

Jan. 2, 1951

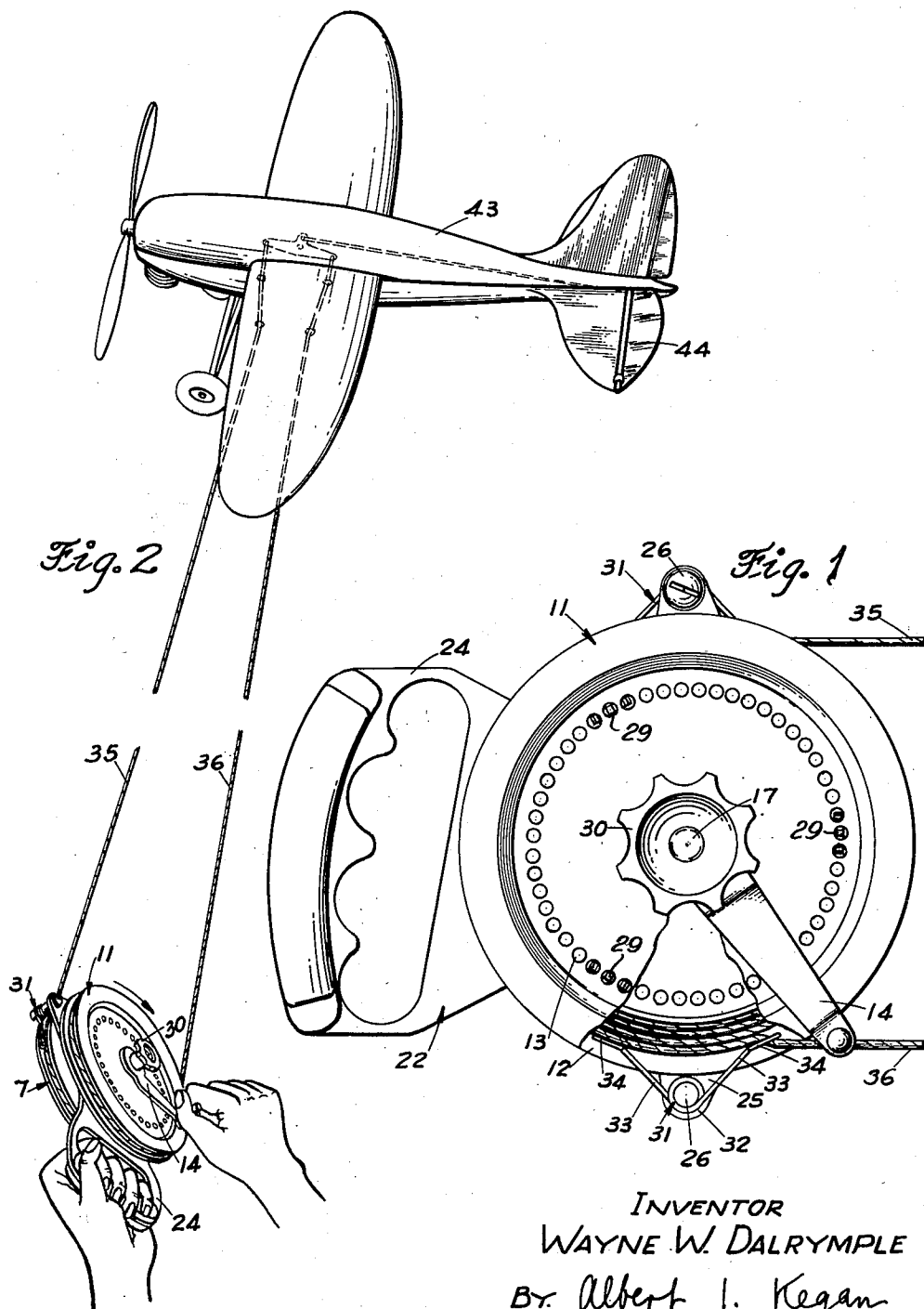
W. W. DALRYMPLE

2,536,875

CONTROL REEL

Filed April 1, 1947

3 Sheets-Sheet 1



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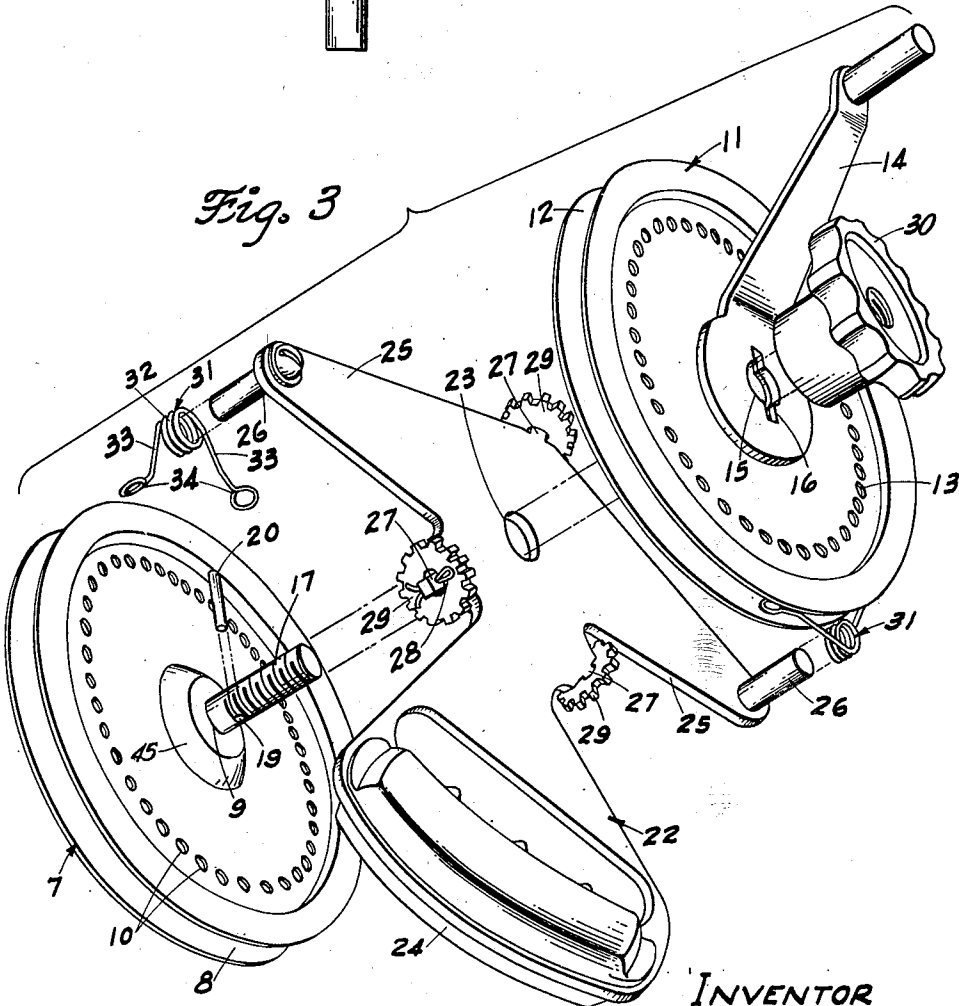
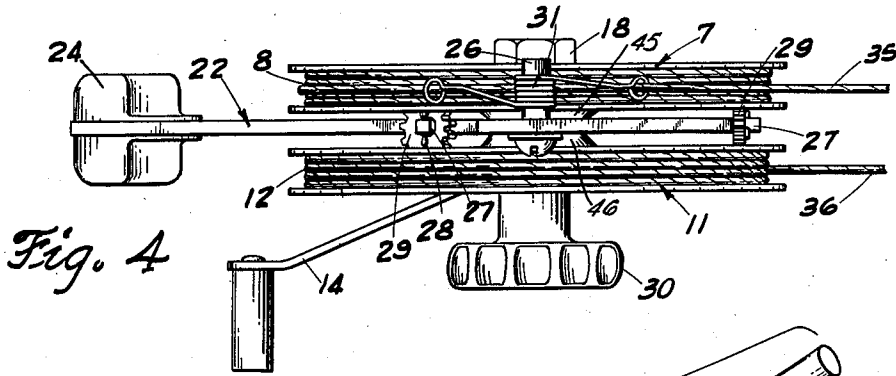
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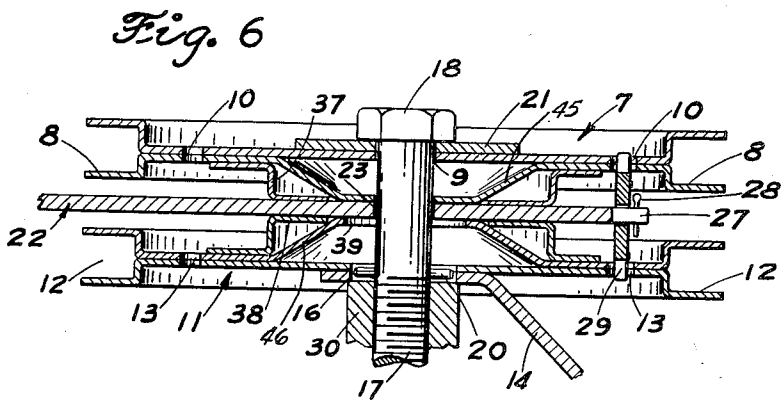
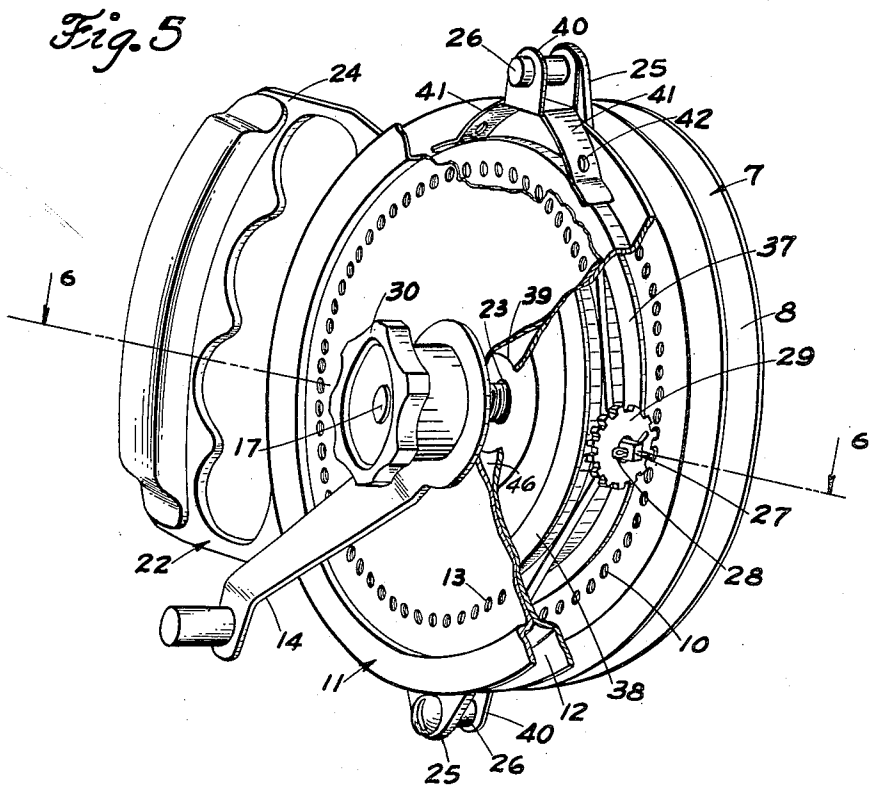
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CONTROL REEL

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,536,875

CONTROL REEL

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Application April 1, 1947, Serial No. 738,519

11 Claims. (Cl. 242—97)

1

This invention relates generally to means for controlling the motion of captive devices. More specifically the present invention pertains to reeling devices from which depend a pair of control lines, which in turn are coupled to the captive device.

In its broad aspect, my improved device, comprises a pair of laterally spaced sheaves or drums which are interconnected in such a manner that when one of the sheaves is rotated in a given direction, the other sheave rotates an equal degree in the opposite direction. Two control lines are wound oppositely about the two counter-rotating sheaves, respectively, and are led simultaneously either to or from the two sheaves at substantially diametrically opposed points. My device is preferably equipped with guides which prevent the control lines from becoming tangled or otherwise interfered with as they are led to or from the sheaves. In addition, my control reel preferably includes a type of journalling for the sheaves which permits adjustment of the lateral spacing therebetween. This lateral adjustment enables the two sheaves to be either locked together for braking or else separated so that they may be rotatably adjusted relative to each other.

Throughout the ensuing specification and appended claims the term "captive device" is used to generally designate model airplanes, captive balloons, model racing cars and boats, kites or the like. In order that the intrinsic usefulness of my invention may be more readily perceived, however, a specific example showing my novel reel used in conjunction with a model airplane is recited in detail hereinbelow.

Because of the erratic nature of the air currents, it is highly desirable to maintain complete control over the flight of model airplanes, and particularly that class of model airplanes which is power driven. Experience has indicated that a model airplane may be readily controlled by two control lines. A variation in the length of the lines permits the radius of flight to be changed. At the same time, a variation in the tension between the two lines permits the same to actuate control elements on the model airplane, which in turn determine the altitude at which the airplane flies. Through these two control factors either the altitude or the radius of flight of a captive device can be rapidly altered to meet fluctuating flight conditions.

It is a principal object of my invention, therefore, to provide a reel for effectively controlling the motion of captive devices through the medium

2

of two control lines which are simultaneously reeled on to or payed off the reel.

Another object of the present invention is to provide a reel for controlling the movement of captive devices, which reel is well balanced, reliable, convenient to use, and simple to manufacture.

The foregoing and such other objects, advantages and capabilities as are disclosed as this description proceeds, or which inhere in my invention, are illustrated in the accompanying drawings in which:

Figure 1 is a side elevational view of a preferred embodiment of my invention, having a portion thereof broken away to illustrate its interior construction;

Figure 2 is a perspective view illustrating the manner in which my invention is employed to control an airborne captive device;

Figure 3 is an exploded view showing in perspective the different components of the assembled reel shown in Figure 1;

Figure 4 is a top elevational view of the reel shown in Figure 1;

Figure 5 is a perspective view of another embodiment of my invention having a portion thereof broken away to illustrate said embodiment to better advantage; and

Figure 6 is a sectional view taken along the line 6—6 of Figure 5.

Like numerals refer to like parts in the drawings and in the description which follows:

Referring now more particularly to the embodiment of my invention shown in Figures 1 through 4 of the drawings, the numeral 7 generally designates one of a pair of sheaves. Sheave 7 includes a grooved edge portion 8, a hub portion 45 and a central bearing 9. A plurality of perforations 10 is formed in the face of sheave 7, which perforations generally define a circle concentric with and of a lesser diameter than the grooved edge portion 8. The perforations 10 are preferably of a configuration and spacing which readily permits meshing of the same with gear teeth, and for that reason the perforations 10 may be regarded as a circular rack gear. The other of said pair of sheaves is generally designated by the numeral 11 and is in most respects a mirror image of the sheave 7, since it includes a grooved edge portion 12, a hub portion 46 (Figure 4), and a plurality of perforations 13 which are identical to the grooved edge portion 8 and perforations 10, respectively. On the other hand, the sheave 11 is dissimilar from sheave 7 in that a crank 14 is rigidly secured to one face thereof. Also, the

sheave 11 is provided with a central bearing 15 having a diagonal slot or keyway 16 extending therethrough.

Both the sheave 7 and sheave 11 are mounted upon a shaft 17. That portion of the shaft 17 which journals the sheave 11 is of somewhat lesser diameter than the diameter of the bearing 9 and is accurately machined to give a smooth bearing surface. The end play of the sheave 7 is constrained by the flange 18 at the one end of the shaft 17. The balance of the shaft 17 which does not act as a bearing surface—as for example, that portion over which the sheave 11 fits—is externally threaded. A cylindrical opening 19 pierces the shaft 17 through the threaded portion, while a drive pin 20 of somewhat greater length than the outer diameter of said shaft is adapted to fit tightly within the opening 19. Since the outer face portion of the sheave 7 which is proximate the bearing 9 rotates relative to the constraining flange 18, I interpose a thrust washer 21 (Figure 6) between the flange 18 and the sheave 7. By this simple expedient potential abrasion of the sheave 7 is materially reduced, since much of the end thrust is taken up by the washer 21. Whereas the sheave 7 is free to rotate about the shaft 17, the sheave 11 is pinned to the shaft 17 upon assemblage by the pin 20 and slot 16 coupling.

The shaft 17, and accordingly the assembled sheave 7 and sheave 11, is journaled in a frame member which is generally designated by the numeral 22. A main bearing 23 extends through the frame member 22 and provides the means for journalling shaft 17 referred to above. Extending from the frame member 22 is a pistol-type grip 24. Also extending outwardly from the frame member 22, and in a direction substantially perpendicular to that of said grip 24, are two arms 25, 25. Each of the arms 25, 25 contains a pintle 26 at its outermost portion, the distance between the pintles 26, 26 and the axis of the main bearing 23 being somewhat greater than the radii of the sheaves 7 and 11. In addition, the pintles 26, 26 set oppositely in their respective arms 25, 25, so that they extend over the grooved edge portions 8 and 12 of the sheaves 7 and 11, respectively, upon assemblage of the reel.

Extending from the frame member 22 are three studs 27, 27, 27, the axes of which are normal to and intersect the axis of the main bearing 23. The three studs 27, 27, 27 are radially spaced from the main bearing 23 a distance equal to the radii of the circles generally defined by the perforations 10 and 13. In addition, the studs 27, 27, 27 are positioned at intervals of approximately 120° from each other to give a well balanced gearing system. Each of the studs 27, 27, 27 is pierced near its outer extremity to receive a cotter pin 28. Adapted to be inserted onto and journaled by the studs 27, 27, 27 are three pinion gears 29, 29, 29, each of which has a configuration such that it readily meshes with the perforations 10 and 13.

The first step in assembling the foregoing elements preferably comprises placing the pinion gears 29, 29, 29 on to the studs 27, 27, 27 and securing the same with cotter pins 28, 28, 28. The shaft 17 is then inserted into the bearing 9 of sheave 7, care being taken to interpose the thrust washer 21 between the sheave 7 and the flange 18. Following this, the shaft 17 is inserted through the main bearings 23 of the frame member 22, whereupon the drive pin 20 is forced through the cylindrical opening 19 until an equal

amount of the pin 20 projects on either side of the shaft 17. After inserting the drive pin 20 in the designated manner, the two ends thereof are centerpunched to make certain that the pin 20 will not work its way out in subsequent use of the reel. Following this operation, the sheave 11 is placed on the shaft 17 so that the slot or keyway 16 is engaged by the pin 20.

The next step is to ascertain that the pinion gears 29, 29, 29 are completely meshed with the perforations 10 and 13. The lateral spacing of the sheaves 7 and 11 is then adjusted to the desired lateral setting by threading an internally threaded brake knob 30 on to the threaded shaft 17 the required amount.

After completing the foregoing assemblage, two line guides generally designated by the numerals 31, 31 are journaled to the pintles 26, 26. The line guide 31, as is best shown in Figure 3 of the drawings, preferably consists of a coiled central portion 32 having two legs 33, 33 extending outwardly therefrom. The legs 33, 33 terminate in closed hoops 34, 34 which, for best performance, are contained within the grooved portion 8 (or 12) of the assembled reel. Since the coiled central portions 32 are essentially torsional springs, the legs 33 may be deflected from their null positions a relatively large amount without permanently deforming the line guides 31, 31. Accordingly the line guide 31 may be installed on the pintle 26 by inserting one of the hoops 34 in the groove 8 (or 12), springing the other hoop 34 up above the rim of the sheave 7 (or 11), and then pressing the coiled central portion 32 onto the pintle 26.

After the line guides 31, 31 are in place, the two lines or wires 35 and 36 are wound in opposite directions about the sheaves 7 and 11, respectively. I have discovered that the lines 35 and 36 have less tendency to become fouled if the outermost section of each line passes through only that hoop 34 which is more remote from the pistol grip 24.

The guide 31 is preferably placed on the pintle 26 with the coiled central portion 32 partially wound up. Hence, the two hoops 34, 34 tend to press downwardly upon the line 35 (or 36), thereby gripping and constraining the same.

A further modification of my invention is illustrated in Figures 5 and 6 of the drawings. By interposing two annularly-shaped spacer washers 37 and 38 between the sheaves 7 and 11, respectively, and the frame member 22, two of the three pintle gears 29, 29, 29 shown in Figure 3 may be dispensed with. The washers 37 and 38 are of somewhat smaller diameter than the diameter of the circles generally defined by the perforations 10 and 13, respectively, and act to maintain the sheaves 7 and 11, respectively, perpendicular to the shaft 17. Hence, the pinion gear 29 shown in Figures 5 and 6 merely interconnects the sheaves 7 and 11 and does not act as a spacer therebetween, as is the case where two or more pinion gears 29 are employed. I have found that this modification of my invention results in less binding between the gears 10, 13, and 29 of the system, and for that reason produces less wear on the gear teeth than would otherwise occur.

Since the spacer washer 38 provides ample lateral support for the inboard side of the sheave 11, it may be used to either augment or replace entirely the lateral support ordinarily derived from the inboard portion of the sheave 11 through which the central bearing 15 passes. Accordingly, when the sheave 11 is fabricated from two sec-

tions, as shown in Figure 6, the diameter of the opening 39 may be made larger than the length of the pin 20 without materially affecting the alignment of the sheave 11. This particular sizing of the opening 39 facilitates both engaging and disengaging the slot 16 with and from the drive pin 20, respectively. The advantages depending from this convenience in making and breaking the coupling between the sheave 11 and the shaft 17 will become more apparent as this exposition proceeds.

Figure 5 also illustrates sheet metal guides 40, 40 for guiding the lines 35 and 36 (not shown) to and from the sheaves 7 and 11, respectively, rather than the line guides 31, 31 shown in Figures 1 through 4. Functionally, the sheet metal guides 40, 40 are more or less identical with the line guides 31, 31, since the legs 41, 41 thereof restrain and guide the lines 35 (or 36), thereby eliminating snarling and fouling of the same. Similarly, the line 35 (or 36) should pass through only that opening 42 in the guide 40 which is distal from the pistol grip 24. Whereas the guides 31, 31 may be snapped into place after the sheaves 7 and 11 are assembled upon the shaft 17, the guides 40, 40 must be assembled more or less simultaneously with the journalling of the sheaves 7 and 11 to the frame member 22. The salient advantage which the sheet metal guides 40, 40 possess over the line guides 31, 31 resides in the relative ease with which the guides 40, 40 may be stamped and/or formed.

In all of the embodiments of my invention shown in the drawings, it is apparent that any rotation of the sheave 11 imparts an equal rotational effect to the shaft 17, since the sheave 11 is keyed to the shaft 17 by the drive pin 20. This arrangement is preferred, since it makes the adjustment of the lateral spacing between the sheaves 7 and 11 independent of any rotational effect. The sheave 7 is free to rotate about the shaft 17, however, and is rotationally constrained only through the interaction of the pinion gear or gears 29 and the perforations 10 and 13. As indicated above, the exact shape and positioning of the perforations 10 and 13 are such that they may for all intents and purposes be regarded as circular rack gears. The pinion gear or gears 29, as the case may be, act in the capacity of reversing or idler gears, since a given motion tangential to a point on a gear 29 is translated into an equal and opposite motion at a point diametrically opposed from the reference point. Hence, any rotational motion which is imparted to the sheave 11 by means of the crank 14 is reversed through the action of the pinion gear or gears 29, with the result that a counter-rotational effect between the sheaves 7 and 11 is obtained. This effect, of course, is the specific intent of the present invention, since it enables two control lines 35 and 36 to be led simultaneously to or from the sheaves 7 and 11, respectively, at two widely spaced points.

The manner in which the assembled reel controls the flight of an airborne captive device is clearly shown in Figure 2. The two control lines 35 and 36, which are wound oppositely about the sheaves 7 and 11, respectively, are in turn attached to a captive device such as the model airplane 43. Figure 1 best shows the manner in which the line 36 passes on to the sheave 11 through the hoop 34 of the guide 31. The line guides 31, 31 (or the sheet metal guides 40, 40, as the case may be) prevent the line from becoming fouled when either being reeled on to or

payed off the sheaves and, in addition, act to keep the lines 35 and 36 wound tightly about the same.

When the sheave 11 is driven in a particular direction by means of the crank 14, the action of the intermeshed gear or gears is such that the sheave 7 rotates oppositely from and in an equal amount to the sheave 11. For that reason, the control lines 35 and 36 simultaneously wind or unwind about the sheaves 7 and 11, respectively, at the same velocity. Since the control lines 35 and 36 may be reeled in or payed out at will, it is apparent that the captive device 43 may be flown at any convenient radii and that these adjustments may be performed without affecting in any way other flight control measures. On the other hand, it is only necessary to vary the relative tension between the control lines 35 and 36 to change the altitude at which the captive device 43 is flying. This change in relative tension may be readily accomplished by holding the arm steady and flexing the wrist up or down, as desired, thereby in effect pivoting the reel as a unit about an axis which is parallel to and spaced from the shaft 17. For example, if the reel is swung downwardly in the direction indicated by the arrow in Figure 2, using the wrist as a pivot, the instantaneous effect is to slacken the line 35 and tighten the line 36. When this occurs, the elevators 44 of the captive device 43 move in such a way as to equalize the tension between the lines 35 and 36, and in so doing act to either increase or decrease the altitude at which the captive device 43 flies. The particular type of elevator control mechanism shown in Figure 2 is but one of many, and is included solely for purposes of illustration.

By manually adjusting the lateral distance between the sheaves 7 and 11 through rotation of the internally threaded knob 30, the sheaves 7 and 11 may be either moved toward each other to bind the hub portions 45 and 46 to the frame member 22 and thereby brake rotational movement, or else moved apart and thereby disconnected to permit adjustment of the sheaves 7 and 11. This latter adjustment is particularly desirable, since it enables the relative tensions between the control lines 35 and 36 to be adjusted by means other than rotation of the reel itself. Also, any discrepancy between the lengths of the two control lines 35 and 36 may be readily corrected. When more than one pinion gear is used, this adjustment is best accomplished by maintaining the pinion gears 29, in mesh with the perforations 10 at all times during the adjustment, so that while the pinion gears 29 are not meshed with the perforations 13 they nevertheless are in some relative position one to the other. The adjustment then comprises moving the sheave 11 a sufficient distance laterally to disengage the perforations 13 from the pinion gears 29; rotating the disconnected sheave 11 relative to the sheave 7 until the desired tension between the control lines 35 and 36 is obtained; and then remeshing the perforations 13 with the pinion gears 29.

The elements described above are preferably stamped or otherwise formed from metal, such as steel or aluminum. Many aluminum and low density alloys are especially suitable, in view of their anti-corrosive properties and light weight. The weight of the total assemblage may be reduced still farther by replacing screws and rivets through spot or seam welding.

It is apparent that I have invented a control

reel for airborne captive devices which is extremely compact, well-balanced, and convenient to use. While I have shown and described a preferred embodiment of my invention as applied to airplane reels, it is to be understood that these embodiments have been given by way of example only, and that various changes and rearrangements of the details shown herein may be made without departing from the spirit of the invention, the scope of which is defined in the appended claims.

Having thus described my invention and illustrated its utility, I claim:

1. A reel for controlling the motion of a captive device through the medium of two control lines connecting said captive device with said reel, comprising: a frame member; a shaft journaled in and extending through said frame member; two sheaves on said shaft and rotatable relative to each other; annularly disposed gear means in that face of each of said sheaves proximal to the other of said sheaves; one or more reversing gears rotatably mounted on said frame member and adapted to mesh with said gear means in each of said sheaves; means for laterally moving said two sheaves relative to each other; and means for driving at least one of said sheaves.

2. A reel for controlling the motion of a captive device through the conjoint action of reeling in or paying out two control lines simultaneously and regulating the relative tensions therebetween, said reel comprising: a frame and a handle extending therefrom; a first sheave, means rotatably mounting said sheave upon said frame and having a circular rack gear in that face proximal to said frame; a second sheave, means rotatably mounting said second sheave upon said frame substantially symmetrical with said first sheave, said second sheave being substantially a mirror image of said first sheave upon mounting thereof; a plurality of pinion gears rotatably mounted on said frame and intermeshed with said first sheave and said second sheave; means for drivably rotating one of said sheaves, whereby the rotation of said one of said sheaves imparts an equal and opposite rotational effect to the other of said sheaves, and means for laterally moving said two sheaves relative to each other, whereby a lateral movement in one direction binds said pinion gears upon said rack gears and stops rotational movement therebetween, and whereby a lateral movement in the opposite direction permits the disengagement of said two sheaves for adjustment therebetween.

3. In a reel as specified in claim 2, two widely spaced guides adjacent the rim portions of said two sheaves, respectively, said guides attached to said frame, whereby said control lines are led toward and from their respective sheaves.

4. A reel for simultaneously reeling in or paying out a pair of control lines which are connected to a captive device, comprising: a frame member, a pair of laterally spaced sheaves pivotally connected to said frame member, said sheaves each having therein a plurality of spaced perforations generally defining a circle which is concentric with and of diameter less than the grooved portions of said sheaves, a plurality of pinion gears carried by said frame member and adapted to mesh with said perforations in said sheaves, said gears being positioned so that their respective axes of rotation intersect the axis of rotation of said sheaves, and crank means se-

cured to one of said sheaves for driving the same.

5. A reel for simultaneously reeling in or paying out a pair of control lines which are connected to a captive device, comprising: a frame member and a handle extending therefrom; a pair of laterally spaced sheaves of equal diameter, means journalling said sheaves to said frame member, said sheaves each having therein a plurality of spaced perforations generally defining a circle which is concentric with and of a lesser diameter than the grooved portions of said sheaves; three pinion gears journaled in said frame member and adapted to mesh with said perforations in said sheaves, said gears being positioned so that their respective axes of rotation are spaced through 360 degrees and intersect the axis of rotation of said sheaves; and a crank secured to one of said sheaves for driving the same.

6. In a device as set forth in claim 5, a pair of guides extending within the grooved portions of said pair of sheaves, respectively, said guides removably secured to said frame member and spaced approximately 180 degrees apart from each other.

7. A device as specified in claim 6, in which the means by which said laterally spaced sheaves are journaled to said frame member include a rotatable shaft journaled in said frame member, said shaft having a head on the one end thereof and external threads on the other end thereof, and an internally threaded member adapted to thread onto said other end of said shaft, whereby the lateral spacing of said sheaves on said shaft may be adjusted.

8. A reel for simultaneously reeling in or paying out a pair of control lines which are connected to a captive device, comprising: a frame member and a handle extending therefrom; a shaft journaled in and extending through said frame member; a first sheave journaled by said shaft on one side of said handle, said first sheave having a plurality of spaced perforations therein generally defining a circle which is concentric with and of a lesser diameter than the grooved portion of said first sheave; a first spacer washer interposed between said first sheave and said handle and having a lesser diameter than that of said spaced perforations in said first sheave; a second sheave journaled by said shaft on the other side of said frame member, said second sheave having therein a plurality of perforations substantially identical in form and arrangement to said perforations in said first sheave, said second sheave having a crank secured to that face which is outboard from said frame member; a second spacer washer interposed between said second sheave and said frame member and having a lesser diameter than that of said perforations in said second sheave; means locking said second sheave to said shaft; and a single pinion gear journaled in said frame member and adapted to mesh with said perforations in said sheaves, said gear being positioned so that its axis of rotation intersects the axis of rotation of said shaft, whereby the displacement of said handle causes said sheaves to revolve equally in opposite directions about said axis of rotation of said shaft.

9. In a device as specified in claim 8, two line guides extending within the grooved portions of said sheaves, respectively, said guides attached to said frame member at substantially diametrically opposed points on said sheaves, whereby

9

said control lines may be led on to and off said sheaves, respectively.

10. A device as set forth in claim 9, in which said shaft includes means for adjusting the lateral spacing of said sheaves thereon, said means comprising: a shoulder on one end of said shaft constraining the lateral movement of said first sheave away from said frame member, said other end of said shaft having external threads thereon; and a brake knob adapted to thread onto said other end of said shaft; whereby the lateral displacement of said brake knob toward said shoulder permits said sheaves to be locked together for braking, while a lateral displacement away from said shoulder permits said sheaves to be disengaged for rotational adjustment therebetween.

11. A reel for controlling the motion of a captive device through the medium of two control lines connecting said captive device with said reel, comprising: a frame member; a shaft journaled in and extending through said frame member; two sheaves on said shaft and rotatable relative to each other; annularly disposed gear means in that face of each of said sheaves proximal to the other of said sheaves; one or more reversing

10

gears rotatably mounted on said frame member and adapted to mesh with said gear means in each of said sheaves; a first circular spacer member interposed between one of said sheaves and said frame member, and having a diameter less than that of said annularly disposed gear means; a second circular spacer member interposed between the other of said sheaves and said frame member and having a diameter less than that of said annularly disposed gear means; means for laterally moving said two sheaves relative to each other; and means for driving at least one of said sheaves.

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