opposite end of housing **43** terminating in the driving element **44** of a magnetic clutch, the driven element **46** of which is positioned on the adjacent end of cylinder **30**. When a "down" command is given and pawl **39** is withdrawn, permitting cylinder **35** to spin in a counterclockwise direction (FIG. 9) in response to the force of spring **36**, driving clutch element **44** is simultaneously energized through brush-type slip rings **45**, and magnetically clutches the clutch element **46**, driving reel **30** counterclockwise to rewind line **28**.

The reference numeral **47** in FIG. 6 designates a brake-shoe provided to prevent undesired rotation or

oscillation of reel **30**. That is to say, when travel of the sections in either direction is abruptly terminated, either by mating of the sections as they are propelled upwardly or by the engagement of latch **17** with base **16** of section **12** when they are retracted, further rotation of reel **30** is instantaneously stopped by brake-shoe **47** to forestall backlash of the line **28**.

The control circuit for the antenna is shown diagrammatically in FIG. 10. The circuit includes a battery **48**, or other convention source, connected through a master control switch **49** to a command switch **51** having a contact blade **50**, an "up" contact **52**, a "neutral" position contact **53**, and a "down" contact **54**. The switch **51** is a momentary switch, making connections at contacts **54** and **52** for very short predetermined periods of time.

The "up" contact **52** is connected to ground through an antenna latch relay **55** which serves when energized to withdraw the spring-biased latch **17**, and a brake-shoe relay **56** which when energized serves to operate the brake shoe **47**.

The "down" contact **54** is connected to ground through winding **59** of the magnetic clutch element **44**, relay **42** of pawl **39**, and brake-shoe relay **56**.

The battery **48** is also connected through a position switch **58** and lead **60** across the winding **64** of motor **31** and a Ledex-type switch **63** having four circumferentially-spaced contacts **62** on its rotor. The operating relay **61** for the switch **63** is connected across the motor winding **64**. The Ledex-type switch is such that the rotor rotates 45 degrees each time a current of predetermined magnitude flows through the relay winding **61**. The position switch **58** is coupled to the latch **17** and is closed only when latch **17** engages the antenna section **12**.

A cycle of operation is now described.

Let it be assumed that the antenna is in its retracted condition with master switch **49** closed.

When the "up" command is given, blade **50** of command switch **51** moves from the neutral position contact **53** to contact **52**, momentarily closing the circuit to energize antenna latch relay **55** and brake-shoe relay **56**. Relay **55** pulls latch **17** outwardly, releasing the base **16** of section **12** and permitting all of the sections with the exception of section **13** to be propelled upwardly by the motive force of compression spring **15**. Simultaneously relay **56** withdraws the normally engaged brake-shoe **47**, so that reel **30** rotates freely as line **28** unwinds.

When the blade **50** of momentary switch **51** returns to neutral position contact **53**, relays **55** and **56** are de-energized, brake-shoe **47** stops rotation of reel **30**, and latch **17** assumes its inwardly inclined position.

All of the elements remain in the positions just described so long as the antenna is extended. The "down" command is given by moving blade **50** of command switch **51** to contact **54**, whereupon relays **59**, **42**, and **56** are energized. Relay **59** activates the magnetic clutch between clutch driving element **44** and driven element **46**, relay **42** withdraws pawl **39** from ratchet **40**, and relay **56** withdraws the brake-shoe **47** from reel **30**, whereupon the antenna sections are propelled downwardly until captured and restrained by latch **17**. Immediately thereafter blade **50** of command switch returns to neutral position **53**, and relays **59**, **42**, and **56** are de-energized. Since latch **17** is again engaging antenna section **12**, position switch **58** closes.

Closing of position switch **58** completes the circuit between the battery and a relay winding **61** (FIG. 10). Current flowing through relay winding **61** causes the rotary contacts **62** of the Ledex-type switch **63** to rotate through 45 degrees, bridging the spaced contacts of the switch **63**. Relay **61** being a high-resistance, low-current winding, and motor coil **64** a low-resistance, high-current winding, current now flows through motor coil **64**, starting the motor. Motor **31** continues to run until the load of spring **36** causes it to stall. When the motor stalls, current again builds up in relay winding **61** and causes the rotary con-

tacts 62 of switch 63 to rotate through another 45 degrees, opening the circuit to motor winding 64. The antenna has now completed a full cycle of operation.

While a medium-length antenna comprising four sections and having a height of approximately twelve feet has been selected to describe the principles of the invention, it will of course be understood that additional sections and also sections of somewhat greater length might be employed, the only factor limiting the length of the extended antenna being the combined weight of the sections working against the load of the spring 15. It is within the scope of the invention to provide an extended antenna of fifty feet or more in height. In the illustrative twelve-foot antenna herein described, a maximum section diameter of one and one-fourth inches would provide sufficient strength for reliable operation.

Triggering of the erection and retraction operations may be either manual or automatic. In simple applications, control by the vehicle operator is practicable, after the manner of making turn-indication signals. In applications where this would not be practicable—say, under the rigors of modern tactical service—obstruction sensors may be incorporated in the system to provide completely automatic operation.

While the invention has been described with specific reference to a vehicular antenna, it will be obvious that the principles may be employed in any environment where rapid extension and retraction of a telescoping device is desirable. For example, the invention would have utility as applied to periscopes, flag standards, and similar extensions on moving vehicles which would be endangered when obstructions are encountered.

While there has been shown and described what is at present considered to be the preferred embodiment of the invention, it will be obivous to those skilled in the art that various modifications and changes may be made therein without departing from the true scope of the invention as defined by the appended claims. For example, the means for propelling the sections upwardly is here shown as a compression spring, but it is within the scope of the invention to employ alternatives such as hydraulic or pneumatic pressure as the source of motive power. Further, the latch herein shown as located adjacent the outer wall of the section of largest diameter and as holding down the base of the section of next larger diameter, might alternatively be located inwardly of the spring 15 and so oriented as to engage the base of the section of smallest diameter.

What is claimed is:

1. In a vehicular radio antenna, the combination of:
a base;
a first tubular section rigidly secured to said base;
a plurality of tubular sections of successively smaller diameters nested within said first tubular section and axially movable with respect thereto;
a first source of motive power for propelling all of said movable sections upwardly;
means for releasably locking the lower end of each movable section with the upper end of the section of next larger diameter when the sections are propelled upwardly;
and a second source of motive power for disengaging the mated ends of said sections and propelling said movable sections downwardly.

2. A vehicular radio antenna in accordance with claim 1 in which said base is comprised of magnetic material, and a fixedly-mounted magnetic socket for receiving and supporting said base.

3. The combination in accordance with claim 1 in which the first source of motive power comprises a compression spring located concentrically within the first tubular section.

4. The combination in accordance with claim 1 in which the means for releasably locking the lower end of each movable section with the upper end of the section of next larger diameter comprises a flange on the lower end of each movable section and a spring-fingered collar on the upper end of the section of next larger diameter.

5. The combination in accordance with claim 1 in which the second source of motive power is a wound spiral spring.

6. In a telescoping antenna including a base, a first tubular section secured to said base, and a plurality of tubular sections of successively smaller diameters telescoped within said first tubular section and axially movable with respect thereto, means for high-speed propulsion of said movable sections outwardly into an extended position and inwardly into a retracted position, said means comprising:
a compression spring located concentrically within said first tubular section and axially between said base and the inward end of the section of next smaller diameter;
means for latching said movable sections to maintain said spring under compression;
means for releasing said latch to release the motive force of said spring to propel said movable sections outwardly;
means for releasably locking the inward end of each section with the outward end of the section of next larger diameter to arrest the travel of said movable sections when they are propelled outwardly;
a reel;
a line wound on said reel and connected to the section having the smallest diameter, said reel rotating freely in one direction as said movable sections are propelled outwardly;
means for rotating the reel in the opposite direction to rewind the line;
and means on the inward end of each movable section for engaging the inward end of the section of next larger diameter;
whereby, as the reel is rotated in the opposite direction to rewind the line, the section of smallest diameter is driven inwardly with a force sufficient successively to release the locked ends of the sections, recompress said spring, and again latch said sections.

7. The invention as defined in claim 4 and means for recharging said second source.

8. The invention as defined in claim 7 wherein said means for recharging said second source comprises a motor coupled to said shaft, said motor being energizable for rotating said shaft in said one direction.

9. A telescoping antenna comprising:
a plurality of nested tubular antenna sections of decreasing diameters;
a source of motive power for longitudinally propelling said sections outwardly;
means for releasably locking one end of each propelled section with the opposite end of the section having the next larger diameter as the sections are propelled outwardly, whereby said sections are propelled into and maintained in an extended position;
and means for retracting said propelled sections, said means comprising a second source of motive power engageable, on the occurrence of a second command signal, with said smallest diameter section for driving said smallest diameter section inwardly, and means on each of said sections for engaging a succeeding section to successively drive said sections inwardly into their retracted position.

10. In an automatically retractable and extendible antenna having a plurality of tubular telescoping antenna sections, the combination comprising:
a first dischargeable motive source coupled to said sections;
means for abruptly discharging said motive source for outwardly propelling said sections from a retracted position toward an extended position;

means for successively restraining each of said sections in said extended position;

a second dischargeable motive source coupled to said sections;

means for abruptly discharging said second motive source for driving said sections toward said retracted position and for recharging said first source;

means for restraining said recharged first source;

said second dischargeable source comprising a wound spiral spring, the inner end of which is connected to a shaft, the outer end of which is connected to a concentric cylinder;

a reel;

a line connected between said reel and said sections;

a clutch coupling said cylinder and said reel upon occurrence of a command for rotation of said reel in one direction;

means for restraining rotation of said shaft in the opposite direction;

and releasable means for releasably restraining rotation of said cylinder in said one direction, said releasable means being released upon the occurrence of said command.

11. In an automatically retractable and extendible antenna having a plurality of tubular telescoping antenna sections, the combination comprising:

a first dischargeable motive source coupled to said sections;

means for abruptly discharging said motive source for outwardly propelling said sections from a retracted position toward an extended position;

means for successively restraining each of said sections in said extended position;

a second dischargeable motive source coupled to said sections;

mean for abruptly discharging said second motive source for driving said sections toward said retracted position and for recharging said first source;

means for restraining said recharged first source;

said second dischargeable source comprising a wound spiral spring, the inner end of which is connected to a shaft, the outer end of which is connected to a concentric cylinder;

a reel;

a line connected between said reel and said sections;

a clutch coupling said cylinder and said reel upon occurrence of a command for rotation of said reel in one direction;

means for restraining rotation of said shaft in the opposite direction;

and releasable means for releasably restraining rotation of said cylinder in said one direction, said releasable means being released upon the occurrence of said command.

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