June 18, 1940. J. K. DE ARMOND ET AL 2,204,579

ANTENNA REEL MECHANISM

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FIG. 1.

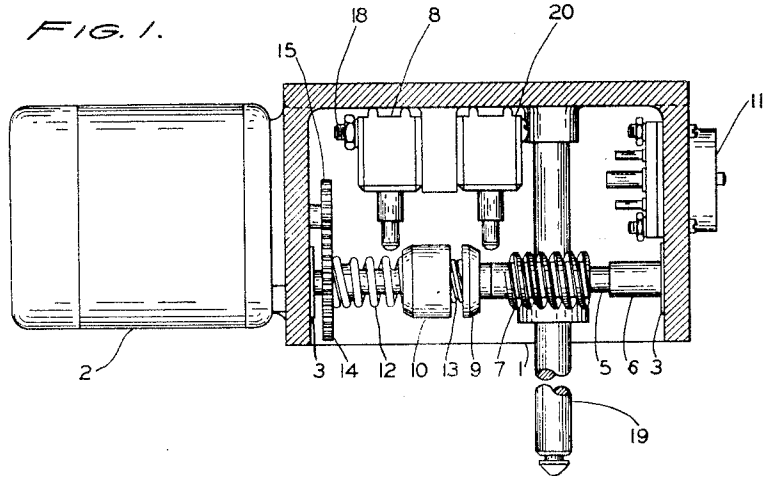
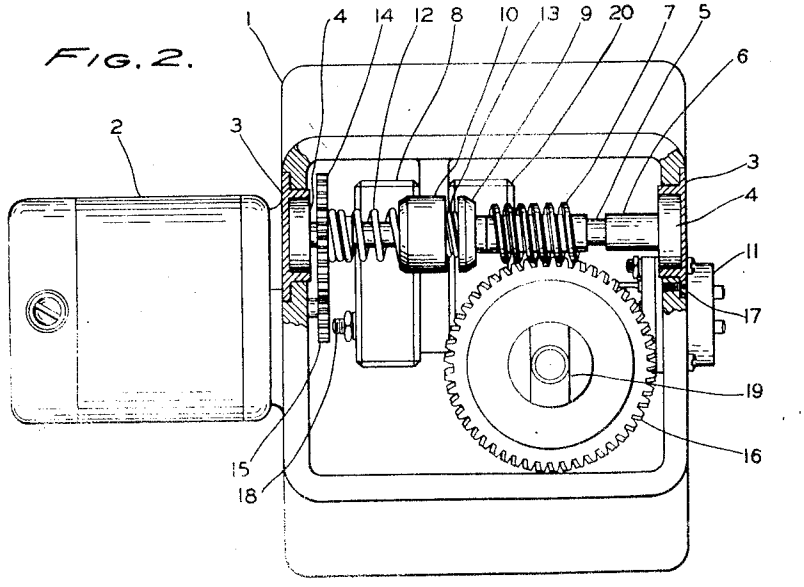


FIG. 2.



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ANTENNA REEL MECHANISM

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FIG. 3.

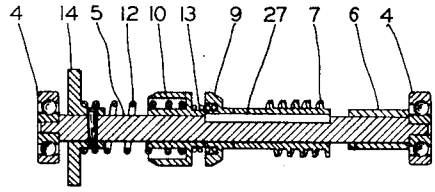


FIG. 4.

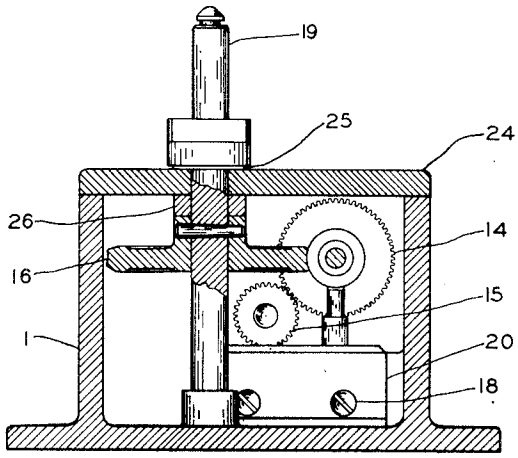
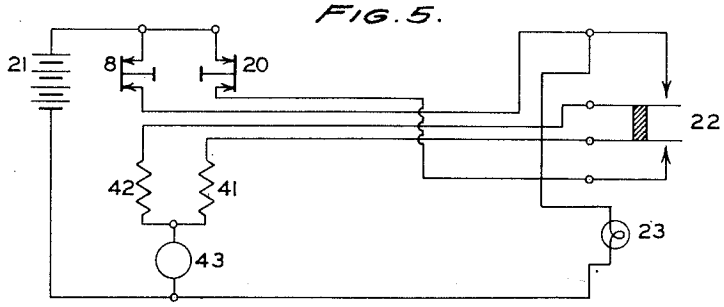


FIG. 5.



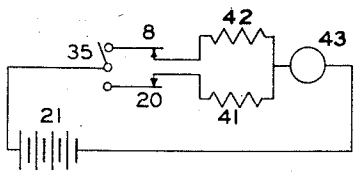


FIG. 6.

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FIG. 7.

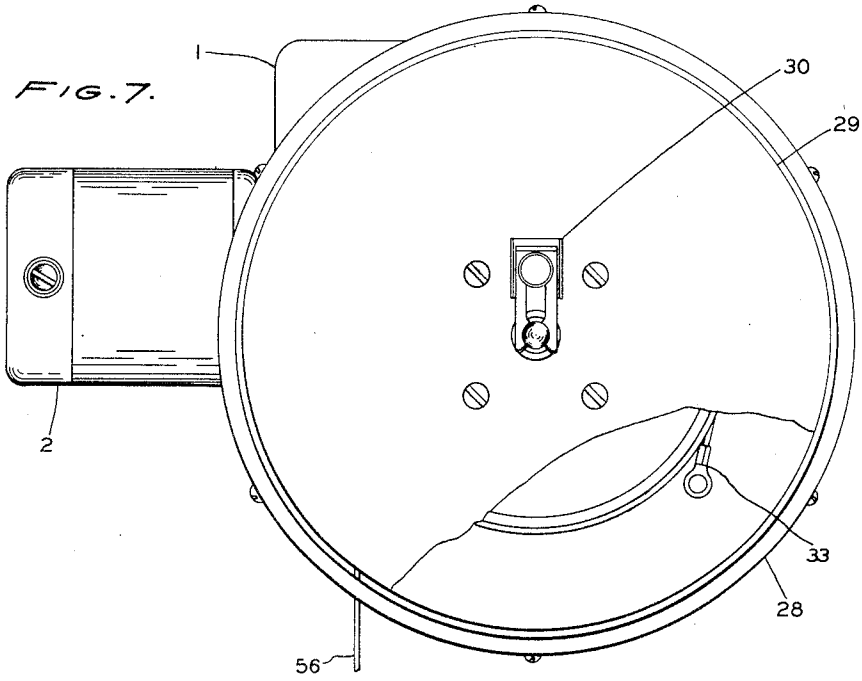
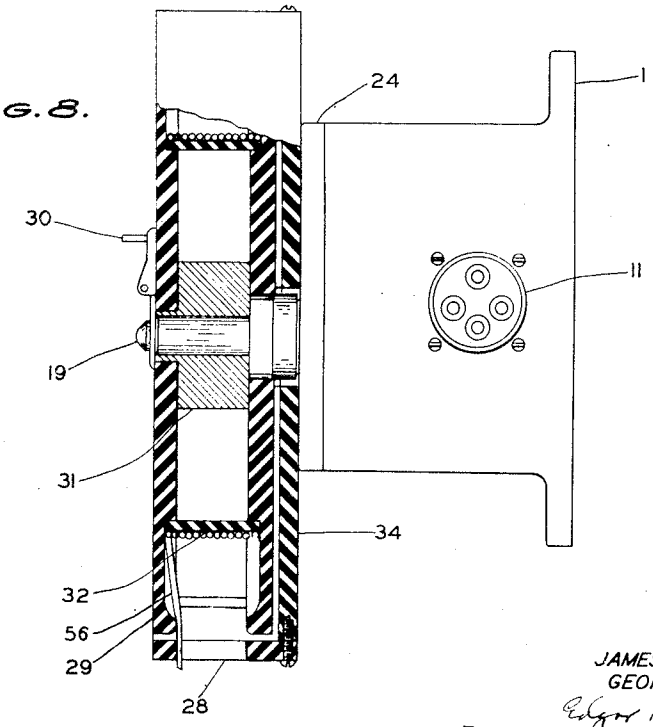


FIG. 8.



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ANTENNA REEL MECHANISM

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FIG. 9.

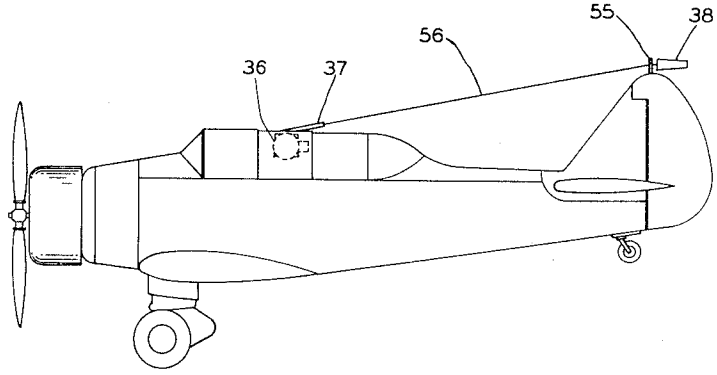
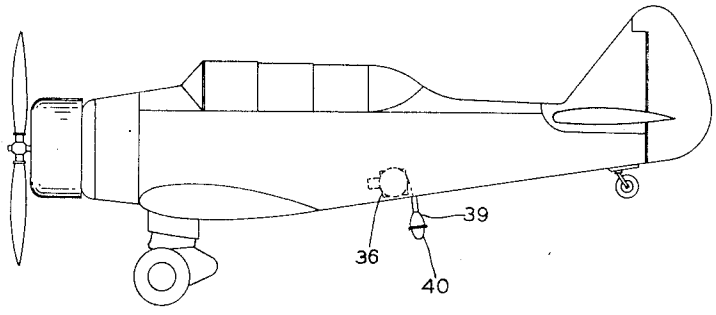


FIG. 10.



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ANTENNA REEL MECHANISM

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FIG. 11.

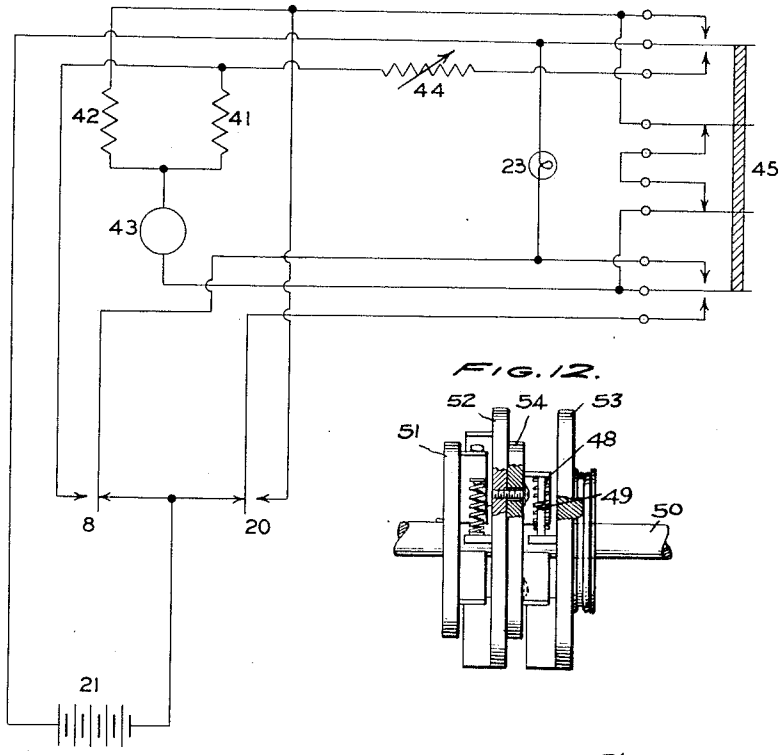


FIG. 12.

FIG. 13.

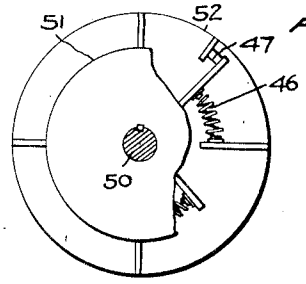
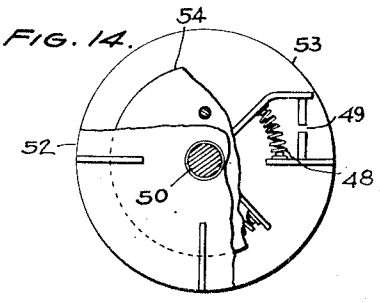


FIG. 14.



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Patented June 18, 1940 2,204,579

UNITED STATES PATENT OFFICE

2,204,579

ANTENNA REEL MECHANISM

James K. De Armond and George L. Haller,
Dayton, Ohio

Application December 15, 1939, Serial No. 309,411

24 Claims. (Cl. 242—101)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to us of any royalty thereon.

This invention relates to an antenna reel mechanism and proposes an improved device of this class for winding and unwinding a weighted antenna wire of the trailing type. The principles of the invention apply to similar mechanisms for use on aircraft in which a wire or cable is to be reeled out and in, such as antistatic discharge wires, tow targets, mail or package collecting hooks and the like.

One object of this invention is to unreel the wire or cable as long as some predetermined tension is maintained on said wire or cable. This feature will automatically stop the unreeling mechanism in case the wire or cable jams in the fairlead, or if for any other reason the wire or cable fails to pay out of the airplane. It will also prevent the complete unspooling of the wire or cable if the manual control switch is thrown to the "out" position when the airplane is on the ground.

An object of the invention is the automatic stopping of the reel mechanism when the full load of wire or cable is payed out. In this way the length of a radio antenna can be predetermined for a specific frequency, and when the wire is completely reeled out, the antenna system is automatically tuned to that frequency.

An object of the invention is the automatic stopping of the reel mechanism when the wire or cable has been completely retracted; and another object is the automatic stopping of the reel mechanism, while retracting the wire or cable, when a predetermined length of wire or cable remains unreeled.

Another object of the invention is the retracting of the wire or cable, and automatically holding the fully or partially retracted wire or cable under a predetermined spring tension.

Another object of this invention is to adjust the length of reeled out wire or cable by retracting or ejecting the wire or cable in small increments. This feature is useful in such operations as tuning an antenna to a definite frequency of operation by adjusting its length.

An object of this invention is to provide electrical braking on the automatic stop control while the reel mechanism is ejecting the wire or cable. This feature prevents overrunning of the reel when the mechanism is stopped with the wire or cable all out. Another object is to provide electrical braking of the reel mechanism when the mechanism is automatically stopped after the wire or cable is retracted. This feature allows the retracted spring tension to be better adjusted.

Another object of the invention is to provide electrical braking of the reel mechanism when the manual control is changed from the ejecting position to the stop position. This feature minimizes the overrunning of the reel, when stopped from the ejecting operation, and equalizes such overrunning with the overrunning of the reel mechanism when stopped manually from the retracting operation. This equalization also provides a more accurate adjustment of the length of the wire in tuning or other operations.

Another object of this invention is to provide a warning light which is extinguished only when the wire or cable is in the automatically stopped retracted position.

An object of the invention is to provide lips on the reel bobbin flanges which prevent the wire or cable piling up on these flanges and cause the wire or cable to wind on the bobbin more evenly; and another object is to provide a simple method of making the reel bobbin detachable for rapid replacement of reel bobbins and wire or cable. Other objects of the invention will appear as the description proceeds.

In the drawings:

Fig. 1 is a top view of the antenna reel mechanism with the case sectioned;

Fig. 2 is a side view of the antenna reel mechanism with case cover removed;

Fig. 3 is a longitudinal section of the worm driving shaft with springs and cams;

Fig. 4 is an end view, partly in section, of the reel mechanism;

Fig. 5 is an electrical wiring diagram of the automatic reel including the manual control switch and the warning light which indicates whenever any wire is not retracted;

Fig. 6 is an elementary electrical wiring diagram of the automatic reel mechanism including the manual control switch;

Fig. 7 is a side view of the automatic reel complete with the wire or cable bobbin and protective cover;

Fig. 8 is an end view of the automatic reel, with the wire or cable bobbin and protective cover in partial section;

Fig. 9 is a view of a typical automatic antenna reel installation in an airplane, in which a predetermined length of wire remains out when the reel is in its automatic retracted position. This portion of the wire which remains unretracted

can be used as a fixed radio antenna during landing and take-off operation;

Fig. 10 shows a view of a typical automatic antenna reel installation, in which a weight is used at the end of the wire, and said weight and wire are shown in the fully retracted position, with said weight held snugly in the fairlead under spring tension;

Fig. 11 shows a complete electrical wiring diagram of the automatic reel mechanism in which the features of electric braking and warning light are included; and

Figs. 12, 13 and 14 are views of an alternative spring and contact system which may replace the keyed worm and worm wheel, and perform the same automatic functions previously described.

Figs. 1 to 4, inclusive, 7 and 8 illustrate one practical embodiment of the invention. A housing 1, which is to be fastened to the airplane at some convenient location, is provided with a boss to mount the series reversible electric motor 2 upon the shaft of which is fastened spur gear 15. Housing 1 is also provided with two bearing retainers 3, held in place by screw 17, in which are mounted two ball bearings 4 which support shaft 5. Mounted on shaft 5 is a sleeve 6, a worm 7, an "out stop" cam 9, a light spring 13, an 'in stop" cam 10, a heavy spring 12, and the spur gear 14 which is in mesh with the motor spur gear 15. The "in stop" switch 8 and the "out stop" switch 20 are mounted in place on the housing by means of bolt and nut 18. In the housing is also mounted a plug 11 through which the electric connections are taken to the control switch. The worm 7 is meshed with the worm wheel 16 which is fastened to the shaft 19. The shaft 19 is centered by means of the spacing washers 25 and 26 bearing on the housing cover 24. A wire or cable spool made up of a keyed aluminum core 31, a Bakelite spool 32, Bakelite flanges 29, is mounted on shaft 19 and held in place by means of the snap slide 30 engaging on the end of shaft 19. The spool must rotate with shaft 19 as the core 31 engages with the keyed portion of the shaft 19. The wire or cable 56 is fastened to the spool by soldering or otherwise fastening to the swivel terminal 33. A spool housing and wire guard made of Bakelite tubing 28 and Bakelite disc 34 is mounted on the gear housing cover 24.

A cross sectional view of the shaft and cam assembly is shown in Fig. 3. This assembly works as follows: The shaft 5 is mounted in and rotates upon ball bearings 4. Spur gear 14 is firmly pinned to the shaft 5 and forms a stop for the heavy spring 12 which is pushing against "in stop" cam 10, which is otherwise free to slide along shaft 5 in a direction to the left or toward the spur gear 14 against the compression of said spring 12, but is shown in its extreme travel toward the worm 7 being stopped by key 27 which is firmly fastened to shaft 5. The "out stop" cam 9 and the worm 7, which may be made in one place, are provided with a key-way which allows longitudinal travel along the shaft 5, but causes the worm to rotate with shaft 5 by means of key 27. The extreme travel of the worm 7 and the "out stop" cam 9 away from the spur gear 14 is limited by the sleeve 6. The light spring 13 tends to keep the worm 7 and the "out stop" cam 9 in contact with sleeve 6, but is shown in Fig. 3 with spring 13 collapsed due to some force on worm 7 toward spur gear 14, but not sufficient force to overcome the initial compressive strengtfl of spring 12.

The elementary electrical circuit diagram, Fig. 6, shows the motor as the armature 43 and the two series fields 41 and 42, the power source or battery 21, the manual control switch 35, the automatic "in stop" switch 8 and the automatic "out stop" switch 20.

The operation of the reel is described as follows: Assume that the wire or cable 56 is partially reeled out. The wire or cable 56 has been wound on the spool 32 in such a direction that the tension of the wire or cable 56, due to its weight and any other weight or drag device, such as is commonly used and well known to the art, is such that it tends to produce counter-clockwise rotation of shaft 19, and consequently the same rotation of worm wheel 16 (see Fig. 2). This tension causes worm 7 and "out stop" cam 9 to move toward spur gear 14, collapsing light spring 13. The motion of "out stop" cam 9 is limited by contact with 'in stop" cam 10, as the heavy spring 12 has enough initial compressive strength to overcome the load produced by the tension of the wire or cable 56, due to its weight and drag device. Placing manual control switch 35 in the down position, Fig. 6, sends current from the battery 21 through the "out stop" switch 20, the field 41, and the armature 43. This current causes the motor 2, Fig. 2, to rotate in such direction that spur gear 15 rotates with top going. This motor spur gear 15 is in mesh with spur gear 14 which is caused to rotate with top coming. This rotation is transmitted to the shaft 5 and hence to worm 7 which causes worm wheel 16 to rotate in a counter-clockwise direction reeling out the wire or cable 56 on spool 32. Assuming that the control switch is left in this position, the wire or cable 56 continues to be reeled out until no more wire remains on the reel. The end of the wire or cable 56 is fastened to swivel terminal 33. As soon as the terminal 33 passes bottom dead center with the wire or cable 56 all out, the tension of the wire or cable 56 and drag device reverses its rotational pull on shaft 19 which is transmitted by worm wheel 16 to worm 7 as a thrust toward sleeve 6 allowing spring 13 to thrust "out stop" cam 9 in a direction toward bearing 6. (Note if out-stop cam were made in one piece with worm 7, spring 13 would be unnecessary for this particular action). The outer face of "out stop" cam 9 in moving toward bearing 6, contacts the plunger of automatic "out stop" switch 20, which forces the plunger of the automatic "out stop" switch 20 in a direction away from shaft 5 and breaks the electrical circuit, which causes the motor 2 to stop rotating spur gear 15. We now have the wire or cable 56 all out with the motor 2 de-energized.

Now assume manual switch 35, Fig. 6, is thrown in the up position, sending current from battery 21 through the "in stop" switch 8, the field 42 and the armature 43. This causes the motor 2, Fig. 2, to rotate in such direction that spur gear 15 rotates with top coming. This action causes spur gear 14 and worm 7 to rotate with top going. This rotation of worm 7 causes worm wheel 16, shaft 19, and the reel bobbin assembly to rotate in a clockwise direction. As soon as the reel bobbin makes a part of a revolution, the swivel terminal 33 passes bottom center and the tension of the wire or cable 56 and drag device, causes worm 7 and "out stop" cam 9 to travel along the shaft 5, collapsing light spring 13, until "out stop" cam 9 contacts "in stop" cam 10. This motion of "out stop" cam 9 allows the plunger of the out stop switch 20 to resume its

normal position, which makes the switch circuit. This causes no change in the present operation of the motor, which continues reeling in the wire or cable **56**. (The out circuit has been de-energized by manual control switch **35**.) The mechanism continues to reel in the wire or cable **56** until the wire or cable **56** is all reeled in, and the weight **40** is tight in the fairlead **39**, Fig. 10, or the drag device **38** is up against the insulated pulley or eyelet **55**, Fig. 9. Then the motor **2**, in continuing its rotation forces the worm **7** to move toward the spur gear **14**. This longitudinal motion is due to the stopping of the worm wheel **16** by the wire or cable **56** being all reeled in against the stop. The stationary worm wheel **16** then acts as a rack for the longitudinal motion of the worm **7**. This motion of the worm **7** is transmitted through "out stop" cam **9** to "in stop" cam **10**, which compresses heavy spring **12** until "in stop" cam **10** contacts the plunger of automatic "in stop" switch **8**, and forces the plunger away from the shaft **5** thereby breaking the electrical circuit which causes motor **2** to stop rotating spur gear **15**. We now have the wire or cable **56** all in, or pulled in tightly, and the motor **2** de-energized. The wire or cable **56** is held in under spring tension, due to the pressure of partially collapsed heavy spring **12** transmitted to the worm **7**, and consequently to the worm wheel **16**, and the wire or cable bobbin assembly.

Now assume that the manual switch **35** is thrown in the down or "out" position energizing the motor circuit through the automatic "out stop" switch and reeling out wire or cable **56** as has been previously described, and that the wire or cable **56** becomes jammed in the fairlead **39**, Fig. 10, and fails to continue to pay out. The tension is then relieved on the reel bobbin and consequently worm wheel **16** is relieved. This tension which was transmitted through worm **7** and "out stop" cam **9** against light spring **13** being relieved, allows light spring **13** to force "out stop" cam and worm **7** toward sleeve **6**. This motion causes contact between "out stop" cam and the plunger of automatic "out stop" switch **20**. The motion of this plunger breaks the circuit of "out stop" switch **20** causing the de-energizing of the motor circuit. This action prevents the unreeling or unspooling of the wire or cable **56** if said wire or cable **56** does not pay out of the airplane, thereby preventing the snarling of said wire or cable. This action will also prevent the unspooling of the wire or cable **56** in case the manual "out" switch is accidentally operated when the airplane is on the ground, for as soon as the weight **40** touches the ground or insufficient drag due to air speed is present on drag device **38**, the tension on the wire or cable **56** is relieved and the reel mechanism stops. The reel mechanism is otherwise completely responsive to the manual switch **35** in any intermediate position of the reeling out or in of the wire or cable **56**, and the motor can be stopped or started in either direction by means of the manual switch **35** in order to adjust the length of the reeled out wire or cable **56**, as, for instance, to tune an antenna by adjusting its length.

The reel bobbin assembly is unique in that it is keyed to the shaft by means of a recess in the aluminum core **31** and held in place by means of the snap slide assembly **30**. This provides for rapid and easy replacement of the reel and wire. The swivel **33**, by means of which the wire or cable **56** is fastened to the reel bobbin assembly, allows the wire or cable **56** to reverse direction of tension, when the wire or cable **56** is all reeled out, without the bending of said wire or cable and consequent breakage due to such bending. The reel bobbin flanges **29** are provided with heavy lips, as shown, in order to direct the wire or cable **56** toward the center of the spool **32**. This prevents the wire or cable **56** from piling up on the flanges **29**, giving a more even distribution of the wire or cable **56** on the spool, and prevents snarling of wire due to overlapping turns.

Fig. 5 shows a modification of the elementary electrical circuit diagram in order to provide a warning light **23** for the airplane operator. The motor circuits are essentially the same as in Fig. 6. The warning light **23** is energized from the battery through the automatic "in stop" switch **8**. The warning light is on at all times, unless the "in stop" switch **8** circuit is broken which occurs, as previously explained, only when the reel is in the fully retracted position. This warning light **23** and its electrical circuit is entirely independent of the manual switch **22** circuit, and the position of the manual switch **22** has no effect on the warning light, except only as the manual switch **22** affects the operation of the reel.

Fig. 11 shows the electrical circuit, which is basically the same as those shown in Figs. 5 and 6, but provides some additional desirable features. Warning light **23** still is dependent only on the operation of the automatic "in stop" switch **8** and independent of the manual "in-out" switch **45**. Resistor **44** is in series with the "out" circuit of motor field **41**, motor armature **43**, manual switch **45**, automatic "out stop" switch **20**, and battery **21**. This resistor causes the motor to run slower than it normally would in the "out" or no load direction and thus the "out" and "in" rotation of the motor can be adjusted so that the speed of the wire or cable in going out or coming in can be made equal, in order to facilitate tuning by adjusting the length of wire or cable.

Other desirable features which appear in the circuit diagram, Fig. 11, and which are about to be described, depend upon electrical or dynamic braking of the motor. This action is accomplished as follows: If the motor is rotating being energized by the batteries and accompanying switches and one series field, and if such circuit is suddenly broken, and the other series field is placed in shunt across the armature, the counter-electromotive force induced by the rotating motor will produce a current in the armature and shunt connected field, which will tend to drive the motor in the opposite direction and hence quickly stop the motor.

Now assume that the wire or cable is partially reeled in, and the manual control **45** is placed in the up or "in" position, and the motor is energized through series field **42** and "in stop" switch **8**. When the wire or cable arrives at the completely retracted position, "in stop" switch **8** is mechanically operated, as previously explained, and the motor circuit is broken, but now a back contact is operated on "in stop" switch **8**, which connects the "out" field **41** in shunt with the armature. This connection stops the motor quickly, allowing an adjustment of heavy spring **12** which will take up only a portion of its tension and allow the

remainder of the tension to be used as a spring action on the wire or cable.

Assume that the manual switch is thrown in the down or "out" position. This causes the motor to operate reeling out the wire, until wire is all out, and the automatic "out stop" switch **20** operates, opening the motor circuit. The automatic "out stop" switch **20**, has a back contact which will connect the "in" field **42** in shunt across the armature **43**, stopping the motor quickly and prevents over-running of the reel bobbin. This above action will obtain if the "out stop" switch **20** is operated, due to the relief of the tension on the wire or cable, as previously explained.

In adjusting the length of the wire in some intermediate position, there normally would be a difference between the over-running of the motor when stopped from the outgoing rotation, and when stopped from the incoming rotation. In order to equalize and minimize this over-running, electrical braking is provided when stopped from the outgoing rotation by means of the circuit associated with the inner two springs of manual switch **45**.

Figs. 12 to 14, inclusive, show an alternative mechanism providing means to perform the same functions as the worm and worm wheel mechanism. Disc **51** is fastened to shaft **50** to which rotational power is applied. Discs **52**, **54**, and **53** are not fastened to shaft **50** but are free to rotate on shaft **50**, except as noted in the following. Disc **51** will transmit power to disc **52** in a clockwise direction through heavy spring **46**. Disc **54** is firmly bolted to disc **52**, or may be made integral with disc **52**. Disc **54** will transmit rotational power in a clockwise direction to disc **53** through pressure on electrical contacts **49**, after light spring **48** has been compressed. The wire or cable may be connected to disc **53**, either by gears, or mounted directly thereon, while the power would be supplied by a motor, either geared or directly coupled, to shaft **50**. Electrical contacts **47** would be associated with the wire or cable retracting circuit, and electrical contacts **49** would be associated with the wire or cable releasing circuit. A clockwise rotation of the shaft **50** would retract wire while a counter-clockwise rotation of shaft **50** would release the wire or cable. Tension on disc **53**, in a counter-clockwise direction, would be required to hold the release contacts **49** together by collapse of the light spring **48**. When the wire or cable had been completely retracted, further clockwise rotation of shaft **50** would collapse heavy spring **46**, which would break the retracting circuit to the motor. This mechanism would then perform the functions of the worm and worm wheel mechanism, as described previously.

It will be understood that any suitable conventional means may be employed for attaching or operatively coupling a radio transmitter to the antenna wire or cable.

Changes, modifications and alternative arrangements are contemplated within the scope and spirit of the invention as defined by the appended claims.

We claim:

1. In an antenna reel mechanism, the combination with a reel for the antenna wire, of a gear wheel and a common shaft on which said reel and gear are mounted for rotation in unison; drive means for rotating the reel to wind and unwind the antenna wire, said means including a reversible motor and a worm meshing with said gear; and means actuated by said worm and including spring elements for storing up energy under drive of the motor to retain the antenna under tension when in retracted position.

2. In an antenna reel mechanism, a reel and gear mounted to rotate in unison; drive means for the reel, said means comprising a reversible motor, a drive shaft, a worm meshing with said gear, said worm being splined to rotate with the shaft and having a sliding movement longitudinally thereof; a circuit including said motor; means including switch elements in said circuit for controlling said motor; means acting in response to said worm in either direction of its sliding movement for selective operation with said switch elements; and spring means operated by the worm for retaining the antenna under tension when in retracted position.

3. An antenna reel mechanism comprising a reel for the antenna wire; drive means for the reel to wind and unwind said wire, said means comprising a reversible motor, a drive shaft, a worm splined on said shaft and slidable longitudinally thereof; a gear wheel meshing with said worm and mounted for unitary rotation with said reel; a circuit including said motor; means including switch elements in said circuit for controlling said motor; means acting in response to said worm in either direction of its sliding movement for selective operation with said switch elements; and means including spring elements actuated by said worm for storing up energy under drive of the motor to retain the antenna wire under tension when in retracted position.

4. A mechanism of the class described, comprising a reel for winding and unwinding a weighted antenna wire, and a gear wheel mounted for unitary operation therewith; drive means for the reel, said means comprising a reversible motor, a drive shaft, a worm meshing with the gear wheel, said worm being splined to rotate with said shaft and having a sliding movement longitudinally thereof; a circuit including said motor; means including automatic switches in said circuit for starting and stopping the motor; means for selectively actuating said switches, said means being controlled by said worm at different stages of its sliding movement to maintain a normal reeling operation until the wire is payed out or reeled in, and said means including a spring element for storing up energy under drive of the motor to retain the wire under tension when in retracted position.

5. An antenna reel mechanism which employs a reel for winding and unwinding a weighted trailing antenna wire; drive means for the reel comprising a reversible motor, a drive shaft, a worm splined on said shaft and slidable longitudinally thereof; a gear wheel meshing with said worm and mounted for unitary rotation with said reel; a circuit system including the motor; means including switches in said circuit system for selectively controlling the motor in accordance with functional performance of the reel; means including a pair of spring elements having a differential action, one of said elements being actuated by said worm during one stage of its sliding movement and during normal reeling operation to permit the switches to remain in circuit closing position; and means responsive to continued sliding movement of said worm to cause another of said spring elements to retain said antenna wire under tension when in retracted position, said means also functioning to actuate one of the switches to interrupt the reeling operation.

6. Antenna reel mechanism for winding and unwinding a weighted trailing antenna wire; drive means for the reel comprising a reversible motor, a driver shaft, a worm splined to rotate with the shaft and having a sliding movement longitudinally thereof; a gear wheel meshing with said worm and mounted to rotate in unison with said reel; a circuit system including the motor, and said system comprising a reeling in circuit and a reeling out circuit; a start-stop switch for initiating the operation of said circuits alternately; means including switches in each of said circuits for selectively controlling the motor; means including a pair of spring elements having a differential action, one of said elements being actuated by said worm during one stage of its sliding movement and during normal reeling in operation to permit the switches to remain in circuit closing position; and means responsive to continued sliding movement of said worm to cause another of said spring elements to retain said antenna wire under tension in retracted position, said means also functioning to actuate the switch in said reeling in circuit to interrupt the reeling in operation.

7. In an antenna reel mechanism for winding and unwinding a weighted trailing antenna wire; drive means for the reel comprising a reversible motor, a drive shaft, a worm keyed to rotate with the shaft and splined to permit sliding movement longitudinally thereof; a gear wheel meshing with said worm and mounted to rotate with said reel; a circuit system including the motor, said system comprising separate circuits for reeling operations in and out, respectively; a start-stop switch for alternately initiating the operation of said last named circuits; means comprising an automatic switch in the reeling-in circuit acting in response to sliding movement of said worm to stop the reeling operation, said means including a spring element for storing up energy in response to the same sliding movement to retain the antenna wire under tension in its retracted position.

8. In an antenna reel mechanism for winding and unwinding a weighted trailing antenna wire; drive means for the reel comprising a reversible motor, a drive shaft, a worm splined on the shaft to rotate therewith and to permit sliding movement longitudinally thereof; a gear wheel mounted to rotate with the reel and meshing with said worm; a circuit system including the motor, said system comprising separate circuits for reeling-in and reeling-out operations, respectively; means comprising a spring element which yields in response to sliding movement of said worm under the weight of the antenna wire in the out position, and a switch in the reeling-out circuit actuated by the same sliding movement of the worm to stop the motor.

9. In an antenna reel mechanism for winding and unwinding a weighted antenna wire; drive means for the reel including a reversible motor, a drive shaft, and a worm splined on the shaft to rotate therewith and having a sliding movement longitudinally thereof; a gear mounted to rotate with the reel and meshing with said worm; a circuit system including the motor, said system comprising separate circuits for reeling-in and reeling-out operations, respectively; switches in each of said circuits; means actuated by said worm including a spring which yields under the weight of the antenna in the reeling-out operation whereby the switch in said reeling-out circuit is closed to operate the motor to complete the reeling-out operation, whereupon the tension on said spring is relieved and as continued operation tends to rewind the reel in reverse direction the switch is again operated by said means to break the circuit and stop the motor.

10. In an antenna reel mechanism, the combination with a reel for the antenna wire, of a gear wheel and a common shaft on which said reel and gear are mounted to rotate together; drive means for rotating the reel to wind and unwind the antenna wire, said means including a reversible motor, a drive shaft, and a worm slidable on said shaft and meshing with said gear; a circuit system including said motor, said system comprising separate circuits for reeling-in and reeling-out operations, respectively; a manually operated switch for alternately operating said circuits; switch elements in each circuit for starting and stopping said motors; means acting in response to said worm in either direction of its sliding movement for selective operation with said switch elements; and means including springs responsive to continued sliding movement of said worm for storing up energy under drive of the motor to retain the antenna wire under tension in its retracted position.

11. In an antenna reel mechanism for aircraft which employs a weighted trailing antenna wire; drive means for the reel including a reversible motor, a drive shaft, and a worm splined on the shaft to rotate therewith and having a sliding movement longitudinally thereof; a gear mounted to rotate with the reel and meshing with said worm; a circuit system including the motor, said system comprising separate circuits for reeling-in and reeling-out operations, respectively; a manually operated switch for alternately initiating the operation of said circuits; an automatic switch in each circuit for controlling the motor; means acting in response to the worm in either direction of its sliding movement for selective operation with said automatic switches; means for stopping the antenna at any predetermined point on the aircraft for use as a fixed antenna; and spring actuated means responsive to continued sliding movement of said worm for storing up energy under drive of the motor to retain the antenna wire under tension in its retracted position, while at the same time operating the switch in said reeling-in circuit to stop the motor.

12. In an antenna reel mechanism for aircraft, a flexible linear conductor; a drag member attached to the trailing end of said conductor; a reel for winding and unwinding the conductor, one end of said conductor being attached to said reel; drive means for the reel comprising a reversible motor, a drive shaft, a worm splined on the shaft to rotate therewith and to permit sliding movement longitudinally on said shaft; a gear wheel mounted for unitary rotation with the reel and meshing with said worm; a circuit system including the motor, said system comprising separate circuits for reeling-in and reeling-out operations, respectively; means actuated by said worm including a spring which yields under the weight of the conductor in the reeling-out operation whereby the switch in said reeling-out circuit is closed to permit the conductor to be completely extended, whereupon the tension on said spring is relieved and as continued operation tends to rewind the reel in reverse direction the switch is again operated by said means to break the circuit and stop the motor; and a swivel connection for attaching the conductor to the reel to accommodate for flexing of the conductor.

13. A mechanism of the class described com-

prising a reel for winding and unwinding a weighted antenna wire, and a gear wheel mounted for unitary operation therewith; drive means for the reel, said means comprising a reversible motor, a drive shaft, and a worm meshing with the gear wheel, said worm being splined to rotate with said shaft and having a sliding movement longitudinally thereof; a circuit system including said motor, said system comprising separate branch circuits and a switch in each of said last named circuits for controlling the motor; and means dependent upon movement of the worm for selectively actuating said switches in accordance with functional performance of said reel.

14. A mechanism of the class described comprising a reel for winding and unwinding antenna wire; means for driving the reel including a reversible motor, a drive shaft, and a worm keyed to said shaft and splined for sliding movement longitudinally thereof; a circuit system including the motor, said system comprising separate reeling-in and reeling-out circuits, respectively; a manually operated switch for alternately starting and stopping said circuits; an automatic switch in each of said last-named circuits for controlling the motor; a warning signal controlled by the switch in the reeling-in circuit independently of the manual switch and remaining operative during normal operation of the reel; and means dependent upon sliding movement of said worm for selectively actuating said automatic switches in accordance with functional performance of said reel.

15. In an antenna reel mechanism for winding and unwinding a weighted trailing antenna wire; drive means for the reel comprising a reversible motor, a drive shaft, a worm keyed to rotate with the shaft and splined to permit sliding movement longitudinally thereof; a gear wheel meshing with said worm and mounted to rotate with said reel; a circuit system including the motor, said system including reeling-in and reeling-out circuits, respectively; a manually operated start-stop switch for alternately operating said last-named circuits; means comprising an automatic switch in the reeling-in circuits acting in response to sliding movement of said worm to stop the reeling operation, said means including a spring element for storing up energy under drive of the motor to retain the antenna under tension in its retracted position; and a warning signal operative with the said reeling-in circuit and controlled by the switch in said circuit independently of the manual switch, said signal remaining operative during normal operation of the reel.

16. A mechanism of the class described comprising a reel; means for driving the reel including a reversible motor and a drive shaft operatively coupling said reel and motor; a circuit system including the motor, said system comprising reeling-in and reeling-out circuits, respectively; a manually-operated switch for alternately starting and stopping said circuits; an automatic switch in each circuit for controlling the operation of the motor; a warning signal in said circuit system, said signal being controlled by the automatic switch in the reeling-in circuit and remaining operative during normal operation of the reel; and means for selectively actuating said automatic switches in accordance with functional performance of said reel.

17. In an antenna reel mechanism for winding and unwinding a weighted trailing antenna wire; drive means for the reel comprising a reversible series-wound motor, a drive shaft, a worm keyed to rotate with the shaft and splined to permit sliding movement longitudinally thereof; a gear wheel meshing with said worm and mounted to rotate with said reel; a circuit system including the motor, said system comprising reeling-in and reeling-out circuits, and said motor having its field windings connected in series in said last-named circuits; an automatic switch in each of said circuits for controlling the motor, and a contact element operative with each switch and with said field windings for establishing shunt circuits with the armature of said motor; means for selectively actuating said switches, said means being controlled by said worm at different stages of its sliding movement to maintain a normal reeling operation until the wire is payed out or reeled in, and said means including a spring element for storing up energy under drive of the motor to return the wire under tension when in retracted position, said means functioning to actuate the switch in the reeling-in-circuit to stop the motor and simultaneously to close the contact for operating the opposed field winding of said motor whereby a counter electromotive force is exerted to stop the motor more quickly and relieve a part of the tension on said spring element.

18. In an antenna reel mechanism for winding and unwinding a weighted trailing antenna wire; drive means for the reel comprising a reversible series-wound motor, a drive shaft, a worm keyed to rotate with the shaft and splined to permit sliding movement longitudinally thereof; a gear wheel meshing with said worm and mounted to rotate with said reel; a circuit system including the motor, said system comprising reeling-in and reeling-out circuits, and said motor having its field windings connected in series in said last-named circuits; an automatic switch in each of said circuits for controlling the motor, and a contact element operative with each switch and with said field windings for establishing shunt circuits with the armature of said motor; means for selectively actuating said switches, said means being controlled by said worm at different stages of its sliding movement to maintain a normal reeling operation until the wire is payed out or reeled in, said means functioning to actuate the proper switch to deenergize the motor and simultaneously to close the corresponding contact for operating the opposed field winding whereby an electrical braking action is exerted to stop the motor quickly.

19. In an antenna reel mechanism for winding and unwinding a weighted trailing antenna wire; a reel and drive means therefor comprising a reversible series-wound motor, a drive shaft, a worm keyed to rotate with the shaft and splined to permit sliding movement longitudinally thereof; a gear wheel meshing with said worm and mounted to rotate with said reel; a circuit system including the motor, said system comprising reeling-in and reeling-out circuits, and said motor having its field windings connected in series in said last-named circuits respectively; a switch for controlling the motor in the reeling-in and reeling-out circuits, respectively, and a contact element operative with each switch and with said field windings for establishing shunt circuits with the armature of said motor; means acting in response to said worm in ether direction of its sliding movement for selective operation with said switches; and means including a resistance element in series with the "out" motor field winding and said reeling-out circuit, and

operative under control of the switch in said circuit to retard the motor when paying out wire or cable.

20. In an antenna reel mechanism, a reel for the antenna wire; drive means for the reel comprising a reversible motor, a drive shaft, means for detachably mounting the reel on said shaft for rotation therewith, a worm splined on said shaft and having a range of sliding movement longitudinally thereof; a gear wheel meshing with said worm and mounted for unitary rotation with said reel; a circuit system including said motor, said system comprising separate reeling-in and reeling-out circuits, respectively; means including switches in each of said last named circuits for controlling the motor; means acting in response to said worm in either direction of its sliding movement for selective operation with said switches; means including spring elements actuated by said worm for storing up energy under drive of the motor to retain the antenna wire under tension when in retracted position, said means also functioning in said position to operate the switch of the reeling-in circuit to stop the motor.

21. In a mechanism of the class described, a rotatable carrier for the wire or cable; drive means for the carrier, said means including a reversible motor, a drive shaft, and a disc assembly for operatively coupling the motor and carrier, said assembly including an inner component keyed to the shaft and an outer component secured to the carrier; a circuit system including the motor; means including switches in said system for controlling the motor in accordance with functional performance of the wire carrier; means for selectively actuating said switches as the wire is payed out or reeled in, said means including an intermediate disc component mounted on said shaft between the inner and outer components as a part of said assembly; means for flexibly coupling said components, and said means including a spring element for storing up energy under drive of the motor to retain the wire under tension when in retracted position.

22. In a mechanism of the class described, a rotatable carrier for the wire or cable, drive means for the carrier, said means comprising a reversible motor, a drive shaft and a disc assembly for operatively coupling the motor to said carrier, said assembly including an inner component keyed to said shaft and an outer component secured to the carrier; a circuit system including the motor, said system comprising a reeling-in circuit and a reeling-out circuit; means including a switch in each of said last-named circuits for controlling the motor in accordance with functional performance of the wire-carrier; means for selectively actuating said switches, said means including an intermediate disc component mounted on said drive shaft between the inner and outer components of said disc assembly; means for flexibly coupling the said components, said means including spring elements having a differential action, one of said elements maintaining the switch in circuit closing position in the reeling-in circut during the reeling-in operation; and means responsive to continued reeling-in operation to cause the other of said spring elements to retain the wire under tension in retracted position, said means also functioning to open said last-named switch to stop the motor.

23. An antenna reel mechanism comprising a reel for the antenna wire, said reel being provided with peripheral flanges and spaced lips on said flanges to aid in centering and distributing the wire on the reel; drive means for the reel comprising a reversible motor, a drive shaft, means for detachably mounting the reel on said shaft for rotation therewith, a worm splined on said shaft and having a range of sliding movement longitudinally thereof, a gear wheel meshing with said worm and mounted for unitary rotation with said reel; a circuit system including said motor, said system comprising separate reeling-in and reeling-out circuits, respectively; means including switches in each of said last named circuits for controlling the motor; means acting in response to said worm in either direction of its sliding movement for selective operation with said switches; means including spring elements actuated by said worm for storing up energy under drive of the motor to retain the antenna wire under tension when in retracted position, said means also functioning in said position to operate the switch of the reeling-in circuit to stop the motor.

24. An antenna reel mechanism comprising a reel for the antenna wire, said reel being provided with peripheral flanges and spaced lips on said flanges to aid in centering and distributing the wire on the reel; drive means for the reel comprising a reversible motor, a drive shaft, means for detachably mounting the reel on said shaft for rotation therewith, a worm splined on said shaft and having a range of sliding movement longitudinally thereof, a gear wheel meshing with said worm and mounted for unitary rotation with said reel; a circuit system including said motor, said system comprising separate reeling-in and reeling-out circuits, respectively; means including switches in each of said last named circuits for controlling the motor; and means dependent upon movement of the worm for selectively actuating said switches in accordance with functional performance of said reel.

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