Jan. 9, 1962 J. H. CONE 3,016,206

ANTENNA

Filed May 22, 1956 3 Sheets-Sheet 1

Fig. 1

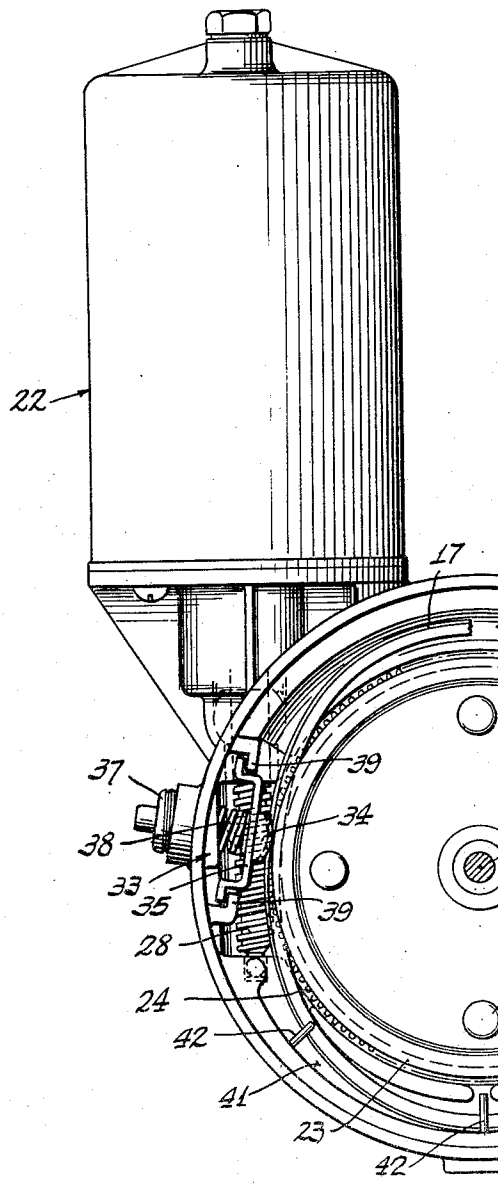
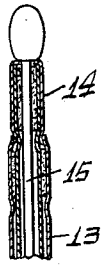


Fig. 2



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Fig. 3

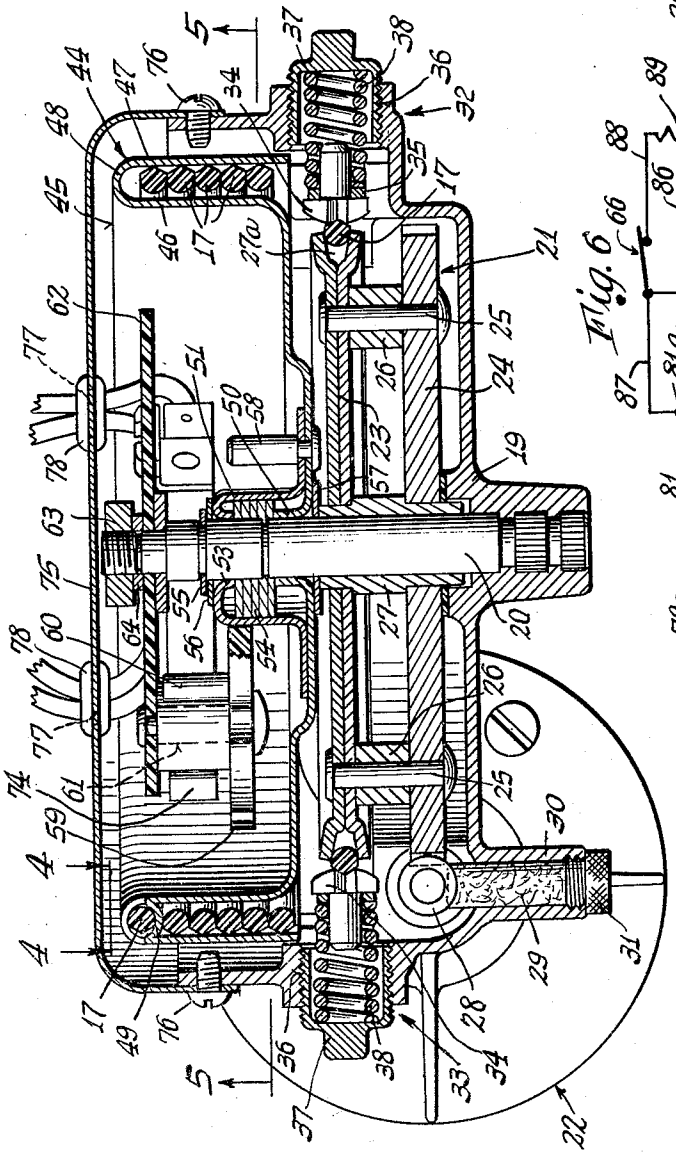


Fig. 6

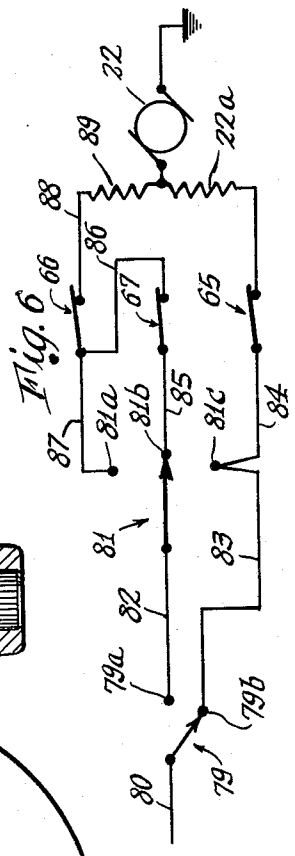
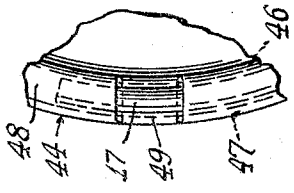


Fig. 4



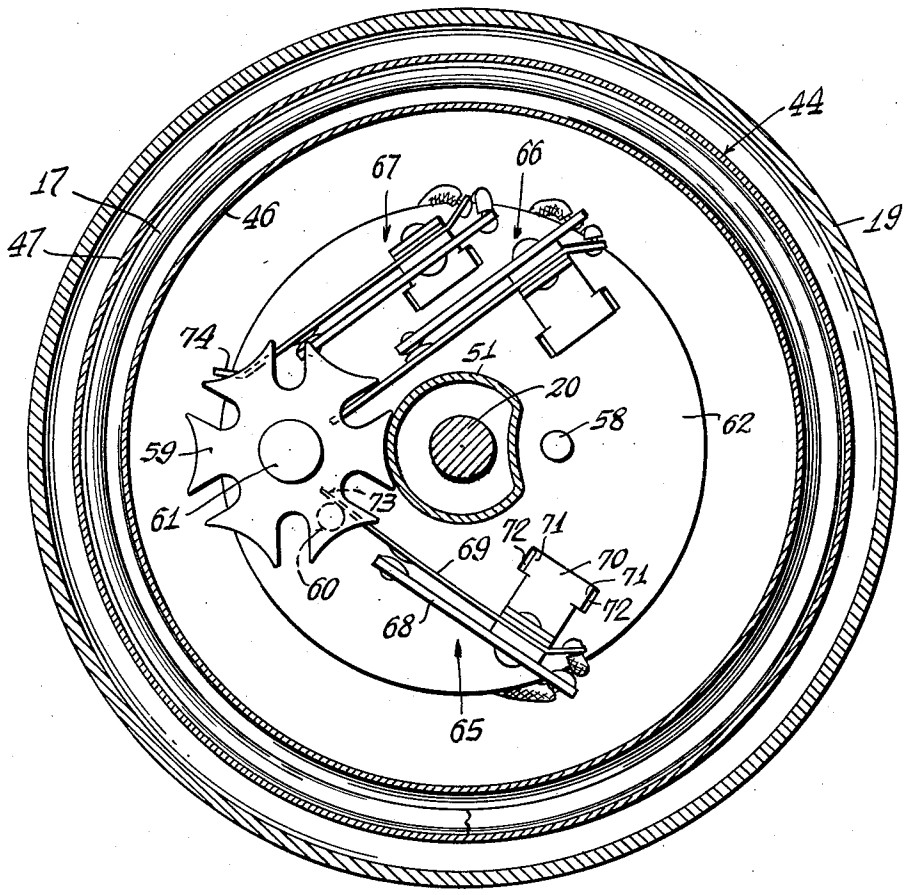
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Fig. 5



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3,016,206

ANTENNA

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Filed May 22, 1956, Ser. No. 586,485
16 Claims. (Cl. 242—54)

This invention relates to an extensible and retractable antenna and more particularly to the type of antenna in which a flexible rod is used to motivate the antenna sections.

An object of this invention is to provide an antenna of the above type in which there is sufficient frictional engagement between the flexible rod and its actuating element to cause motivation of the antenna sections, but in which the frictional engagement is insufficient to prevent manual moving of the antenna sections.

Another object of this invention is to provide an actuating mechanism for the driving of the flexible rod of an antenna in which substantially the same magnitude of force as that used to extend the antenna is utilized to retract the antenna, thereby minimizing malfunctioning of the unit, increasing the life thereof and enabling usage of more economical elements.

A further object of this invention is to provide a driving mechanism for the sections of an antenna of the type referred to above in which the power transmitted to the flexible rod is derived solely by friction and in which the amount of power is a function of the frictional engagement caused only by friction inducing elements.

It is another object of this invention to provide, in an antenna of the above-disclosed type, automatic controls for ceasing the movement of the antenna at its most retracted position, at its most extended position and at a position intermediate thereof which is sufficient for normal radio reception, but which is low enough to avoid the striking of objects such as garage doors, ceilings, low hanging tree branches, etc.

It is a further object of the invention to provide an antenna in which the automatic controls respond to the position of the antenna and not to the position of the driving mechanism. Hence manual operation of the antenna sections cannot change the position at which the power-driven movement of the antenna ceases.

Heretofore, in antennas having a flexible rod for actuating the sections and frictional engagement with the periphery of a driving pulley for causing movement of the rod, difficulty has been encountered during the retraction of the antenna by the rod binding itself on the pulley. Such action causes the motor either to stall or causes stripping of the gears between the motor and the driving pulley whenever a greater than normal force is required, which may occur if the sections have dirt or grit etc. accumulated thereon. In addition thereto, during extension of the antenna, the rod tends to release itself from the pulley which decreases the force transmitted from the pulley to the rod and may actually cause the rod to slip on the pulley and the antenna not to be extended.

According to the present invention, a feature thereof is the provision of spring elements for causing engagement of the rod with the driving pulley in order to make the force transmitted during extension of the antenna substantially equal to the force transmitted during retraction. This is accomplished by providing engagement of the driving pulley and the rod at substantially only two spaced points and of maintaining the rod spaced from the pulley between these points whereby a capstan or self-loading effect during retraction and an unloading effect during extension are obviated. The rod is maintained spaced from the pulley by guide means which in effect displaces

the center of the loop of the rod from the center of the pulley thereby creating substantially straight sections of the rod at the two diametrically spaced points where it contacts the pulley.

Another feature of the invention is the provision of a drum on which the portion of the flexible rod which is not in the antenna sections is stored, and in which amount of rotation of the drum is controlled solely by the amount of rod in the drum. Automatically controlled switches actuated by the drum are, accordingly, responsive solely to the height of the antenna section as determined by the amount of rod stored in the drum to control the movement of the antenna.

Other features and advantages will hereinafter appear.

In the accompanying drawing:

FIG. 1 is an elevation partly in section of the antenna comprising the present invention.

FIG. 2 is a section of the upper portion of the antenna.

FIG. 3 is a section of the driving and storing mechanism for the flexible rod.

FIG. 4 is a detail taken on the line 4—4 of FIG. 3.

FIG. 5 is a view taken on the line 5—5 of FIG. 3 showing the automatic control mechanism.

FIG. 6 is a schematic diagram of the electrical system of the antenna.

Referring to the drawing, there is shown in FIGS. 1 and 2, an antenna comprising an elongate tubular casing **10** having attached thereto an antenna lead-in wire fitting **11**. A stationary elongate tubular antenna section **12** is mounted within the casing **10** and telescoping outer, central and inner antenna sections **13**, **14** and **15** respectively, are mounted for movement within the section **12**. The casing **10** is provided, adjacent its upper end, with a threaded portion **16** which may be used, for example, for fastening the antenna to an automobile body, in the manner that is well known in the art.

The innermost antenna section **15** is preferably in the form of a solid rod and is actuated by an elongate flexible driving element or rod **17** which is attached to the lowermost end of the section **15** by a connector **18**. The rod **17** may be advantageously formed of a plastic material, such as fibre forming polymeric amide. The flexible rod **17**, according to the present invention is frictionally driven by the periphery of a driving pulley which, in turn, is actuated by a reversible electric motor. A portion of the rod which is not in the antenna sections is stored in a freely rotatable reel, mounted adjacent the driving pulley so that a compact, efficient unit is realized.

Referring to FIG. 3, there is provided a housing or frame **19** having a fixed crossed shaft **20**. A gear and pulley assembly which transmits the power from a reversible electric motor **22** is generally indicated by the reference numeral **21**. This assembly consists of a driving pulley **23** and a gear **24**, which preferably may be of plastic material. Rivets **25** interconnect the two parts while spacing washers **26** encircle the rivets to maintain the parts in the desired spaced relation. A hub **27** provides bearing surfaces between the assembly **21** and the cross-shaft **20**. The periphery of the driving pulley **23** is circular and is formed to have a cross-sectional wedge-shaped opening **27***a* into which the flexible rod **17** is biased. The motor **22** is provided with a worm **28** which mates with the gear **24** to drive the pulley at a reduced speed. In contact with the worm **28** is a lubricating wick **29** positioned in a hollow boss **30** while a cap **31** closes the opening in the boss.

According to the present invention, the flexible rod **17** would normally have insufficient engagement with the driving pulley **23** to cause movement of the antenna sections, and thus, spring means are provided to cause sufficient frictional engagement of the rod **17** with the pe-

riphery of the driving pulley 23 so that the motor power can be transmitted to the rod to actuate the antenna sections. Two pressure devices 32 and 33, spaced diametrically opposite each other are provided. Each pressure device preferably consists of a pressure stud 34 which may be press fitted into a pressure arm 35. A tapped opening 36 is provided in the housing 19 and a threaded cap 37 is screwed therein. A spring 38 circumscribes the pressure stud and abuts against the cap 37 so that the pressure of the spring on the arm and stud can be adjusted by movement of the cap 37. A pair of abutments 39 are provided, preferably integrally cast with the housing 19 to limit movement of the pressure devices. By having the pressure devices diametrically opposed and substantially equal to the radial force of one is opposed and balanced by the other and there is thus eliminated any composite radial force on the bearing 27 which would tend to cause misalignment between the bearing and the shaft 20. Such a construction permits a more economical bearing and shaft structure since there is no unbalanced load on the cross shaft and a longer life of the antenna is assured.

As shown in FIG. 1, the flexible rod 17 has one end connected to the antenna section 15 by way of connector 18 and is led through a straight conduit 40 to the periphery of the driving pulley 23. The conduit 40 and the periphery are in the same plane and the conduit is aligned so as if extended it would be substantially tangential to the periphery of the pulley 23. The pressure device 32 is angularly displaced slightly below the point of tangency and constitutes a feature of the present invention. It has been found that if the pressure stud 34 is located at the point of tangency, a combination of manufacturing tolerances may cause the rod to be further wedged into the opening 27*a* to cause the rod and the conduit 40 to be out of line which would deform the rod 17 and tend to unload the pressure stud. While in the presently disclosed location, the rod 17, due to its tendency to straighten out after engagement of the pressure stud 34, is continuously biased against the pressure stud 34 and into engagement with the periphery without deforming the rod, which enables tolerances to be larger with a consequent reduction in the cost of manufacture.

When a friction driving pulley is utilized to actuate a flexible rod, the rod tends to wrap itself more tightly against the periphery due to a self-loading action when retracting, and when extending, tends to unload itself from the periphery and thus more force is transmitted between the pulley and the rod when retracting than when extending. This is objectionable because the driving motor and the connections between the driving pulley and the motor have to be of such strength that they can transmit the higher force; if they are not, then the unit is subject to malfunctioning. If an abnormal force is needed to retract the antenna as when there is grit, scum, etc., on the antenna sections or they become bent, then the motor is apt to stall and burn out or cause stripping of the gears or other destructive results may occur, demolishing the unit. However, according to the present invention, the extending and retracting forces are made substantially equal and are governed substantially solely by the pressure of the pressure devices 32 and 33 on the rod. In accomplishing this, there is provided a guideway 41 located in the path of movement of the flexible rod 17, between the pressure devices 32 and 33. This guideway maintains the flexible rod out of engagement with the periphery of the driving wheel except at the pressure devices 32 and 33. The guideway is formed integrally with the housing 19 and has pins 42 for preventing movement of the rod axially of the pulley. The guideway is coplanar with the periphery of the driving pulley 23 and is somewhat circular with a larger radius than the pulley. Moreover, it is shaped to reduce friction between the sides and the rod as clearly shown in FIG. 1.

After the flexible rod 17 passes the pressure device 33, it is guided by a helical channel 43 into the storing unit 44.

The storing unit 44 maintains the stored portion of the rod 17 in a helix. In accomplishing this, there is provided a drum or reel 45 having inner and outer extending axial side walls 46 and 47 and a connecting bight portion 48. The side walls are spaced apart sufficiently to freely receive each convolution but not enough to allow the convolutions to overlap.

As shown in FIG. 3 and FIG. 4, a small segment of the bight portion 48 is stamped inwardly as at 49 so that the end of the flexible rod 17 may be inserted therein and then the bight portion is crimped to fasten the rod to the reel.

The reel is annular and has a stamped central section to provide an opening and an annular flange 50. An annular reenforcing element 51 is preferably provided and has a radial flange 53 providing a bearing surface on the shaft 20. A strengthening washer 54 is preferably interposed between the flange 50 and the flange 53 to provide rigidity. A retaining ring 55 and a steel washer 56 maintain the reel in the desired location on the shaft while another washer 57 is interposed between the hub 27 and the reel 45. Accordingly, the reel is mounted for free rotation on the shaft 20 but the rotation is controlled by the rod.

The amount of stored rod in the reel is directly related to the height of the antenna and is utilized to control automatic switches for stopping actuation of the driving motor 22 when the antenna has reached preselected positions. Utilization of the reel 45 to control the device, rather than the rotation of the pulley 23 obviates malfunctioning of the unit whenever the antenna sections are manipulated by hand. Also any slippage between the driving pulley and the rod 17 does not disturb the relationship of the automatic switches to the height of the antenna. In accomplishing this, there is provided in the instant embodiment, a Geneva movement which serves to actuate three control switches. One switch serves to stop the motor when the antenna reaches its fully retracted position, another switch serving to stop the motor when the antenna reaches its fully extended position and a third switch for stopping the motor when the antenna reaches a position suitable for normal radio receiving but which is below the fully extending position so that the antenna will not hit obstructions as, for example, low hanging branches or tops of garages, or garage doors, etc. A pin 58 is riveted to the reel 45 for engagement with a star wheel 59. It will be apparent that as the reel 45 rotates, each revolution will index the star wheel 59 a determinate angular distance. The star wheel carries a cam which, in the embodiment shown, is a pin 60 for actuating the aforementioned automatic control switches. The star wheel 59 is mounted for free rotation on a shaft 61 carried by a plate 62. The plate 62 is mounted on the shaft 20 and is held in position by a nut 63 and a lock washer 64 so that the plate will not rotate on the shaft 20. The plate 62 has also mounted thereon a down-limit switch 65, a fully-extended switch 66 and a normally extended switch 67. Referring to the switch 65, there is provided a stationary contact 68 and a flexible contact 69. These contacts are insulatedly mounted on an angle 70 having tabs 71 which project through slots 72 in the plate 62 and are bent over to fasten the switch in position. The contact 69 is biased so as to be normally in engagement with the contact 68 and has an extended portion 73 which is engaged by the pin 60 of the star wheel 59 to open the contacts. Switch 66 is similarly constructed while switch 67 is provided with a bent portion 74 on the flexible contact which provides for actuation of the switch by the pin 60 but does not limit movement of the pin 60 beyond the portion 74.

A cover 75 is fastened as by screws 76 to enclose the housing 19. The cover is provided with two holes 77 in which are positioned grommets 78 through which the electrical leads to the switches are led into the interior of the housing.

Referring to FIG. 6, there is shown a schematic diagram of the electrical controls of the instant invention. In this embodiment, the manual control may be actuated by the position of the radio "on-off" switch. This manual switch which may be ganged to the radio switch so that one knob operates both is provided with a single-pole double-throw switch **79** in which there is a lead **80** connectible to the positive side of a source of electricity. There is also provided a single-pole, triple-throw position determining switch **81** which is manually operative to override the switch **79**. A lead **82** connects contact **79***a* of switch **79** to the switch arm of the switch **81**. A contact **79***b* by a lead **83** is connected to contact **81***c* of switch **81**. A lead **84** connects the switch **65** to the down field **22***a* of the motor **22** and then to the ground. A lead **85** is connected from contact **81***b* of switch **81** to one terminal of switch **67** while the other terminal, by a lead **86**, is connected to a terminal of switch **66** as is contact **81***a* of switch **81** by means of lead **87**. A lead **88** connects the other terminal of switch **66** through the up-coil **89** of the reversible motor **22** and then to the ground.

In operation of the device the radio switch **79** is shown in its "off" position, i.e., in engagement with the contact **79***b* which through the lead **83**, contact **81***c*, lead **84**, switch **65** and to the down-field of the motor **22** will cause the antenna to be retracted upon turning the radio off and the circuit will be broken by the down-limit switch **65** when the antenna is fully retracted. With the switch **81** in engagement with contact **81***b* and with the radio turned from "off" to "on," current can flow to the lead **80**, contact **79***a*, lead **82**, contact **81***b*, lead **85**, switch **67**, lead **86**, switch **66**, lead **88**, up-coil **89** and to the ground to cause the antenna to be extended to its normal intermediate position upon turning the radio on. If desired, movement of the switch **81** to engagement with the contact **81***a* will bypass switch **67** and cause the antenna to be fully extended until the circuit is broken by the opening of switch **66**. Furthermore, if desired, movement of the switch **81** so that it is in contact with contact **81***c* would cause the antenna to retract even with the radio on. Where it is desired to use only two limit switches, namely the fully retracted switch **65** and the fully extended switch **66**, the manual position determining switch **81** may be eliminated.

There has thus been disclosed an automatic antenna in which the antenna sections are retracted upon turning the radio off and in which the antenna sections are extended to a normal receiving height suitable for use near broadcasting stations, but which is low enough to avoid the striking of the antenna against low hanging objects. Additionally, the antenna when desired may be either fully extended or completely lowered, irrespective of the radio switch.

There is furthermore, in the specific embodiment described, an antenna in which a flexible rod is utilized to actuate the antenna sections in which a friction driving means is employed to actuate the antenna with substantially the same amount of force applied to extend the antenna as to retract it. In addition, by reason of the illustrated construction, oil, dirt, etc., on the flexible rod fails to effect the operation of the antenna since two spaced pressure devices create the necessary frictional engagement between the driving pulley and the flexible rod.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. An extensible and retractable antenna comprising an antenna section mounted for telescoping movement into and out of a stationary, tubular section; a flexible rod connected to the antenna for actuating the section upon longitudinal movement of the rod; a rotatable pulley mounted to have portions of its periphery in engagement with the rod; motor means connected to the pulley to rotate same; pressure means located at not more than two spaced points adjacent the periphery of the pulley, for causing sufficient frictional engagement between the pulley and the rod only at the spaced points where the pressure means is located so that the pulley may actuate the rod; and means for preventing frictional engagement between the rod and the periphery of the pulley except at each spaced point.

2. The invention as defined in claim 1 in which the pressure means is located at two spaced points diametrically opposed to each other and exert substantially equal pressure whereby the radial force on the pulley of one is substantially opposed by the radial force of the other.

3. The invention as defined in claim 2 in which the pressure means consists of two studs; each stud having a head shaped to conform to the adjacent surface of the rod; an arm on which the stud is mounted; a spring engaging the arm for biasing and moving the stud into frictional engagement with the rod; and stop means for limiting the movement of the stud.

4. The invention as defined in claim 1 in which the pressure means includes a spring and in which there are means for adjusting the pressure of the spring.

5. The invention as defined in claim 1 in which there is a frame on which the stationary antenna section is mounted and in which the rotatable pulley is mounted; a straight conduit extending between the stationary antenna section and the interior of the frame, said conduit being aligned such that an extension thereof would be substantially tangential to the periphery of the pulley; in which the pressure means consist of two elements positioned diametrically of the pulley, and in which one of the elements is slightly angularly displaced from the point of tangency away from the conduit.

6. An extensible and retractable antenna comprising an antenna section mounted for telescoping movement into and out of a stationary tubular section; a flexible rod connected to the movable section for actuating the latter upon longitudinal movement of the rod; a pulley mounted to have its periphery in engagement with the rod; motor means connected to the pulley to rotate same; pressure means including not more than two pressure elements located at two spaced points adjacent the periphery for causing sufficient frictional engagement between the pulley and the rod only at the spaced points so that the pulley may actuate the rod; and means for guiding the rod away from the pulley after it leaves a pressure element and toward the pulley as it approaches a pressure element.

7. An extensible and retractable antenna comprising an antenna section mounted for telescoping movement into and out of a stationary tubular section; a flexible rod connected to the movable section for actuating the latter upon longitudinal movement of the rod; a pulley mounted to have its periphery in engagement with the rod; pressure means for causing the pulley periphery to be in driving frictional engagement with the rod; motor means connected to the pulley to rotate same; and guide means for maintaining the rod spaced from the periphery of the pulley except at not more than two spaced predetermined positions.

8. The invention as defined in claim 7 in which pressure means are located at both predetermined positions for causing sufficient frictional engagement between the pulley and the rod so that the pulley may actuate the rod at these positions.

9. An extensible and retractable antenna comprising an antenna section mounted for telescoping movement into and out of a stationary, tubular section; a flexible rod connected to the movable section for actuating the latter upon longitudinal movement of the rod; a pulley adapted to have its periphery in engagement with the rod; pressure means for causing the pulley periphery to be in driving frictional engagement with the rod; motor means connected to the pulley to rotate same; and means limiting the amount of frictional engagement between the rod

and the pulley to not more than two spaced points so that the rod may, when the antenna section is manually moved, slide on the pulley.

10. The invention as defined in claim 9 in which the periphery of the pulley is circular and in which the means limiting the amount of frictional engagement is a substantially circular guideway having a radius larger than that of the pulley and substantially coaxial therewith and adjacent thereto and in which the guideway extends for less than 180 degrees.

11. An extensible and retractable antenna comprising an antenna section mounted for telescoping movement into and out of a stationary section; a flexible driving rod connected to the antenna section; electrical motor means for longitudinally moving the rod and hence the antenna section; and a circuit including the motor, leads connectible to a source of power, switch means responsive to the position of the antenna section for stopping the motor either at a position prior to the antenna section reaching its fully extended position or at a position when the antenna section is fully extended, and a manually operated switch for selecting at which position of the antenna section the motor is stopped.

12. An extensible and retractable antenna comprising an antenna section mounted for telescoping movement into and out of a stationary section; a flexible driving rod connected to the movable section; electrical motor means for longitudinally moving the rod and hence the antenna section; a circuit including leads connectible to a source of power, switch means actuated by movement of the driving rod for stopping the motor either at a position where the antenna is fully retracted, at a position where the antenna is fully extended or at a position prior to the antenna section reaching its fully extended position, and a manually operated switch for selecting at which position of the antenna section the motor is stopped.

13. The invention as defined in claim 12 in which there is a rotatable reel for storing the rod, and in which the switch means is actuated by the reel.

14. An extensible and retractable antenna comprising an antenna section mounted for telescoping movement into and out of a stationary section; electrical motor means; means driven by the motor for longitudinally moving the movable section; and a circuit including the motor, leads connectible to a source of power, two switches with each being connected when actuated to deenergize the motor; means for actuating one switch only when the antenna is fully extended and for actuating the other switch only when the antenna is at a partially extended position; and a manually operated switch connected in the circuit for selecting one or the other of the two switches to deenergize the motor when said selected switch is actuated.

15. An extensible and retractable antenna comprising an antenna section mounted for telescoping movement into and out of a stationary tubular section; a frame having a straight conduit extending from the interior thereof into the stationary section; a flexible rod having one end attached to the movable section; a pulley mounted on the interior of the frame and having its periphery tangential to the axis of the conduit; a reversible electric motor and means connecting the motor to the pulley to rotate the same and for preventing rotation of the pulley except in response to actuation by the motor; two pressure studs positioned adjacent the periphery of the pulley at diametrically spaced points; adjustable spring means for causing the pressure studs to be biased toward the pulley and for causing portions of the rod to engage the pulley to enable the pulley to frictionally drive the rod; a guideway located between the pressure studs for maintaining the rod spaced from the portions of the pulley between the pressure studs; a drum mounted for free rotation and having the other end of the rod attached thereto; a helical channel formed in the frame leading from the pulley to the drum to guide the rod from the pulley to the drum; said drum having a pin cooperating with a rotatable star wheel to form a Geneva movement; a cam carried by the star wheel and movable in a circular path as the drum receives or unloads the stored portion of the rod; three normally closed switches having actuating elements disposed in predetermined locations in the path of travel of the cam; and a circuit including the electric motor, the switches, leads connectible to a source of power, a manually operated switch for selecting the stopping position of the motor either at a position where the antenna is fully retracted by closing said circuit to the motor by one of the normally closed switches, or at a position where the antenna is fully extended by closing said circuit to the motor by another of the normally closed switches or at a position prior to the antenna section reaching its fully extended position by closing said circuit to the motor by the third of the normally closed switches and a selecting switch for stopping the motor by the one of the normally closed switches independently of the manually operated switch.

16. An extensible and retractable antenna comprising an antenna section mounted for telescoping movement into and out of a stationary section; a flexible driving rod connected to the movable section; electrical motor means for longitudinally moving the rod and hence the antenna section; a circuit including leads connectible to a source of power, a manual operating switch and switch means for stopping the motor independently of the manual switch at a position where the antenna is fully retracted, at a position where the antenna is fully extended and at a position prior to the antenna section reaching its fully extended position, a reel for storing the rod, in which the switch means is responsive to the amount of rod stored in the reel, and in which the reel has a hub and pin cooperating with a star wheel to form a Geneva movement and the star wheel carries a cam for actuating the switch means.

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