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AERIAL LANDING HARP FOR AEROPLANES

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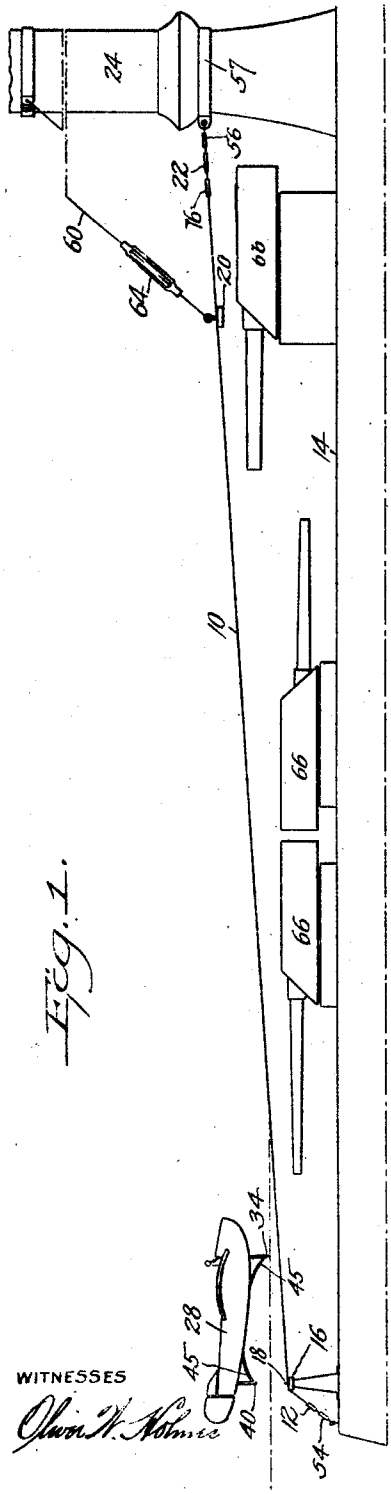


Fig. 1.

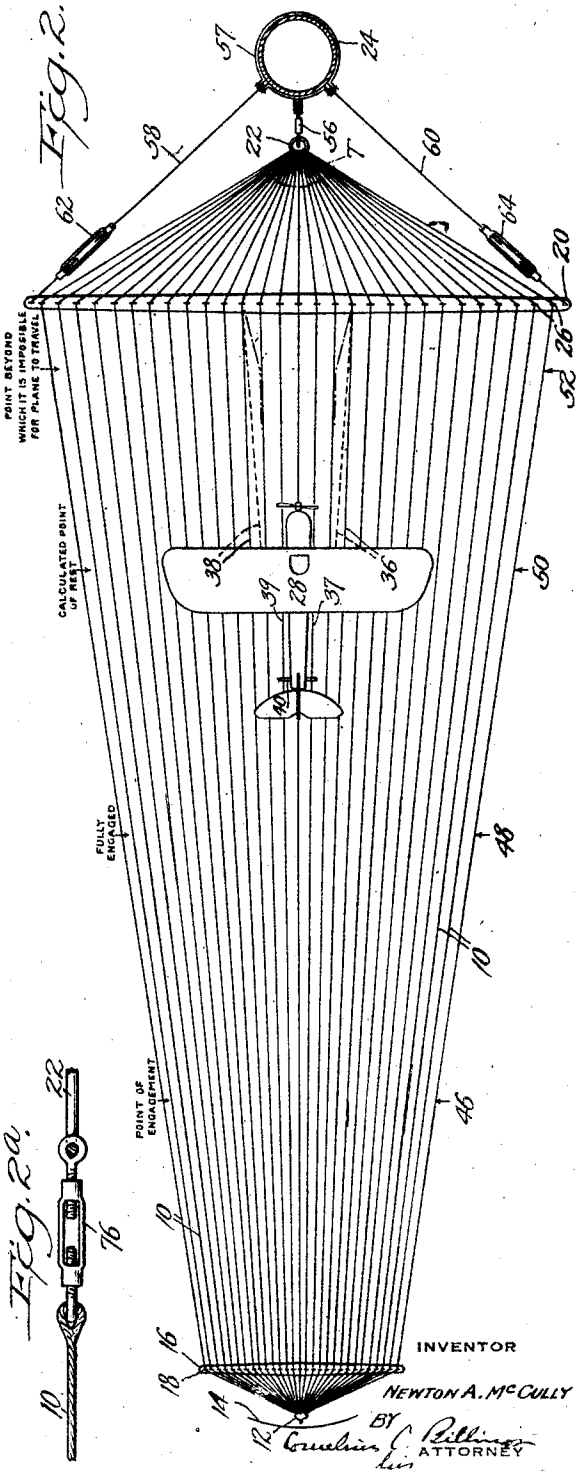


Fig. 2.

Fig. 2a.

WITNESSES

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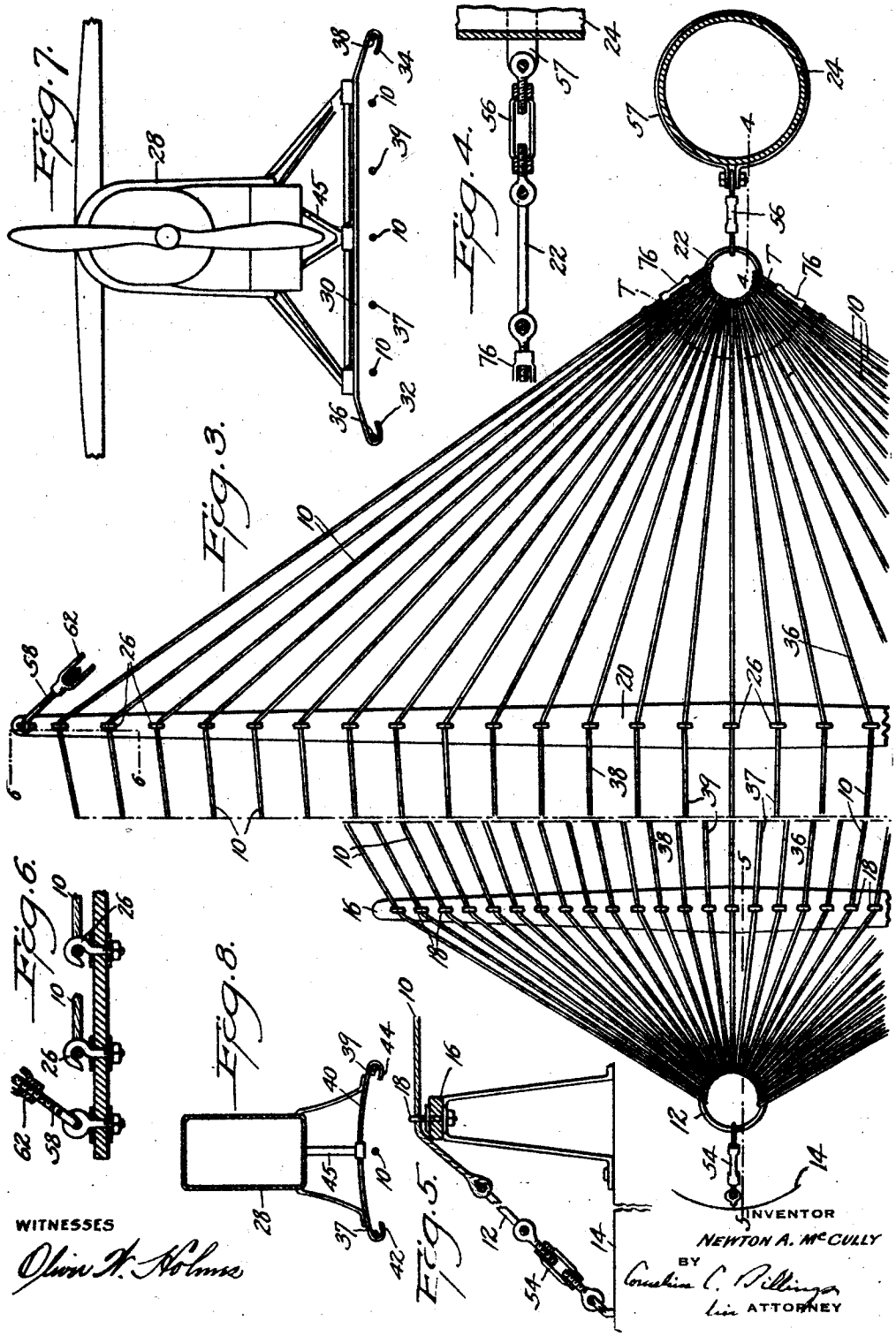
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WITNESSES

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UNITED STATES PATENT OFFICE.

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AERIAL LANDING HARP FOR AEROPLANES.

Application filed October 14, 1925. Serial No. 62,358.

My invention relates to apparatus for safely receiving and securing aircraft upon landing, and, more particularly, to landing apparatus capable of receiving an aeroplane when landing in restricted areas or quarters, as, for example, on the decks of ships or on the tops of buildings, or where an extensive, smooth, landing field is not available.

The objects of my invention are, among others, to provide landing apparatus of simple, inexpensive construction which may readily be installed and built without specially skilled labor; by which the aeroplane may be brought gradually to positive stop without the necessity for complicated arresting mechanism; which may be suspended in the air and neither in itself nor in any of its attachments create any eddies or disturbances of air currents; which does not require an absolutely accurate approach within a very small area, the aeroplane having a relatively wide choice of area in which to effect its landing; in which dangers of capsizing the aeroplane or of turning it end over end are avoided, and in which the arresting of the aeroplane in a safe, upright position is insured when engaging the landing apparatus in any portion throughout a wide area to enable landings at sea to be made while the ship or other support for the landing apparatus is rolling or pitching.

Other objects of the invention are to provide a self-contained harp or hammock shaped landing apparatus which is of comparatively light weight; which consists of a few parts to be stored in a restricted space, and can be rigged up as a unit and installed quickly on a war ship without interfering with gunfire; which can be installed on any vessel with little alteration of existing arrangements; and upon which the aeroplanes may land during an engagement with the guns beneath continuing an uninterrupted fire, and from which the aeroplanes may be readily disengaged, and lifted off by means of a boom, ready to repeat their flights.

With these and other objects in view, which may be more fully understood from the following description, the invention comprises the apparatus described in the following specification and claims.

The various features of the invention are illustrated in the accompanying drawings forming a part of this specification, which:

Fig. 1 is a somewhat diagrammatic side view of an apparatus embodying a preferred form of my invention as applied to the after or quarter deck of a war ship,

Fig. 2 is a plan view of the landing apparatus shown in Fig. 1, Fig. 2ª is a detail showing an adjustable cable connection.

Fig. 3 is a plan view on a larger scale of the apparatus, the apparatus being shown foreshortened for the sake of compactness and clearness of illustration,

Fig. 4 is a vertical sectional view of a portion of the apparatus taken on line 4—4 of Fig. 3,

Fig. 5 is a detail sectional view taken on line 5—5 of Fig. 3,

Fig. 6 is a detail sectional view of a portion of the apparatus taken on line 6—6 of Fig. 3,

Fig. 7 is a front, vertical, view of an aeroplane and a section of the engaging portion of the landing, and,

Fig. 8 is a corresponding similar view in cross section through the rear portion of the aeroplane.

In my present invention, the landing harp comprises a hammock shaped apparatus consisting of a number of gradually diverging, tightly stretched, wires or cables which the aeroplane engages by means of depending spaced hooks and, as it moves forwardly lengthwise of the wires, compresses or otherwise deflects the diverging portions of the wires or cables and is thus brought to rest. The gradually diverging cables of the landing apparatus are arranged in a single plane which slopes slightly upwardly towards its forward end in order not only to provide an inclined plane but also to clear the turrets of the ship, but which is otherwise approximately horizontal. The forwardly diverging ends of the wires are secured to a transverse spar or spreader, which may be suspended from a mast of a ship, while the rear converging ends of the cables are rigidly mounted upon standards secured to the deck, this manner of supporting the cables thus permitting them to be mounted above the guns, turrets or other apparatus on the deck of the ship and to be tilted to compensate for the rolling of the ship. A sufficient width of nest or series of cables is provided so that the aeroplane may engage them throughout a relatively wide transverse area.

Referring more particularly to the accompanying drawings, the landing apparatus comprises a number of wires or cables 10 secured in a ring 12 anchored to the deck of a

ship 14 at the extreme after end thereof or other suitable base and extending forwardly over a horizontal support or rail 16 positioned athwartships and slightly forwardly of the after anchorage or securing cleat for the wires. As the wires or cables 10 extend over the support 16 they are spread horizontally thereon at evenly spaced distances by means of spaced hooks 18 projecting upwardly from the support or rail and then extend forwardly in a single, upwardly inclined plane to, and over a forward, transverse spreader or spar 20, and each cable is secured by a turnbuckle to a ring 22 which in turn is secured preferably by a turnbuckle 56 to a mast-band 57 secured to the mast 24 in any suitable way, as by bolts, at any suitable height. The turnbuckle for each cable is illustrated in Figs. 2ª and 4, and the group of turnbuckles for the entire series are designated by the reference T because of the limited space in the drawings. In passing over the spar 20, the cables are spaced uniformly thereon by means of hooks 26 which are spaced at greater distances apart than the spacing of the hooks 18 on the support or rail 16 so as to cause the wires 10 to diverge forwardly.

To engage the wires 10 of the landing apparatus, an aeroplane 28 is provided with a flat, transverse, rod or bar 30 suspended horizontally at a short distance below the forward part of the aeroplane and provided at its ends with downwardly and inwardlly curved hooks 32 and 34, which, as the aeroplane drops onto the wires and moves forwardly, hook about a pair of wires 36 and 38, respectively of the wires 10. The rear portion of the aeroplane is also provided with a horizontal bar or rod 40 having downwardly and inwardly curved hooks 42 and 44 at its ends spaced more closely to each other to engage the rear, converging, portions of the wires 37 and 39. The horizontally arranged hooked bars or rods 30 and 40 are braced to the aeroplane by suitable girders 45 to withstand the strains and stresses to which they will be subjected.

As the aeroplane lands on the apparatus, it drops onto the after portion of the wires or cables 10 at about a distance from the rear indicated at the number 46 in the drawings, the hooks 32 and 34 lying immediately outside of a pair of nonadjacent cables or wires 36 and 38, as clearly shown in the drawing, and the hooks 42 and 44 will engage a pair of nonadjacent inner cables 37 and 39, also as clearly shown, the bars 30 and 40 resting upon said cables. As the aeroplane moves forwardly, the hooks 32 and 34, and 42 and 44 fully engage the cables as indicated in Figs. 7 and 8, this condition being reached as the aeroplane reaches a position about on a line with the point marked 48 in the drawings (Fig. 2). As the aeroplane moves forwardly from the line 48, the wires or cables 36 and 38 and 37 and 39 being held respectively at a fixed distance by the hooks 32 and 34 and 42 and 44 are deflected from their gradually diverging spacing and are caused to diverge very sharply from the engagement with the hooks 32 and 34 of the aeroplane to the hooks 26 on the spar 20, as indicated by the broken lines in Fig. 2. The deflection of the wires or cables causes a strong rearward or after thrust on the aeroplane which increases very sharply as the aeroplane moves forwardly not only increasing the tension of the cables but also the angle of the slope which reacts against the hooks of the aeroplane. Deceleration is caused principally, if not wholly by the rearward or after thrust produced by this deflection of the engaged wires. Ordinarily, this reaction should bring the aeroplane to rest as it reaches a distance on a line with the number 50 but an aeroplane travelling at an abnormal landing speed may travel somewhat further. As the aeroplane approaches a distance on a line with the number 52, the angle of deflection of the wires or cables 36 and 38 becomes so great as to positively stop the plane, this sudden deflection being indicated by the dot and dash line of Fig. 2.

As a large number of supporting wires or cables may be provided in a moderate space, and as the engagement of the outer of the aeroplane hooks with any of the wires from or between the outermost wires of the apparatus will serve to hold the plane on the apparatus, a comparatively wide field or area of choice for the aeroplane to land on is provided. Moreover, regardless of the angle at which the aeroplane may be travelling, within limits, when reaching the wires 20 it will travel forwardly on the apparatus without danger of running over the edges. The upward forward slope of the cables also tends to right the aeroplane regardless of the angle of its incidence with the wires or its rolling or sidewise tilting. The cables or wires 10 should be of sufficient strength to withstand the stress produced by the deflecting action of the aeroplane, wires of ¾ inch diameter of flexible steel cable having a breaking strength of twenty tons being suitable, and the wires are provided with turnbuckles to enable them to be brought to and maintained at the proper tautness. However, should a cable break or part, the hooks of the aeroplane will immediately engage an adjacent cable. Each cable separately, and the cables as a group, will also be adjusted to the proper degree of tautness by means of the turnbuckle 76 on each cable and the turnbuckle 54 between the after ring 12 and the anchorage at or adjacent to the taffrail of the ship and the turnbuckle 56 between the forward ring

22 and the mast-band 57 encircling the mast 24.

The after mounting of the wires is preferably fixed in relation to the taffrail of the ship but the suspension of the spar 20 is such as to permit the spar to swing or tilt or vibrate relative to the ship and thus to remain level or substantially level as the ship rolls. To further support the forward spar, guy wires or ropes 58 and 60 extending from or near the "top" of the mast 24 to the opposite ends of the spar. The guy wires or ropes 58 and 60 may be tautened by means of turn buckles 62 and 64, or suitable tackle.

The apparatus is such that it may be suspended above turrets 66 or other structures on the deck of a ship and thus not interfere with the usual gunfire. The cables may also be easily and quickly detached and lifted out of position. For this purpose, the ring 12 may be dismounted from its anchorage to or near the taffrail of the ship and then brought forwardly and upwardly, the cables being readily dismounted from the hooks 18 and also from the hooks 26 on the spar 20, the wires or cables being thus brought into a compact strand and may be readily stored.

As the apparatus is of a very simple and of comparatively light construction it may be made of sufficient strength to meet all conditions of operation without bringing it to a troublesome weight. As the cables comprised in the apparatus offer no substantial resistance to the air through which they move, they create no objectionable currents or eddies and as they are mounted above the eddies and currents that may be created by the ship or other mounting base, a quiet atmosphere is provided for the landing of the aeroplane.

The apparatus constructed as above described, which, when inclined as by the rolling of a ship, causes an aeroplane in level flight when first engaging the nest of wires or cables to assume a position in their plane, and so effectively insure engagement.

As changes of construction could be made within the scope of my invention, it is intended that all the matter contained in the above description or shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of a series of cables, each of said cables being secured at their respective ends to single elements, means for supporting and spacing said cables one from the other situated near the forward and rear ends thereof respectively, means on said supports to engage and hold the cables, the cable engaging means on the forward support being spaced at greater intervals than the cable engaging means on the after support, the engaged cables diverging from said after to said forward support, and means for anchoring the respective ends of the harp to fixed supports to hold the harp in suspension.

2. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of a series of cables, each of said cables being secured at their respective ends to rings, bars for supporting and spacing said cables one from the other situated near the forward and rear ends thereof respectively, hooks on said bars to engage and hold the cables, the hooks on the forward bar being spaced at greater intervals than the hooks on the after bar, the engaged cables diverging from the after to the forward supporting bar, means for anchoring the respective ends of the harp to fixed supports to hold the harp in suspension.

3. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of an after support, a forward support at a higher level than said after support, hooks at spaced intervals on said supports, the hooks on said forward support being spaced at wider intervals than those on said after support, and spaced cables extending between said hooks and diverging and sloping upwardly for the continuous distance between the after and the forward support.

4. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of a fixed after support, a suspended, substantially horizontal, forward support and cables at spaced intervals extending from said after to said forward support and diverging continuously from said after to said forward support.

5. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of a fixed after support, a suspended, substantially horizontal, forward support at a higher altitude than said after support, and cables at spaced transverse or athwartships intervals extending from said after to said forward support and diverging continuously from said after to said forward support.

6. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of a fixed after support, a suspended, substantially horizontal, forward support at a higher altitude than said after support, hooks at regularly spaced intervals on said after support, hooks regularly spaced at wider intervals on said suspended support, and cables extending between said hooks of said after and said forward sup-

ports and slightly diverging for the continuous distance from said after to said forward supports.

7. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of a series of cables grouped together, each cable being secured at its after end to a base by a common securing means, and each cable being secured at its forward end to an upright by a common securing means, an after support for said cables, hooks on said support at spaced intervals to guide said cables, a subtantially horizontally disposed spar suspended from said upright, and a series of hooks on said spar spaced at wider intervals than those on said after support to hold said wires slightly diverging in a forward direction throughout the entire distance between the after support and the horizontally disposed spar.

8. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of a series of cables, anchored at their after ends by a common securing means to a base and at their forward ends by a common securing means to a mast, a horizontal after thwartship support for said cables, a supporting spar at the forward ends of said cables, guy wires or ropes for said spar, and spacing means on said after support and on said spar to hold said cable in spaced positions and slightly diverging forwardly throughout the entire distance between the after support and the spar.

9. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of a series of spaced, taut, cables each diverging forwardly from the other, and an aeroplane having depending inwardly curved hooks to engage and deflect any pair of non-adjacent cables of the series as said areoplane moves forwardly thereover and thereupon.

10. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of a series of spaced cables stretched slightly out of parallel with each other between supports at fixed distances, and an aeroplane having means to engage any pair of non-adjacent cables of the series and compress them as it travels lengthwise thereof.

11. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device provided with an after support, a forward support, forward and after rings, a spar immediately aft of the forward ring, hooks at spaced intervals on said spar and on said after support, and cables stretched between said rings and held in spaced relation by the hooks on said spar and said after support, the hooks on said spar being spaced at wider intervals than those on said after support.

12. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of an after horizontal support, a forward supporting mast, forward and aft rings, a spar immediately after of the forward ring, hooks at spaced intervals on said spar and on said after support, and cables stretched between said rings and held in spaced relation by the hooks on said spar and said after support, the hooks on said spar being spaced at wider intervals than those on said after support.

13. An aerial landing harp for aeroplanes comprising a unitary hammock shaped device consisting of a series of single cables divergingly spaced for the entire distance between a pair of supports at fixed distances from each other, and an aeroplane having means to engage any pair of non-adjacent cables in travelling lengthwise thereon, and to create a rearward thrust by deflection of the engaged cables in travelling thereon.

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