June 11, 1929. L. B. SPERRY 1,716,670

DEVICE FOR LAUNCHING AND LANDING AEROPLANES FROM AND UPON SUSPENDED POSITIONS

Filed June 27, 1922 3 Sheets-Sheet 1

Fig. 1.

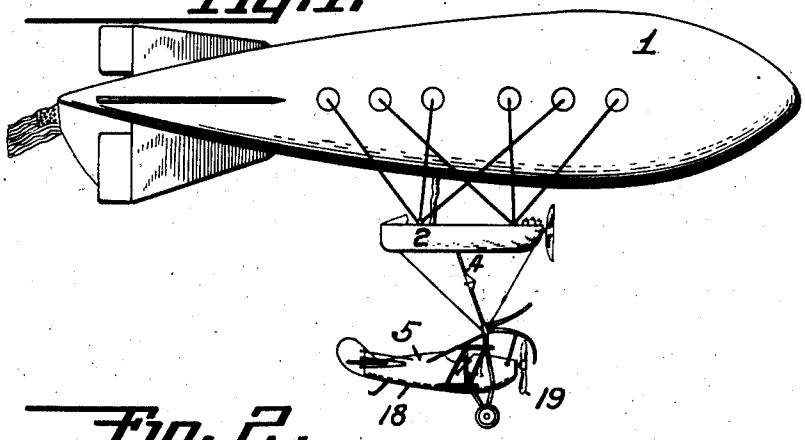
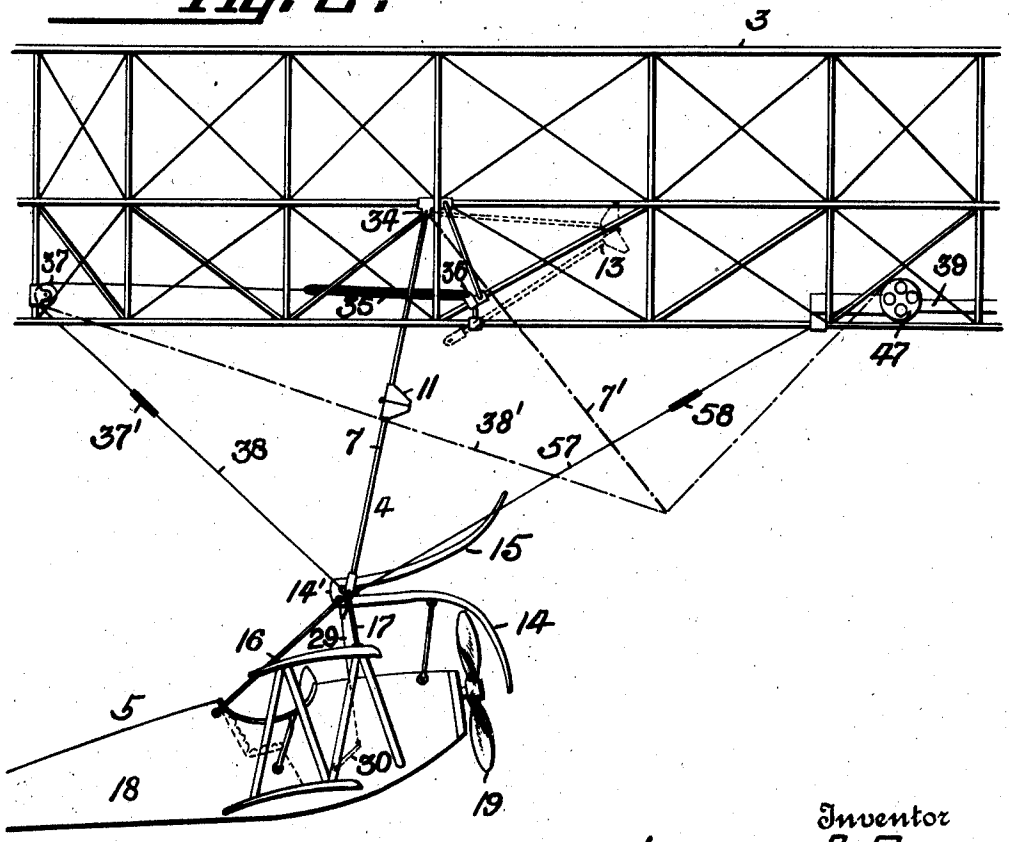


Fig. 2.



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Filed June 27, 1922 3 Sheets-Sheet 2

Fig. 3.

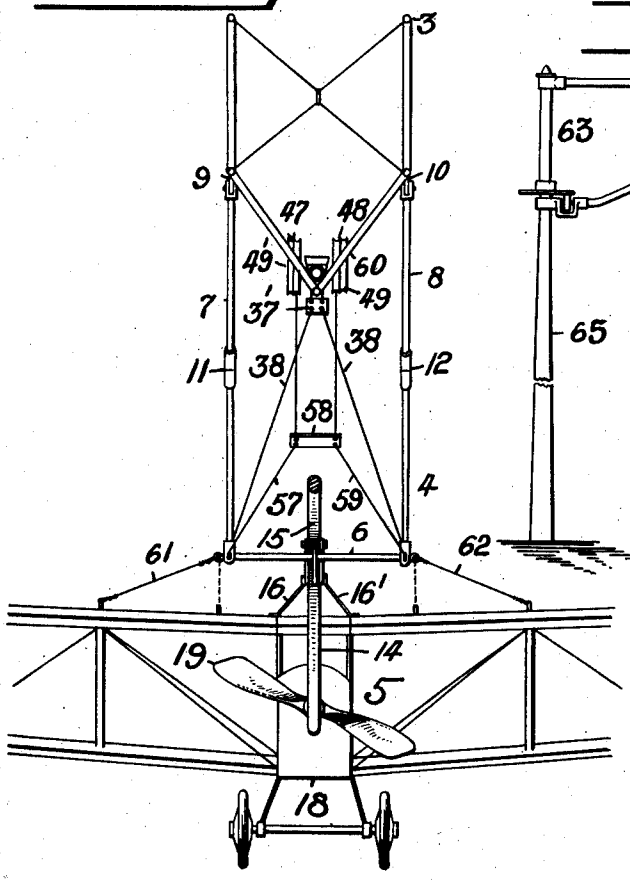
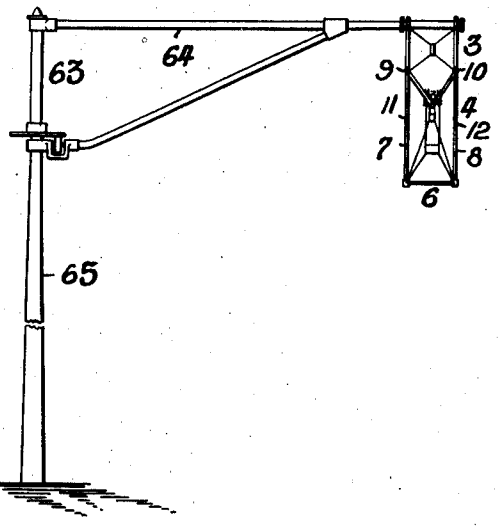


Fig. 4.



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DEVICE FOR LAUNCHING AND LANDING AEROPLANES FROM AND UPON SUSPENDED POSITIONS

Filed June 27, 1922 3 Sheets-Sheet 3

Fig. 5.

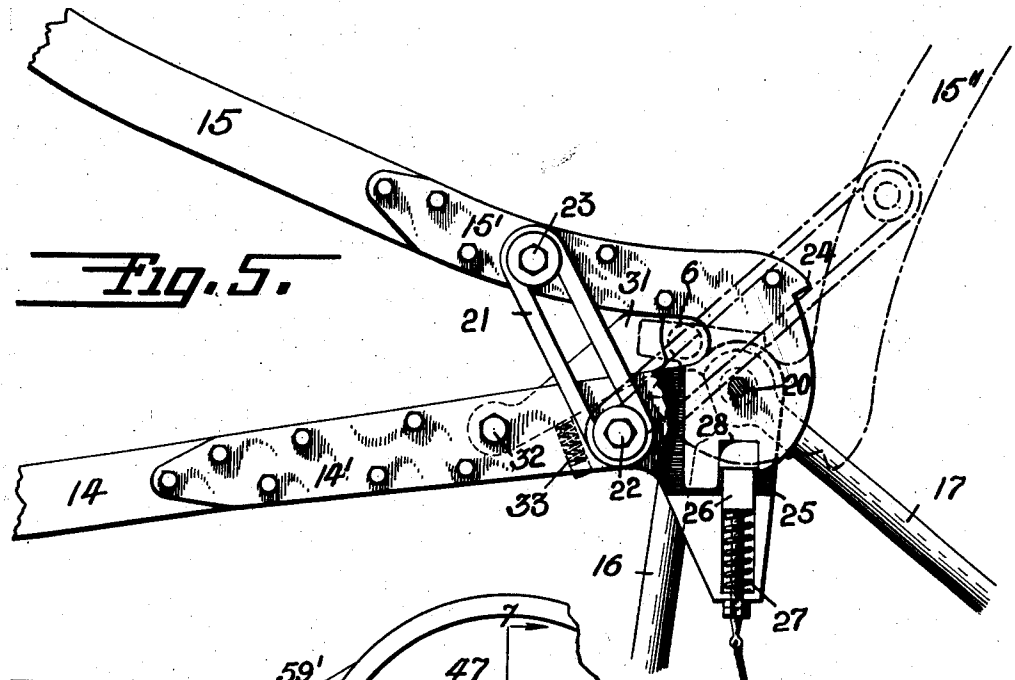


Fig. 6.

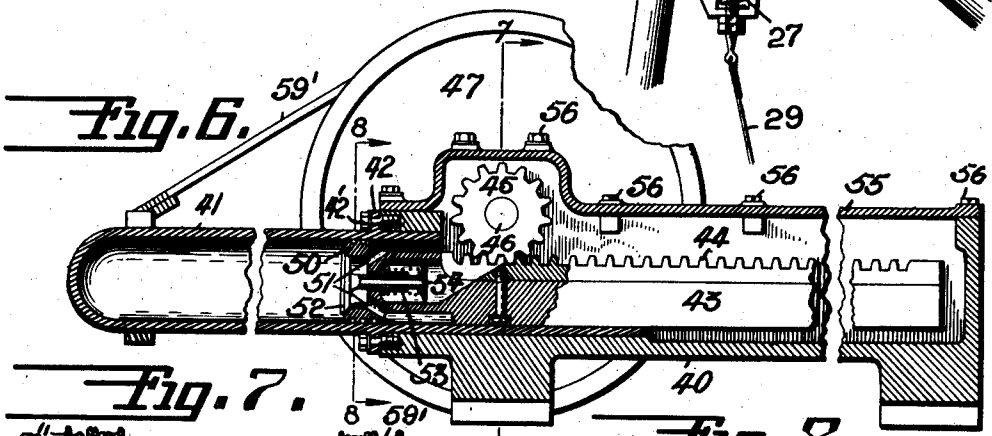


Fig. 7.

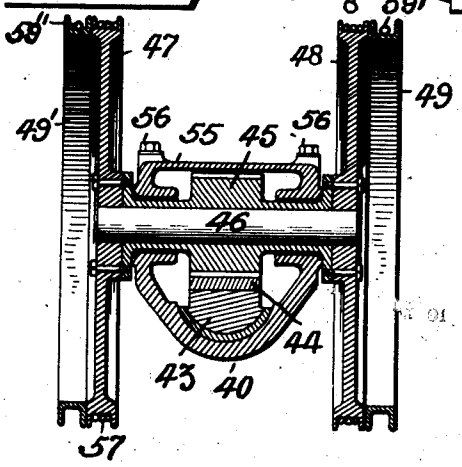
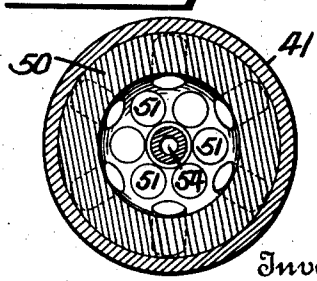


Fig. 8.



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Patented June 11, 1929. 1,716,670

UNITED STATES PATENT OFFICE.

LAWRENCE B. SPERRY, OF FARMINGDALE, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO LAWRENCE SPERRY AIRCRAFT COMPANY, INC., OF FARMINGDALE, LONG ISLAND, NEW YORK, A CORPORATION OF NEW YORK.

DEVICE FOR LAUNCHING AND LANDING AEROPLANES FROM AND UPON SUSPENDED POSITIONS.

Application filed June 27, 1922. Serial No. 571,252.

This invention relates to aeroplanes. More specifically, it relates to the launching and landing of such machines from and upon suspended positions.

In the naval service, mother-ships are employed for aeroplanes. Due to mines, submarines, hostile bomb dropping aircraft and other causes, mother-ships cannot always be safely employed. Also, in land warfare, heretofore, there has been nothing to take the place of mother-ships. I propose to use dirigibles, balloons, or other lighter-than-air craft as mother-ships for aeroplanes in both services. Suitable means are provided for carrying the aeroplane on such craft, launching it therefrom and its return thereto.

I accomplish this result by suspending a yielding member from the dirigible, or other craft, preferably a trapeze, provided with suitable energy dissipating or shock absorbing mechanism, and by equipping the aeroplane with suitable mechanism for engaging the member carried by said carrier.

The use of my invention, however, is not necessarily confined to military or naval service, since the aeroplane could be used with commercial carriers in messenger, or other service. Nor, is my invention limited to use with carriers, since it can be employed where suitable launching or landing fields are not available, as for instance, on board ship or on buildings, in which cases, the swinging mechanism is supported by suitable means.

My invention will be better understood from the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

In the drawings illustrating what I now consider to be a preferred form of my invention,

Fig. 1 is a side elevation of a dirigible and aeroplane showing the embodiment of my invention;

Fig. 2 is an enlarged detail of Fig. 1 illustrating the supporting mechanism carried by a dirigible;

Fig. 3 is a front elevation of Fig. 2.

Fig. 4 is a modified form of my invention.

Fig. 5 is an enlarged detail of the mechanism carried by the aeroplane for engaging the supporting mechanism.

Fig. 6 is a sectional side elevation of the shock absorbing mechanism controlling the trapeze;

Fig. 7 is a section taken on the line 7—7 of Fig. 6.

Fig. 8 is a section taken on the line 8—8 of Fig. 6.

Referring to the drawings, the numeral 1 indicates a conventional type of dirigible, carrying a gondola or cabin 2, in which is located a supporting frame 3, for a suspension means or trapeze 4, from which an aeroplane 5 is shown suspended. The trapeze may consist of a horizontal bar 6, supported by two rods 7 and 8, pivotally secured to the frame 3 at 9 and 10, respectively, as shown in Fig. 3, and is arranged to swing in a plane parallel to the longitudinal axis of the dirigible, that is, in the direction of its travel, in a manner readily understood. The rods 7 and 8 are respectively provided with hinged shoulders 11, 12, located substantially at their middle portions, in order that said rods may be doubled up and the trapeze stored within the gondola, when not in use, in the manner indicated by the dash and dot lines 13 in Fig. 2 in which position it will not offer any wind resistance.

The aeroplane 5 is provided with two curved members 14, 15, supported in a vertical plane in the axis of the aeroplane, with their ends diverging and pointing in the direction of travel, as shown in Fig. 2, which serve as guides for landing on the trapeze. The guides 14, 15, are rigidly secured to metallic supporting members 14′, 15′, respectively, as shown in Fig. 5. The lower member 14′ is rigidly supported by rods 16, 16′ and 17, 17′, extending from the fuselage 18 in the manner hereinafter indicated. The guide member 14 is designed to extend over and in front of the propeller 19, so as to guard the propeller when the aeroplane is landed, or hooked on the trapeze. The upper member 15′ is rotatably mounted on an axle 20 supported by rods 17, 17′, and is normally urged toward the member 14 by any suitable resilient means, such as a heavy rubber band 21. This band may be held in operative position by means of bolts and washers at 22, 23, as shown in Fig. 5. On its outer edge, near its pivoted end, the member 15′ is provided with a stop 24 to limit the upward movement of arm 15, by striking a projection 25 formed on mem-

ber 14′. The member 15′ is locked in a closed position, as indicated in Fig. 5, by a latch 26, arranged to move in a suitable slot formed in member 25, and normally urged into engagement with the member 15′ by a spring 27. Said member 15′ has a slot 28 suitably located to be engaged by latch 26, when in a closed position. A cable 29 is suitably attached to said latch, and at its opposite end is secured to a foot lever 30, located in the cockpit of the fuselage, as indicated in dash and dot lines in Fig. 2, so that the aviator may operated the latch by foot. A trigger 31, pivoted at 32 on member 14′, is normally urged upwardly against the member 15′ by a spring 33, for a purpose to be later described. As the aeroplane approaches the trapeze for the purpose of hooking thereon, the mechanism carried by it just described, is in the locked position, with its several parts in the relation shown in Fig. 5. The aviator will pilot his machine to strike the horizontal bar 6, with either of the guides 14, 15 at some point between their extreme ends. The continued flight of the machine is directed by the curvature of said guides, which causes the bar 6 to strike against the rubber band 21, and to compress and ride over trigger 31, which is then returned to its normal position by spring 33. The bar 6 indicated by dotted lines is held between the locked members 14′, 15′, as shown in Fig. 5 in a manner readily understood.

When it is desired to land the aeroplane on a dirigible, since both bodies are in motion, obviously, the dirigible is preferably approached from the rear. The aeroplane follows in the path of the dirigible at a somewhat greater speed, generally considered to be about 30 feet per second more than the speed of the dirigible at the time the aeroplane is hooked on the bar 6 of the trapeze in the manner just described. When so hooked, the momentum of the aeroplane causes it to carry the trapeze forward about its axis 34. The engine of the aeroplane now having been stopped, the air resistance of the planes tends to retard the aeroplane, but in order further to assist this retarding process, and more rapidly decelerate the aeroplane, a shock absorbing system has been provided. Any suitable agent may be employed for this purpose, such as steel springs, and the like, but I preferably use a rubber cord system. A suitable number of rubber cords 35 of proper diameter are secured to the frame 3, preferably at a point in a vertical plane, through the longitudinal axis of the dirigible located below the axis of the trapeze, as indicated at 36. Two suitable guide pulleys in axial alignment are located on the rear end of the frame 3, when its forward end is regarded as that facing the direction of travel. But one of these pulleys, indicated at 37, is visible in Fig. 2, which, it will be observed is in substantially the same horizontal plane as point 36. A cable 38, is suitably secured at one end to a point near the lower end of rod 7, passes over one of the pulleys 37, and extends forward to the rubber cords 35, to which it may be secured or through whose loops it may pass. From these rubber cords, the cable 38 continues rearwardly to the other pulley 3, over which it passes, and continues downwardly to a point located near the lower end of rod 8, to which it is suitably secured. A suitable block 37′ for guiding the cable 38 to the pulleys 37, is preferably located between the said pulleys and the trapeze as shown in Figs. 2 and 3. The trapeze pendulously hangs downwardly from hinge 34 as shown in Fig. 2, its substantially vertical position being normally maintained by the frictional resistance of the cable system. From the foregoing, it will be seen that when the rod 6 of the trapeze is engaged by the aeroplane hooking mechanism, the trapeze swings forward about its axis 34, to a position indicated in dash and dot lines at 7′, (see also Fig. 1) during which movement the cable 38 has traveled to a position indicated by similar lines at 38′, which movement has been opposed by the rubber cord 35, thereby decelerating the aeroplane in a manner readily understood. In accordance with well known laws governing pendulous bodies, the aeroplane will retrace its movement in the opposite direction, from its limit of forward swing, which return movement is accelerated by the contraction of the cords 35. It has therefore been necessary to provide a decelerating system for such recoil. I preferably use an oil controlled device for this purpose, although any other suitable recoil system could be employed. This recoil device is suitably supported on the forward end of frame 3, beyond the forward swinging limit of the trapeze as indicated at 39 in Fig. 2.

As shown in Fig. 6, the recoil device consists of an elongated walled casing 40 open at one end. This casing is mounted with its open end facing the forward end of frame 3. A cylinder 41, closed at one end is fitted at its opposite end into the open end of said casing and secured thereto by means of a collar 42, formed on the outside of the cylinder, and screw bolts 42′. A piston 43 is within the casing 40 arranged to reciprocate within the cylinder 41. The piston carries a rack 44 which is engaged by a pinion 45 on a shaft 46 which carries drums 47, 48, 49 and 49′. The piston head 50 is formed with a number of passageways 51, best illustrated in Fig. 8 leading from the casing 40 into the cylinder 41, which are controlled by a valve 52. The valve 52 is held in its seat by a spring 53 in the usual manner. A passageway 54 extends through the valve 52 connecting the inner part of casing 40 with the cylinder 41, both of which are filled with a suitable oil. A cover 55 arranged to fit the casing 40 is secured into posi-

tion by bolts 56, so as to form a single oil filled chamber of cylinder 41 and casing 40. A cable 57, secured at one end near the lower end of rod 7, extends forward to a suitable guide block 58, and thence to drum 47. A similar cable 59 secured at one end near the lower end of rod 8, extends forward to block 58 and thence to drum 48. Obviously, the rotation of drums 47 and 48, will cause the piston 43 to move, through the rotation of pinion 45 on rack 44. In its backward swing from the position 7', the trapeze will, through cables 57, 59, rotate the drums in a clockwise direction as viewed in Fig. 6, that is, cause the pinion 45, through the rack 44, to move the piston into the cylinder 41, which movement is regulated by the flow of oil through the central passage 54 of valve 52. To again restore the piston to operative position, a second set of drums 49, 49' has been provided, which is arranged to be rotated in a counter-clockwise direction as viewed in Fig. 6, and thereby actuate the pinion and rack in a direction opposite to that just described. The counter-clockwise rotation of drums 49, 49' may be caused in different ways, but I preferably use rubber cords 59' and 59'', secured at one end to the frame 3 at 60, see Fig. 3, and at their opposite ends to the drums 49, 49', respectively. When drums 49, 49' are rotated in a clockwise direction, the cords 59', 59'' are wound thereon, that is, during the period of the return movement of the trapeze. As the trapeze swings forward, the rubber cords 59', 59'' are free to rotate the drums 47, 48 and return the piston to its original position in the manner described. In order to accelerate this return movement, the passages 51 and valve 52 have been provided. As will be readily understood, the flow of oil through the numerous passages 51 will unseat the valve 52, and thereby permit the comparatively free passage of oil from the casing chamber to the cylinder.

In view of the foregoing detailed description, the operation of my invention may be briefly described. Assuming that the aeroplane is in flight, and it is desired to make a landing on the trapeze of the dirigible, the aeroplane will approach the dirigible from the rear, with the upper guide rod mechanism in locked position as shown in Fig. 5. On striking bar 6 of the trapeze with either of the guides 14 or 15, the aeroplane is guided so as to cause the bar 6 to ride over the trigger 31, where it is held by the trigger. The continued forward movement of the aeroplane is decelerated by the rubber cords 35. During this forward movement, the piston 43 is set in an operative position through the counter-clockwise rotation of drums 47, 48, 49, 49', by cords 59', 59''. On reaching the limit of its forward movement, the return movement of the aeroplane is decelerated through the action of piston 43, the movement of which is limited by the flow of oil through the central passage 54.

On reaching a stable position, the aeroplane will be supported with its tail end downward, as shown in Fig. 2, in which position the planes of the aeroplane will offer a greater air resistance when the carrier is in flight. The supports 16, 16' and 17, 17' have been particularly designed to support the aeroplane with its center of gravity in back of the point of suspension. As the carrier travels, the air resistance against the planes causes the rear portion or tail of the aeroplane to rise until the longitudinal axis of the aeroplane is horizontal, and as the speed of the carrier increases, the forward end of the aeroplane may tilt slightly downwards, thereby greatly assisting the launching of the aeroplane. The special advantage, however, of this arrangement is the decrease in weight of the aeroplane upon the carrier, thereby enabling the carrier to reach higher altitudes to avoid hostile craft and the like.

After the aeroplane has landed, in order to avoid the rotation of the aeroplane about a vertical axis, it is suitably secured by small cables extending from its respective wings to the bar 6 as indicated at 61 and 62 in Fig. 3. If it should now be desired to launch the aeroplane from its suspended position, the cables 61 and 62 are released, and the aeroplane motor is started, a suitable mechanism for the aviator to start the motor from the cockpit being employed, such as that shown in the copending application of Charles B. Kirkham, Serial No. 579,359, filed Aug. 3, 1922, which application is assigned to the applicant herein. Thereupon, the aeroplane is released by depressing the foot pedal 30, which withdraws the latch 26 from the slot 28, thus permitting the guide 15 to move upwardly to the position 15'' indicated in broken lines in Fig. 5. It is obvious that the weight of the machine throws the arm 15 upward when released. When so released the aeroplane may coast until its motor has developed the necessary power. The guide 15 is returned to its normal position through the action of rubber band 21, and the slot 28 is engaged by the latch 26, thereby resetting the guides for landing.

When applying my invention for launching and landing aeroplanes from suspended positions on ships, buildings and the like, a frame, diagrammatically indicated at 63 in Fig. 4 having a trapeze and the decelerating and recoil mechanism shown in Fig. 2, and hereinbefore described, is secured to a horizontal support 64, which is arranged to revolve on the vertical column 65. The trapeze is hooked by the aeroplane in the same manner as above described, when a landing is made. However, when the aeroplane is launched from a device of this character, it is necessary for the aeroplane to develop

the necessary speed before it is released from the trapeze. The motor is started and the action of the propeller will revolve the aeroplane about the vertical axis 65. When the necessary speed has been developed, the areoplane is released and takes flight, in a manner readily understood.

While I have described my invention as embodied in concrete form in accordance with the provisions of the patent statutes, it should be understood that I do not limit my invention thereto, since various modifications thereof will suggest themselves to those skilled in the art, without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

What I claim and desire to secure by Letters Patent is:

1. In a device for launching and landing aeroplanes, the combination with a support, of means pendulously supported thereon, resilient means for absorbing shocks received by said means, an energy dissipating means for absorbing the recoil from shocks received by said pendulous means.

2. In a device for launching and landing aeroplanes, means pivotally suspended, resilient means for decelerating the movement of said means in one direction, and energy dissipating means for retarding the movement of said pivotally suspended means in the opposite direction.

3. In a device for launching and landing aeroplanes, yielding means arranged to be engaged by an aeroplane, means for retarding the forward movement of said yielding means when so engaged, and means for retarding the return movement of said yielding means from its forward position.

4. In a device for launching and landing aeroplanes, the combination with a support, of means pivotally supported thereon arranged to be engaged by an aeroplane, means for absorbing the shock when so engaged and means for absorbing the recoil of said shock.

5. In a device for launching and landing aeroplanes, a trapeze, resilient means for retarding the movement of said trapeze in one direction and energy dissipating means for retarding the movement of said trapeze in its opposite direction.

6. A device for launching and landing aeroplanes comprising in combination, a catch bar pendulously supported from a movable support, a hook carried by an aeroplane for engaging said pendulously supported means, and means for damping the oscillations of said pendulous means when engaged by an aeroplane.

7. A device for launching and landing aeroplanes, comprising in combination, means for supporting an aeroplane, means carried by an aeroplane for engaging said supporting means during flight to suspend said aeroplane, and means controllable from the aeroplane whereby the aeroplane may be launched from said suspended position.

8. A device for launching and landing aeroplanes, comprising in combination, means for supporting an aeroplane, means carried by an aeroplane for engaging said supporting means during flight to suspend said aeroplane, means whereby the aeroplane may be launched from said suspended position, and means controllable from the aeroplane for releasing the same from its said suspended position during launching thereof.

9. A device for launching and landing aeroplanes comprising in combination, means for supporting an aeroplane, means carried by the aeroplane for engaging said supporting means during flight to suspend said aeroplane, said last-named means being positioned ahead of its center of gravity, means whereby the aeroplane may be launched from said suspended position, and means for releasing the aeroplane from its said suspended position during launching thereof.

10. A device for launching and landing aeroplanes comprising in combination a support, means pivotally suspended thereon, means carried by an aeroplane for engaging said means, means for absorbing the shock received by said pivotally suspended means when engaged by an aeroplane and means for absorbing the recoil of said suspended means when so engaged.

11. In a device for launching and landing aeroplanes, a support, suspended supporting means thereon, and means carried on an aeroplane for engaging said suspended means comprising a set of guides arranged to form a forwardly facing hook and means for locking the said hook on said suspended means when engaged by it.

12. The combination with a relatively large aircraft having a pendulous forwardly-facing hook for supporting an aeroplane, means carried by an aeroplane for engaging said pendulous means and means for damping the oscillations of said pendulous means when engaged by an aeroplane.

13. In a device for launching and landing aeroplanes, a support, suspended supporting means thereon and means carried on an aeroplane for engaging said suspended means comprising a hook having a lower fixed guide member and an upper guide member pivotally secured, means for locking the upper guide member in position and means for locking the hook on said suspended means.

14. In a device for launching and landing aeroplanes, a support, suspended supporting means thereon, and means carried on an aeroplane for engaging said means comprising a hook formed with a lower fixed guide member and an upper guide member pivotally secured, means locking the upper guide member in operative position, means for locking said suspended supporting means between

said guide members, and means for releasing the upper guide member whereby the aeroplane is released from its suspended position.

15. In combination, a carrier having a yielding support upon which an aircraft may effect a landing, resilient means acting upon said support in one direction and energy dissipating means acting on said support in the opposite direction.

16. In combination, a carrier having a yielding support, an aeroplane having means for engaging said support, said means being arranged to normally suspend the aeroplane with its front end tilted upwardly, and means for releasing the aeroplane from its suspended position.

17. In combination, a carrier having means for supporting an aeroplane in a suspended position, means whereby said supporting means may be withdrawn from their operative position and stored within the carrier, resilient means acting upon said supporting means in one direction and energy dissipating means acting upon said supporting means in the opposite direction.

18. The combination with a relatively large aircraft having means for supporting an aeroplane, means carried by an aeroplane for engaging said supporting means during flight to suspend said aeroplane, and means controllable from the aeroplane for launching the aeroplane from its said suspended position.

19. In combination, a carrier having a pendulous means for supporting aeroplanes, resilient means for absorbing shocks received by said means, energy dissipating means for absorbing the recoil from such shocks, and means carried by an aeroplane for engaging said pendulous means.

20. In combination, a carrier having a yielding means for supporting an aeroplane, a resilient means for absorbing shocks received by said means when engaged by an aeroplane, means for absorbing the recoil from such shocks, means carried by an aeroplane for engaging said yielding means, means for starting the aeroplane motor when supported by said yielding means and means for releasing the aeroplane from said yielding means.

21. The method of landing and launching aeroplanes from dirigibles which consists in supporting a yielding element on the dirigible, engaging said element by a hooking mechanism on said aeroplane by flying the hook into said element, locking said aeroplane in suspended position, and releasing said locking means when the aeroplane is to be launched.

22. In a device for launching and landing aeroplanes, means for supporting the aeroplane in a suspended position, and shock absorbing means for said supporting means comprising a pinion responsive to the movement of said supporting means, a piston formed with a rack in engagement with said pinion, a cylinder, a housing for said pinion and rack containing oil and a valve on said piston for controlling the passage of oil between the cylinder and housing.

23. In a device for launching and landing aeroplanes, pendulous means for supporting an aeroplane in a suspended position, and means for decelerating said pendulous means comprising an enclosed unit containing oil, a piston therein formed with a rack, a pinion in said unit in engagement with said rack, a drum actuated by said pendulous means arranged to rotate said pinion, and a valve on said piston.

24. In a device for launching and landing aeroplanes, means for supporting an aeroplane in a suspended position and retarding means for said means comprising a drum rotatable in response to the movement of said first means, an enclosed unit containing oil, a piston therein responsive to the rotation of said drum, a valve on said piston for retarding the piston, and means for restoring the drum to its original position.

25. The combination with a dirigible of a trapeze suspended therefrom, and an aeroplane having means adapted to effect a hooking engagement with said supporting means during flight as the aeroplane flies under and overtakes the dirigible.

26. In combination with a relatively large aircraft, a trapeze construction suspended therefrom and extending below the same, and means associated with said construction tending to maintain it vertical with reference to the aircraft, while the said craft is in flight for automatic engagement by another aircraft, substantially as described.

27. In combination with a relatively large aircraft, of a trapeze construction suspended therefrom, and means for elevating said construction to and housing it within the sides of said aircraft, substantially as described.

28. In combination with a relatively large aircraft, having a cabin related thereto, of a trapeze construction adapted to be suspended below said cabin, including depending members and bar connection between the lower ends thereof and means for elevating said trapeze construction to a stream line position relative to said cabin.

29. In combination with a relatively large aircraft, having a cabin related thereto, of a trapeze construction adapted to be suspended below said cabin, including depending members and bar connection between the lower ends thereof and means for elevating said trapeze bar structure within the enclosure of the cabin.

In testimony whereof I have affixed my signature.

LAWRENCE B. SPERRY.