April 2, 1940. E. W. GENT 2,195,859

REELING SYSTEM AND METHOD

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FIG. 1

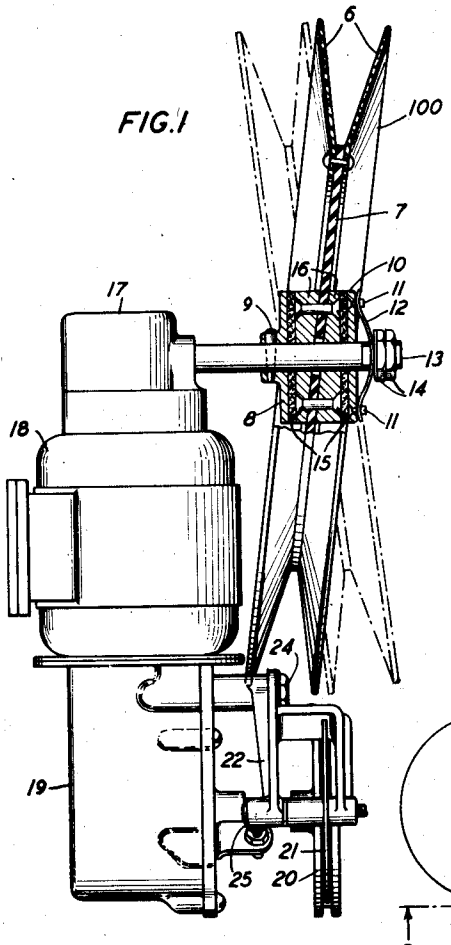

FIG. 2

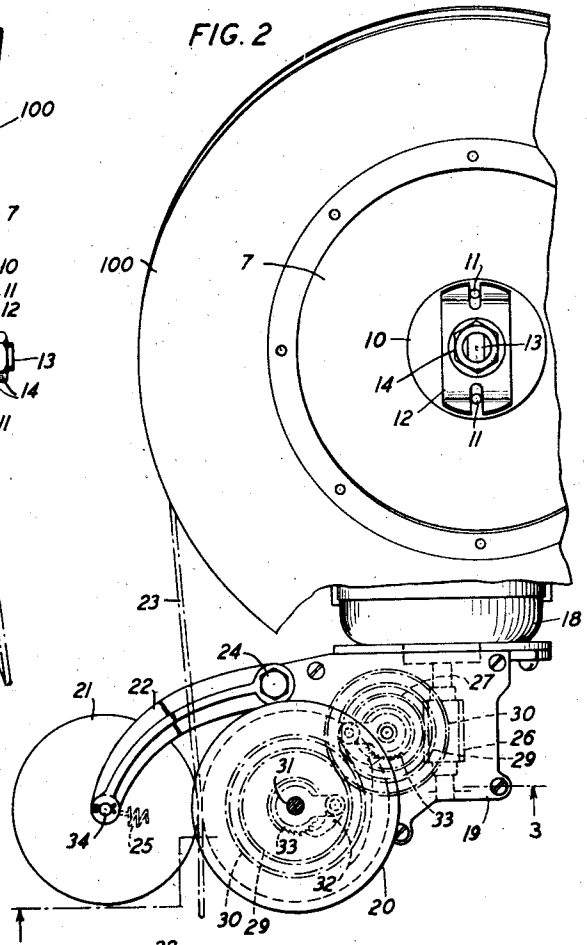

FIG. 3

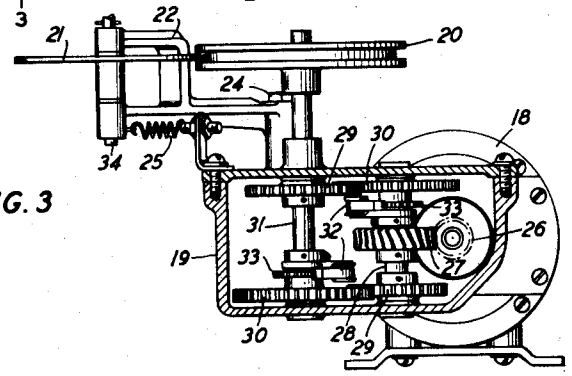

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FIG. 6

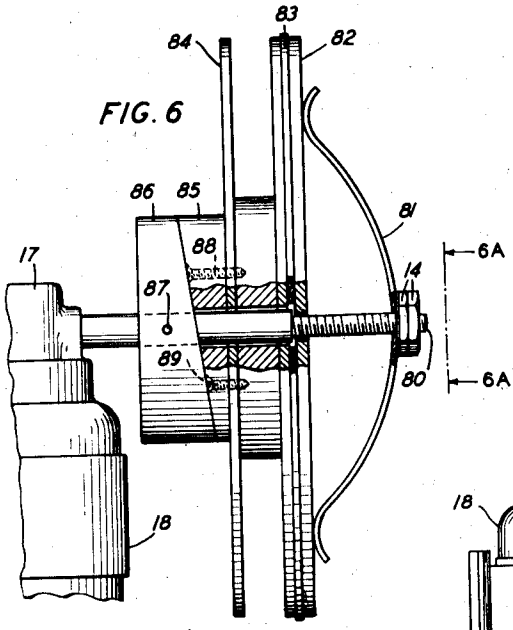


FIG. 4

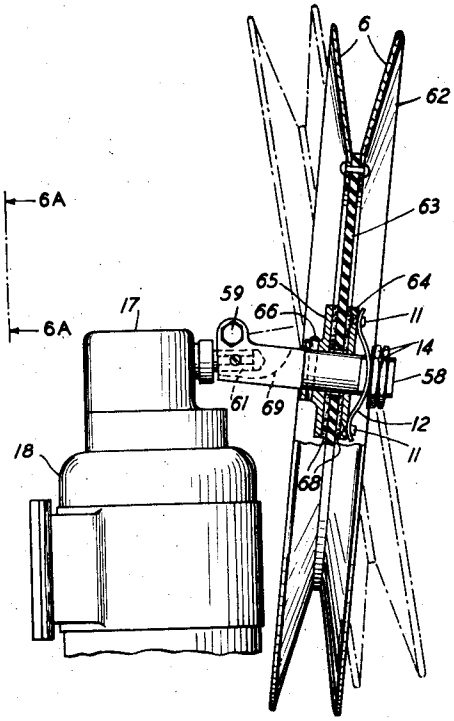


FIG. 6A

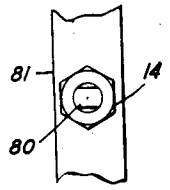
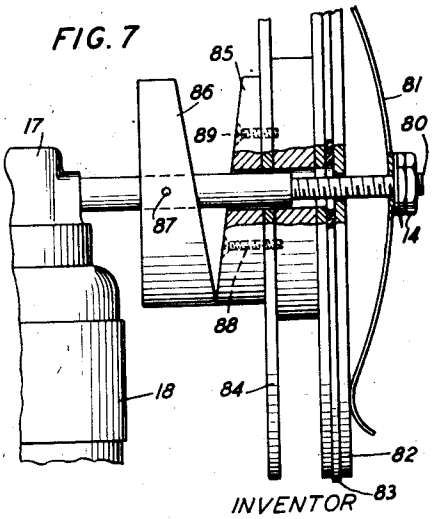


FIG. 5

FIG. 7



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REELING SYSTEM AND METHOD

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FIG. 8

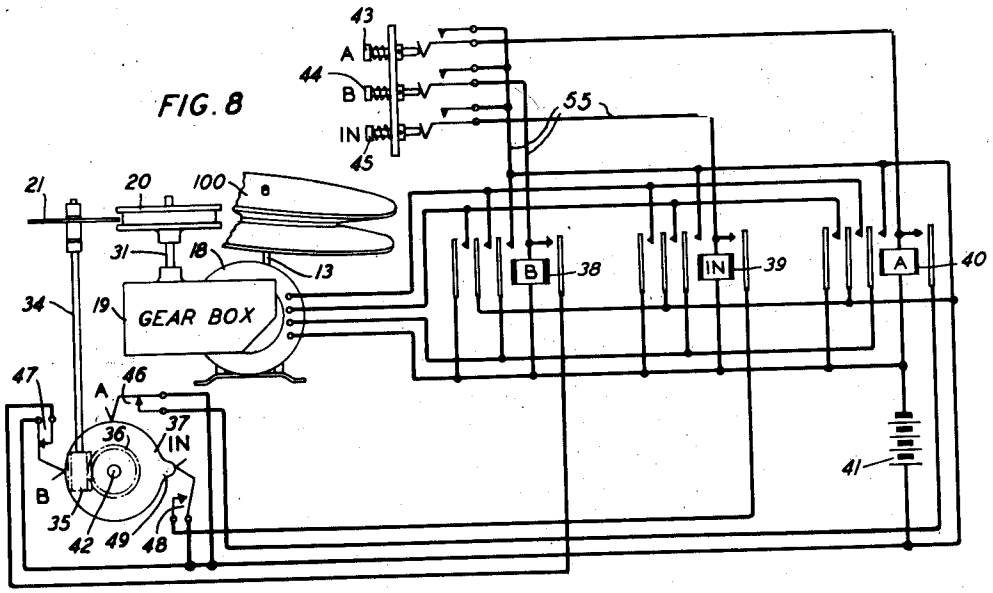
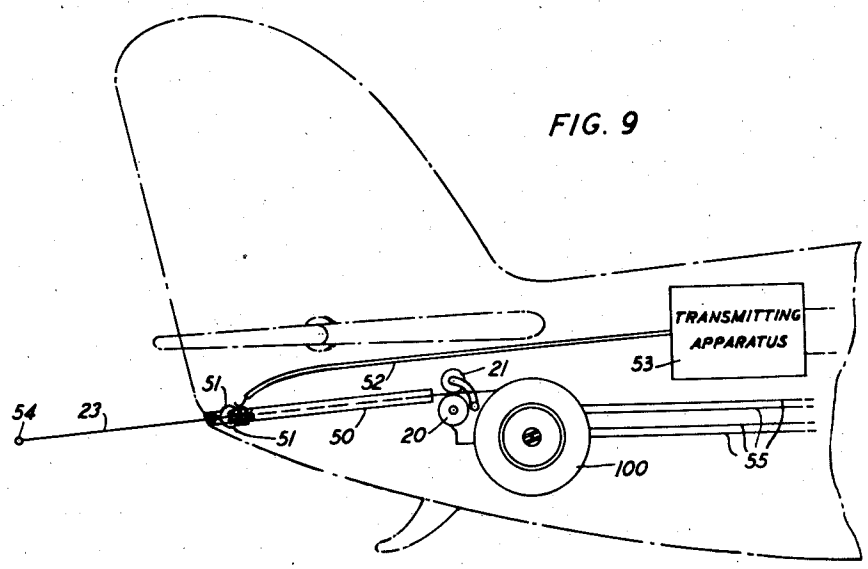


FIG. 9



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Patented Apr. 2, 1940 2,195,859

UNITED STATES PATENT OFFICE

2,195,859

REELING SYSTEM AND METHOD

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Application August 11, 1937, Serial No. 158,473

11 Claims. (Cl. 242—54)

This invention relates to improvements in reeling systems and methods.

This application is a continuation in part of my application, Serial No. 118,232, filed December 30, 1936.

A particular object of this invention is to provide a reeling system which will insure that the reeled material is wound upon and pulled from the reel under a substantially uniform and appropriate degree of tension, thereby avoiding snarling difficulties and other winding irregularities encountered with reeling systems providing inadequate control of winding and unwinding tensions.

A further object is to provide systems and methods of imparting and controlling cross-feeding motions to reeled materials for the purposes of effecting particular distributions of the winding on the reel and of decreasing snarling and embedding of turns of upper layers in the layers beneath.

A further feature of the invention is the provision of a reel having a tapered winding space, the lateral dimension of which increases with the diameter of the winding with the objects of securing compactness of winding and of decreasing the likelihood of end turns of upper layers becoming wedged between the reel and the end turns of the layers beneath. This feature moreover facilitates "over-cross-feeding" as will be explained hereinafter and is of assistance in obtaining particular distributions of the winding on the reel.

Another object of the invention is the provision for antenna reeling systems of length indicating means which are actuated directly by the antenna as it is reeled in or out and which are therefore not affected by slippage between the antenna and the antenna driving means.

Other objects and advantages of the invention will be apparent during the course of the following description:

The specific embodiment employed to illustrate the principles of this invention is an antenna reeling system for use with aircraft. In the accompanying drawings:

Fig. 1 is a top view of the driving motor with the antenna reel attached to one end and the positive antenna driving means attached to the other. A partial sectional view of one form of reel and of one form of means for causing a wobbling motion to be imparted to the reel in turning are shown in this figure;

Fig. 2 is a side view of the combination shown in Fig. 1. A phantom view of the gearing of the positive antenna driving means is given in this figure;

Fig. 3 is an end view of the combination shown in Fig. 1 with the reel and its shaft not shown. A sectional view of the gear box of the positive antenna driving means is given in this figure;

Figs. 4 and 5 show two additional forms of means for causing a wobbling motion to be imparted to the reel in which the wobbling or lateral motion of the reel occurs whenever the shaft is rotated even though the reel is not permitted to rotate;

Fig. 6 shows a reel having a rectangular winding space and means for causing the reel to oscillate laterally along the shaft.

Fig. 6*a* shows an end view of the shaft to illustrate how it is milled so that the spring and tension plate may be caused to turn with the shaft;

Fig. 7 shows the mechanism of Fig. 6 with the reel in its position nearest the end of the shaft to more fully illustrate the operation of the mechanism;

Fig. 8 shows the electrical controlling circuit providing means for letting out any one of a plurality of predetermined lengths of the antenna and withdrawing the same when desired, the cam operating the control contacts being shown as being operated by the rotation of the "idler" roller of the feed roll mechanism;

Fig. 9 shows one method of locating the antenna reeling system in the tail of an airplane and connecting the antenna to the radio apparatus.

The mode of operation will be apparent from the following description:

In Fig. 1 the reel 100 consists of aluminum sides 6 riveted to the fiber web 7 which is held at an angle with respect to the shaft 13 by means of the tapered washers 16 which are also riveted to the fiber web 7. The reel assembly is not attached to the shaft 13 but is driven by friction between leather washers 15 and the tapered washers 16 above mentioned. Leather washers 15 are held in place by the hub piece 8 which is secured to the shaft 13 by pin 9 and by piece 10 which is pressed inward by spring 12. The end of shaft 13 is milled flat on opposite sides as shown and threaded. Spring 12 is slotted at its center to fit the milled end of shaft 13 and must therefore turn with it. The ends of spring 12 are slotted to fit pins 11 projecting from piece 10. Piece 10 therefore also rotates with shaft 13. The pressure of spring 12 on piece 10 may be adjusted by changing the position of nuts 14. This pres-

sure, of course, determines the strength of the frictional drive between shaft 13 and reel 100. The antenna reeling system of this invention operates satisfactorily when the spring 12 is adjusted so that a pull of approximately two pounds is required to cause slippage of the reel 100 with respect to the shaft 13 with the reel full. The tapered washers 16 by holding the reel at an angle with respect to shaft 13 cause a wobbling movement to be imparted to the reel in turning.

The winding space of reel 100 is tapered, its lateral dimension increasing as the distance from the center of the reel increases. The lateral motion imparted to the reel when turning has the effect of cross-feeding the reeled material to the reel. The object of cross-feeding is, of course, to make the material progress laterally with respect to the axis of the reel as it is wound thereon. Normally the direction of cross-feed is reversed when the material reaches the end of the winding space toward which it is progressing so that it immediately starts back toward the other end. To assist in eliminating the tendency toward the embedding and snarling of turns of outer layers in layers beneath and to obtain a more varied distribution of the winding upon the reel "over-cross-feeding" may be employed. "Over-cross-feeding" comprises delaying the above-mentioned reversal of the cross-feed beyond the instant that the reeled material reaches the end of the reel toward which it is progressing so that the winding would extend beyond the end of the reel were the reel not provided with sides. The sides of the reel, however, cause the over-cross-fed portion of the material to slide toward the axis of the reel without lateral progress. After "over-cross-feeding," usually for a fraction of a turn only, the direction of cross-feed is reversed and the material starts progress toward the opposite end of the spool. Over-cross-feeding obviously, therefore, changes the point at which reversal of the direction of cross-feed takes place and therefore changes the distribution of the turns of adjacent layers of the winding relative to each other. A tapered winding space facilitates "over-cross-feeding" since the tapered sides of the reel will more readily guide the over-cross-fed material into position at the ends of the winding space. With a tapered winding space as shown in Fig. 1, the amount of over-cross-feeding is gradually decreased as the winding space is filled since the actual width of the winding space increases with each layer of the winding. The change in the amount of over-cross-feeding and the increase in effective winding diameter and winding space width as the reel fills produce a tendency to distribute the winding uniformly on the reel. As the turns of successive layers are not distributed in the same manner since the amount of over-cross-feeding is decreasing and the width of the winding space is increasing with each layer, the embedding and snarling of the turns of any particular layer with the turns of lower layers of the winding is eliminated. Gear box 17 contains a train of gears through which motor 18 drives shaft 13. 33½ revolutions per minute has been found a convenient speed for such a reel having a minimum diameter of seven inches. The fiber web 7 serves also to insulate the antenna wire wound on the reel 100 from ground. The drive roll 20 and idler roller 21 should be made of phenol fiber or otherwise arranged so as to maintain the insulated condition of the antenna wire.

At the other end of motor 18 is mounted gear box 19 containing the gears employed in furnishing the requisite power to the positive driving means for letting out and drawing in the antenna. This arrangement is shown in detail in Fig. 3 wherein worm 26 is rigidly mounted on the shaft of motor 18 and drives the worm gear 27 which is rigidly mounted on shaft 28. The two gears 29 are rigidly mounted on their respective shafts 28 and 31 but the two gears 30, each of whose hubs also carry a ratchet wheel 33 are free on their shafts. A ratchet 32 engaging ratchet wheel 33 is rigidly affixed to each of the shafts 28 and 31 and so arranged that when the motor is turning in one direction, one ratchet engages its ratchet wheel 33, and power is then transmitted by means of the gear 30 on the same hub and the gear 29 with which said gear meshes to shaft 31 while the other ratchet slips over its ratchet wheel and the other gear 30 on its hub consequently transmits no power. For example, with the motor as viewed in Fig. 3 turning in a clockwise direction, shaft 28 will turn in such a direction that the ratchet 32 on shaft 28 will engage its ratchet wheel causing the gear 30 on the shaft 28 to transmit power to the gear 29 on shaft 31. With the motor turning in a counter-clockwise direction the ratchet on shaft 28 will slip and power will then be transmitted by the gear 29 on the shaft 28 to the gear 30 on shaft 31. The ratchet for shaft 31 will for this direction of rotation engage its associated ratchet wheel and transmit power to turn shaft 31 in the opposite direction. Since gears 29 by design have fewer teeth than gears 30, this arrangement imparts a greater speed of rotation to shaft 31 than shaft 28 in one direction and a lesser speed of rotation in the opposite direction. The purpose of the arrangement will become apparent hereinafter. Shaft 31 carries driving roll 20, the periphery of which is slotted to fit the antenna wire. Idler roller 21 of width suitable to fit freely into the slotted drive roll 20 is supported on axle 34 held in arm 22. Arm 22 is hinged on the bolt 24, and the edge of the roller 21 is made to hold the antenna wire firmly in the slot of drive roll 20 by the pull of the tension spring 25 so that the antenna wire is positively driven in either direction by the rotation of roll 20 in that direction. The speeds provided by the gear trains in gear box 19 are such that the speed with which drive roll 20 drives the antenna wire away from the reel 100 is somewhat greater than the maximum speed at which the antenna wire would normally leave the reel 100 when the reel is full and rotating at its normal speed as determined by the rotation of motor 18 acting through the gear train in gear box 17 to turn shaft 13. The speed with which drive roll 20 drives the antenna wire towards the reel 100 is somewhat less than the minimum speed at which the antenna wire would normally be wound upon the reel 100 when it is empty and rotating at its normal speed as above described. The result of this arrangement is that reel 100 must constantly slip on its shaft 13 and the wire between the drive roll 20 and the reel 100 will be maintained at a comparatively uniform tension determined by the frictional coupling between shaft 13 and reel 100 as described above. This tension will increase somewhat as the winding diameter decreases with the amount of wire payed out. A minimum slippage of approximately 2 per cent between the reel and its shaft has been found satisfactory with the antenna reeling system of this invention for the purpose of maintaining an even reeling tension. When the lateral motion is imparted

to the reel by the mechanisms shown in Figs. 4, 5 and 6 other considerations having to do mainly with the desired distribution of the winding on the reel may make a larger amount of slippage desirable as will be explained hereinafter.

Figs. 4 and 5 show other means for imparting a wobbling movement to the reel of a reeling system. In Fig. 4 motor 18 drives shaft 61 through a gear train enclosed in gear box 17. In this instance the reel is carried on a shaft 58, one end of which is arranged as shown to clamp on shaft 61 so that the axis of 58 forms a particular acute angle with the axis of shaft 61 and when shaft 61 rotates reel 62 carried on shaft 58 is given a wobbling motion. A slot is milled in the left end of shaft 58 to a depth indicated by the dotted line 69 to facilitate clamping shaft 58 on shaft 61. Reel 62 consists of aluminum sides 6 riveted to the fiber web 63 which is held at right angles with respect to shaft 58 by washer 64 and hub piece 65 which press leather washers 66 against web 63. Hub piece 65 is fastened to shaft 58 by pin 66. Washer 64 is pressed toward web 63 by spring 12 which engages pins 11 on washer 64. Nuts 14 serve to adjust the tension of spring 12. Pins 11, spring 12 and nuts 14 perform the same function and operate in the same manner as described in connection with Fig. 1.

In Fig. 5 the means for imparting a wobbling movement to the reel resembles in some respects that shown in Fig. 1. However, in Fig. 5 the tapered washers 73 and 74 turn with the shaft rather than with the reel. In Fig. 5 motor 18 drives shaft 76 through a train of gears housed in gear box 17. Tapered washer 74 is pinned to shaft 76 by pin 9. Leather washers 77 are placed between the reel web 72 and the tapered washers 73 and 74. The shaft 76 is milled flat at the end on opposite sides and tapered washer 73 and spring 12 are perforated so as to fit over the milled end of the shaft and maintain a particular position with respect to the shaft as indicated in Fig. 5. As will presently appear a similar arrangement is employed in the mechanism of Fig. 6 and may be more clearly understood by the end view of the shaft of Fig. 6 shown in Fig. 6a. Spring 12 holds tapered washer 73 against the outside leather washer 77 which, in turn, presses the web of reel 70 against the inside leather washer 77 and the latter is backed against the tapered washer 74. The tension of spring 12 may be adjusted by the nuts 14.

The means for imparting a wobbling movement to the reel, shown in Figs. 4 and 5, unlike that shown in Fig. 1, will impart the same wobbling motion to the reel whether or not the reel is permitted to rotate with the shaft on which it is mounted. This permits an adjustment of the effective amount of cross-feed by changing the relative speed of rotation of the reel with respect to its shaft. For example, if the reel is permitted to rotate with the shaft it will produce the effect of a cross-feed across and back once for each revolution of the shaft. If, however, the reel is caused to slip with respect to the shaft so that it makes one revolution for two revolutions of the shaft the effective cross-feed has been doubled since the reel has wobbled from a particular position through its wobbling cycle twice during the single revolution of the reel. In a similar manner, it is obvious that any desired number of turns for a given cross-feeding cycle may be obtained by driving the reel by other means at a speed which will impart to the reel the number of revolutions corresponding to the number of turns desired during the interval in which the shaft carrying the reel makes one revolution.

An embodiment of an arrangement conveniently adaptable to obtaining multiple-turn layer windings is shown in Fig. 6. This mechanism comprises a shaft 80 driven through a train of gears in gear box 17 by motor 18. This mechanism also employs two tapered washers or cams 85 and 86 to provide a lateral oscillatory motion of the reel 84. In this mechanism one tapered washer 86 is secured to the shaft 80 by pin 87 and the other tapered washer 85 is secured to the reel 84 by screws 88 and 89. Reel 84 has a rectangular winding space and is free on shaft 80, though to prevent possible tilting of the reel 84 with respect to shaft 80 it is preferable that it have a slide-fit thereon. Spring 81 whose tension may be adjusted by nuts 14 holds plate 82 against leather washer 83 which contacts with the right side of reel 84 forcing the reel to the left until washer 85 makes contact with washer 86. The extreme left position of the reel 84 is shown in Fig. 6 and the extreme right position of reel 84 is illustrated in Fig. 7. The lateral position of reel 84 is of course determined by the angular positions of washers 85 and 86. Fig. 6a shows the end view of shaft 80. Pressure plate 82 and spring 81 are perforated to fit the milled end of shaft 80 so that they will rotate with it. Pressure plate 82 may of course move laterally along the milled portion of shaft 80.

The remainders of the antenna reeling systems contemplated in connection with the mechanisms of Figs. 4, 5 and 6 may be substantially as shown in Figs. 1, 2 and 3 substituting of course the desired bearing and reel arrangements for those indicated in Figs. 1 and 2. In connection with the mechanism of Fig. 6 it should be noted that lateral movement of the reel takes place only when the reel is not permitted to rotate at the same speed as its shaft. Three varieties of lateral oscillation mechanisms are thus shown; the first illustrated by Fig. 1 wobbles the reel only when the reel rotates with its shaft, the second illustrated by the alternative arrangements of Figs. 4 and 5 which wobble the reel whether or not it is permitted to rotate with its shaft and the third illustrated by Figs. 6 and 7 which as above mentioned produces lateral movement of the reel only when the reel is not permitted to rotate at the same speed as its shaft. It is obvious that a large variety of winding distributions may be obtained by employing these varieties of mechanisms and proper relative rotational speeds of reel and shaft.

Referring to Fig. 8, shaft 34 also carries worm 35 rigidly attached to it and worm 35 engages worm wheel 36, the latter being rigidly attached to shaft 42 which carries cam 37. Cam 37 has a raised projection 49 which is arranged to open any one of the switches 46, 47 and 48 when the cam is turned so that said projection 49 registers with an actuating spring of any one of said switches, otherwise the said switches are closed. When the antenna is drawn in completely, projection 49 on the cam opens switch 48 and stops the motor. The actuating springs of switches 46 and 47 may be set at any desired circumferential position with respect to the periphery of cam 37 corresponding to points at which desired lengths of antenna have been let out. The antenna may be let out by pushing either button 43 or 44. As is apparent from the wiring shown in Fig. 8, this results in pulling up the relay associated with said button, namely, 40

or 38, respectively, by current from battery 41. Each relay carries one set of contacts shown at the right, locking it up when pulled up by pressing its associated switch button and other contacts closing power supply leads from battery 41 to motor 18 to drive the motor in the proper direction so that the antenna will be driven out by the drive roll 20 until projection 49 on cam 37 is turned to register with the actuating spring of switch 47 or 46, respectively, associated with the button pushed. When the switch associated with the button pushed is opened by projection 49 of cam 37, the actuated relay is released and the connections from the battery to the motor are opened causing the motor to stop. The antenna may be brought in again by pushing button 45 which applies power from battery 41 to relay 39. This relay pulls up, locks up by its contacts at the right, and closes power leads from the battery 41 to the motor 18 to drive the motor in the proper direction so that the antenna will be driven in by the drive roll 20 and wound up by the reel 100. When completely in, projection 49 on cam 37 will have returned to its starting point where it opens switch 48 which releases relay 39 and stops the motor. A large selection of antennae lengths may obviously be obtained by employing an additional push-button, relay and switch for each additional length desired. For unusually long antennae it may be found necessary to introduce additional gears between gears 35 and 36 so that one revolution of cam 37 will correspond to the longest antenna desired.

Fig. 9 shows the reeling system of this invention installed in the tail of an airplane, the antenna 23 being let out through a tube 50. The connection between the antenna and the radio apparatus is made by means of contact springs 51 and the transmitting apparatus may be connected to the spring through a suitable transmission line 52. Only the push-button keys 43, 44 and 45 of Fig. 7 need be mounted within reach of the operator, connection between the reeling system and the keys being established through wires 55 of Fig. 9. Obviously, the tube 50 and, as mentioned above, the drive roll 20 and the idler roller 21 should be made of a suitable insulating material, such as phenol fiber or should be otherwise insulated to avoid grounding the antenna wire. A small object, such as a balsa-wood ball, or "fish" 54, may be attached to the end of the antenna wire if desired to impart tension to hold the antenna in position.

Many other applications and modifications within the spirit and scope of the invention and embodying the principles herein disclosed will occur to persons skilled in the art and no effort has here been made to be exhaustive.

What is claimed is:

1. An antenna reeling system for aircraft comprising a reel carrying an antenna wire, means for causing a wobbling motion to be imparted to said reel upon the rotation of said reel, a set of feed rolls, and means for holding the wire between the feed rolls and the reel in a taut condition both in the reeling in and in the reeling out operations.

2. An antenna reeling system for aircraft including a reel carrying an antenna wire, a set of feed rolls, a rotary driving means, means including a frictional coupling for connecting said reel to said driving means, and means including two gear trains of different gear ratios and having unidirectional couplings operable for opposite directions of rotation for connecting said feed rolls to said driving means, said feed rolls being arranged to drive the antenna wire away from said reel at a speed greater than that at which it would normally unwind from said reel and to drive the antenna wire towards said reel at a speed less than that at which it would normally wind upon said reel so that for both winding and unwinding operations continuous slippage of the frictional coupling connecting said reel to said driving means will occur and the portion of the antenna wire between said reel and said feed rolls will be maintained at a uniformly varying tension determined by the strength of the said frictional coupling and the amount of wire on said reel.

3. An antenna reeling system for aircraft comprising a reel carrying an antenna wire, a driving motor, a frictional coupling and a train of gears connecting said reel to said motor, antenna feed rolls aligned in a common vertical plane with the center of said reel, said plane being at right angles to the axis of said reel, a second train of gears connecting said feed rolls to said motor, said feed rolls continuously pulling the wire from said reel during the entire reeling out operation at a speed exceeding the normal unwinding speed of said reel, so that continuous slippage occurs in said frictional coupling and a substantially uniform tension in a direction substantially at right angles to the axis of said reel, is maintained upon the wire between said reel and said antenna feed rolls during the entire unreeling operation, whereby snarling of said antenna wire is avoided.

4. A reeling system comprising a reel, a motor, connecting means including a frictional coupling connecting said reel to said motor, a set of feed rolls, a second connecting means including a unidirectional coupling operable during the entire unwinding operation connecting said feed rolls to said motor and a third connecting means including a second unidirectional coupling operable during the entire winding operation connecting said feed rolls to said motor, said second connecting means causing said feed rolls to have a greater peripheral speed than said reel and said third connecting means causing said feed rolls to have a lesser peripheral speed than said reel whereby the material being wound upon or unwound from said reel is maintained at a substantially uniform tension during the entire winding and unwinding operations.

5. An antenna reeling system for aircraft including a reel carrying an antenna, feed rolls for paying out and retracting said antenna, said feed rolls including an idler roller driven by said antenna, and cam-operated means driven by the shaft of said idler roller for stopping the operation of said reeling system when a predetermined length of antenna has been reeled out or drawn in.

6. A reeling system including a reel, a shaft, said reel mounted on the free end of said shaft, the axis of said free end of said shaft forming an acute angle with the axis of the remainder of said shaft so that when the remainder of said shaft is rotated about its axis a wobbling motion is imparted to said reel.

7. A reeling system including a reel, a shaft, said reel assembled on the free end of said shaft, the axis of said free end of said shaft forming an acute angle with the axis of the remainder of said shaft, a frictional coupling, coupling said reel with said shaft and means causing the speed of rotation of said reel to differ from the speed of rotation of said shaft whereby a desired cross-feeding effect determined

by the relative speed of rotation of said reel to said shaft is obtained.

8. In a reeling system, the combination of a reel assembled on a shaft, the reel being free to turn on said shaft, a pair of washers assembled on said shaft one on either side of said reel, said washers being constrained to turn with said shaft, means for causing said washers to exert pressure upon the sides of said reel, the faces of said washers adjacent to said reel being beveled to hold said reel so that its axis forms an acute angle with respect to the axis of said shaft.

9. In a reeling system, the combination of claim 8, and means for causing the reel to turn at a speed differing from that of the shaft upon which it is assembled.

10. In a reeling system, the combination of claim 8, the angle of the axis of the reel with respect to the axis of the shaft being sufficient to produce over cross-feeding of the reeled material to the reel.

11. In a reeling system, the combination of a shaft, a reel assembled on said shaft, the reel being free to turn on said shaft, a pair of beveled washers assembled adjacent to each other on said shaft with their respective beveled surfaces toward each other, one of said washers being affixed to said shaft, the other of said washers being affixed to said reel, means operating by friction on said reel to turn said reel when said shaft is turned, and means for causing said reel to turn at a different speed than said shaft.

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