June 18, 1929. M. C. BAUMANN 1,718,189

RETRACTABLE LANDING GEAR

Filed Aug. 30, 1920 3 Sheets-Sheet 1

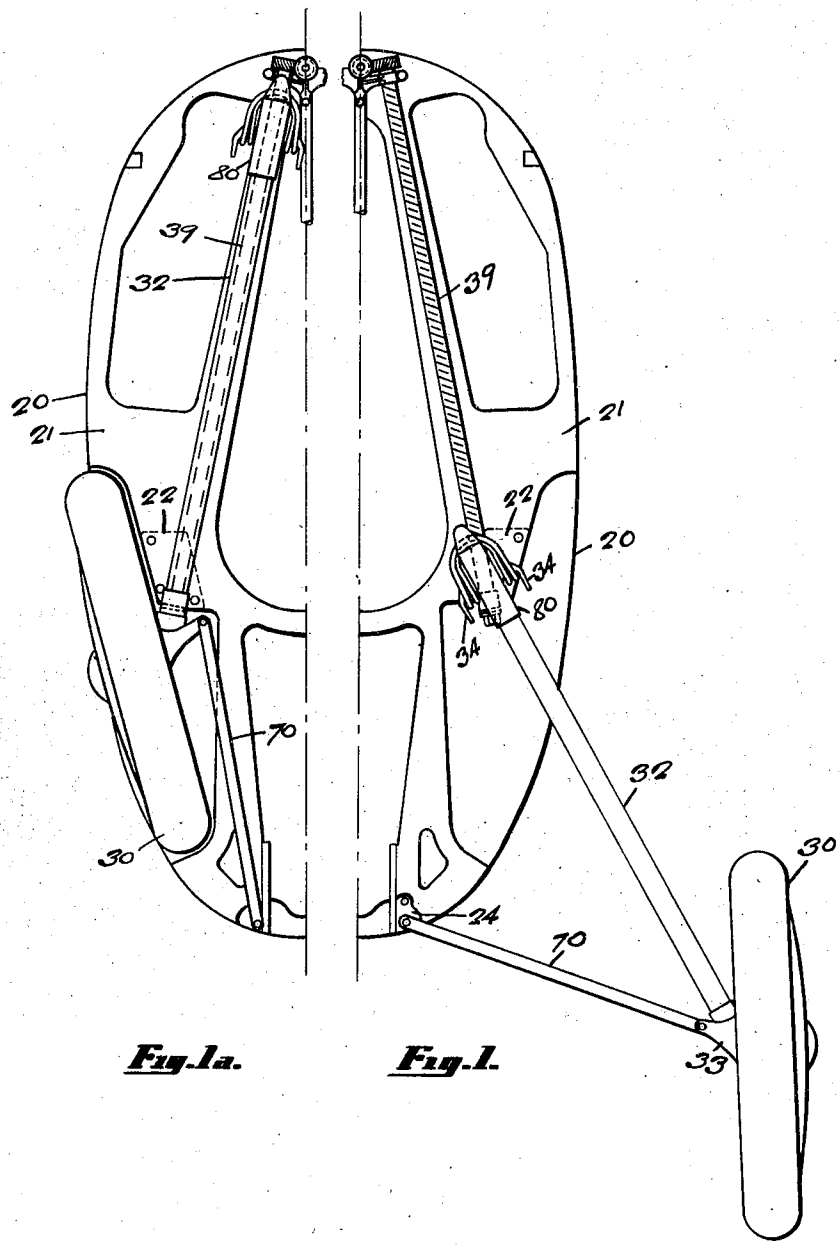


Fig. 1a. Fig. 1.

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RETRACTABLE LANDING GEAR

Filed Aug. 30, 1920 3 Sheets-Sheet 2

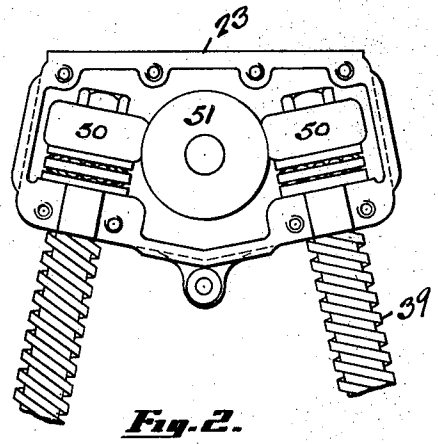


Fig. 2.

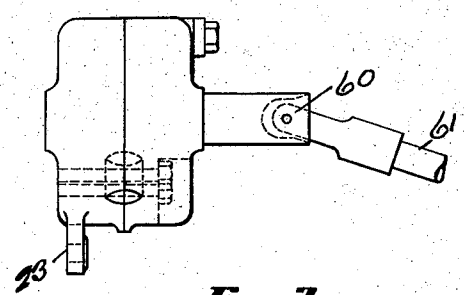


Fig. 3.

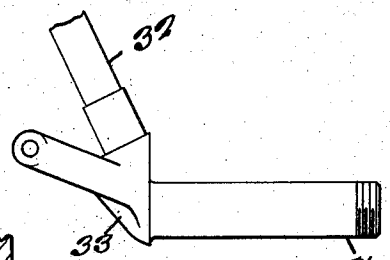


Fig. 8.

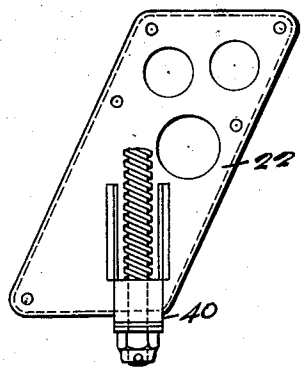


Fig. 4.

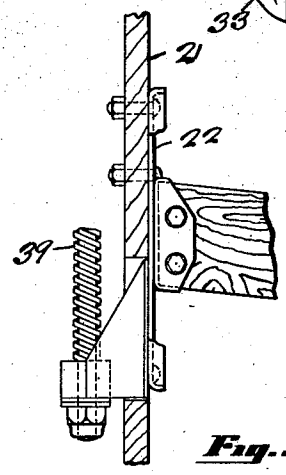


Fig. 5.

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RETRACTABLE LANDING GEAR

Filed Aug. 30, 1920 3 Sheets-Sheet 3

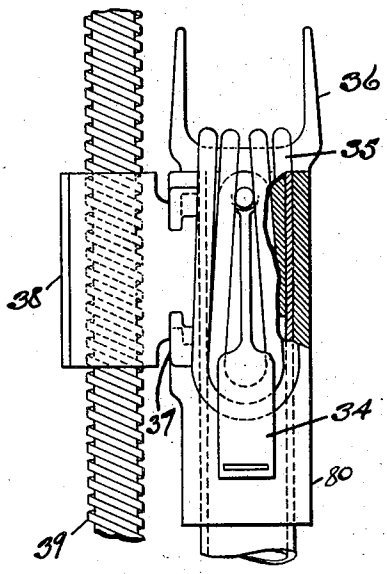


Fig. 6.

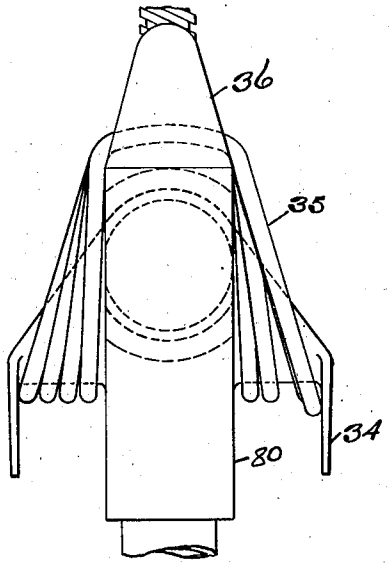


Fig. 7.

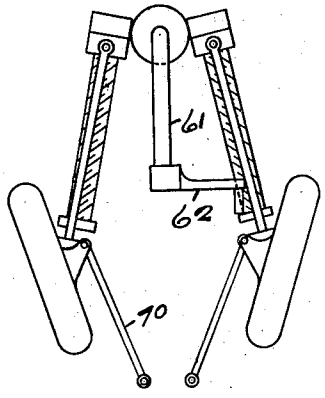


Fig. 9.

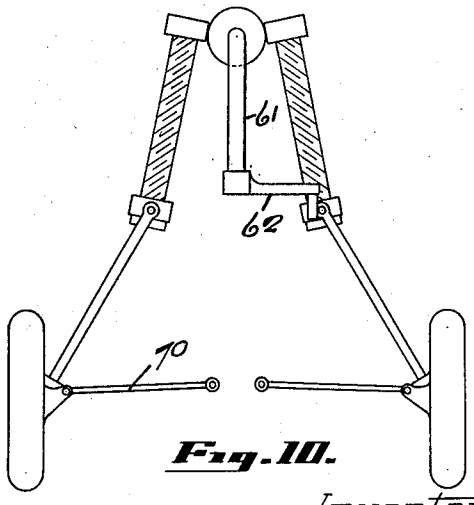


Fig. 10.

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UNITED STATES PATENT OFFICE.

MILTON C. BAUMANN, OF DAYTON, OHIO.

RETRACTABLE LANDING GEAR.

Application filed August 30, 1920. Serial No. 406,763.

The present invention relates to airplanes and particularly to landing gear therefor.

Among the objects of the invention is to render more efficient the action of the landing gear while in extended position and to more effectively decrease the air resistance of landing gear parts when in the retracted position.

Other objects and advantages of the present invention will appear from the following description, reference being had to the accompanying drawings, wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a more or less diagrammatic view of one-half of the landing gear forming the subject of the present application.

Fig. 1ª is a similar view of such landing gear showing the parts in the flight position.

Fig. 2 is a view of one-half of the gear box with the retracting worms and the worm gears in a position therein.

Fig. 3 is a side view of the gear box with the pinion of the driving gear extending therefrom and also showing the universal joint connection with the operating shaft.

Fig. 4 is a detail of the anchor plate for the bottom of the retracting worm.

Fig. 5 is a side view of the same plate showing its attachment to the bulkhead.

Fig. 6 is a view partly in section of the swivel and its attachment to the spindle carrying rod.

Fig. 7 is an elevation of the swivel, viewed from the right of Fig. 6.

Fig. 8 is a detail of the spindle carrying rod with the wheel removed.

Figs. 9 and 10 are diagrammatic views showing the relative position of the several parts of the landing gear when in flight and landing positions respectively.

In Fig. 1 the outer shell of the fuselage is indicated 20 as being formed upon a bulkhead 21. Attached to bulkhead 21 by means of plates 22, 24 and gear box 23 and provided with suitable bearings therein, are the moving parts of the landing gear.

The landing gear proper consists of the wheel 30 mounted upon a spindle 31, attached rigidly to the lower end of a tube or rod 32 by means of a forging or casting 33, the spindle, forging, and rod thus forming a single rigid piece.

This rod 32 forms a sliding joint at its upper end in a sleeve 80, which sleeve is provided with down turned forks 34 for the purpose of retaining elastic cord 35 which operates under these forks and over the end of rod 32, the latter being also provided with a fork for the purpose of retaining the elastic cord in place. This latter fork is indicated at 36.

This sleeve 80 forms one member of the swivel joint 37, the other member of which is in the form of an internally threaded sleeve 38 adapted to coact with the retracting worm 39.

This retracting worm is journalled at its lower end in a bearing supported in a stirrup 40 attached to plate 22, which plate is, as above mentioned, fastened to bulkhead 21.

Figs. 4 and 5 clearly illustrate the method of mounting plate 22 on bulkhead 21.

The upper end of this worm 39 is journalled in a suitable gear box 23 and is provided with antifriction bearings and a worm gear 50, coacting with a worm gear 51 which is provided with a suitable spindle extending outside of the gear box and attached through universal joint 60 to rod 61 extending to the instrument board of the plane and provided at its end with the crank 62 as indicated diagrammatically in Figs. 9 and 10.

It will be noted that the worm shaft 39 is mounted at its upper end with an antifriction thrust bearing and at its lower end in a plain bearing. The purpose of this method of mounting is as follows:

When the wheels are being lifted by means of the operating crank or motor, the thrust is taken by the upper bearing and an antifriction bearing is provided to render this operation more easily performed. On the other hand, when the wheels are in landing position, the upward thrust of the wheels is taken by the lower plain bearing and there is sufficient friction in this bearing to prevent the worm shaft 39 from revolving and allowing the fuselage to come in contact with the ground circuits. This arrangement is obviously desirable when the pitch of the thread on shaft 39 is considered. In order to make the operation of retracting the wheels rapid, the pitch of the thread on shaft 39 will necessarily be rather high. This tends to increase the reversibility of the thread and this form of mounting the shaft was devised to overcome this difficulty.

It will be understood that while in the description, as mentioned, only one of these worms 39 has rod member 32 with wheel 30, these parts are duplicated for the other side of the plane.

Figs. 9 and 10 illustrate very clearly the operation of the device, Fig. 9 showing the wheels in flight position and Fig. 10 illustrating the position of the gear at the time of landing.

It is thought that the further description of the operation of the device is unnecessary in view of the detailed description above, and the showing in the drawings.

In Figs. 1, 1ª, 9 and 10 there is illustrated only one folding brace rod 70, but it should be understood that there are two or more of these usually, in order to take longitudinal shocks upon the wheel 30 when the machine is travelling along the surface.

It will be readily seen that by the present device substantially all of the air resistance of the landing gear during the flight of the airplane has been eliminated, as the rod and brace members are withdrawn entirely within the fuselage while the wheels in retracted position occupy the position indicated in Fig. 1ª, effectively closing the pocket or hole provided for them and having only a small portion thereto extending into the air stream. It will be understood that suitable slots will be provided for the passage through the lower portion of the fuselage of all of the rods or folding brace members 70.

It should be noted that while the device is described and shown as a hand operative mechanism, it is contemplated that it may be power operated. In order to accomplish this result it would be sufficient to mount upon the plane in the air currents, a small air operated motor and convey the power thus produced to the operating shaft 61 through a clutch mechanism of some sort and such mechanism may even be provided with reverse mechanism in order that the landing gear may be raised or lowered as the operator desires while the plane is in flight. While the motor of this sort is suggested, nevertheless, it is obvious that any other suitable form of motor might be substituted therefor without departing from the invention.

While the form of mechanism herein shown and described, constitutes a preferred form of embodiment of the present invention, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What I claim is as follows:

1. A retractable landing gear for airplanes, comprising wheels mounted upon spindles rigidly secured to upright members, shock absorbing means upon the upper end of said members and movable therewith to different positions of adjustment, means operating to lift the upright members with the attached spindles and wheels into the fuselage of the airplane.

2. A retractable landing gear comprising a retracting worm, a threaded sleeve upon the worm, a substantially rigid member having reciprocatory movement with the sleeve and carrying at its lower end a landing wheel, shock absorbing connection between said member and the sleeve, and means for rotating the worm.

3. A retractable landing gear for airplanes including a wheel mounted upon a spindle carried by an upright strut member, an adjusting screw for reciprocating the strut member into and out of the fuselage of an airplane and a laterally extending brace member pivoted at one end to the fuselage and at its other end to the wheel carrying structure for guiding the wheel and bracing it in extended landing position.

4. In an airplane, a substantially circular opening in the fuselage, a retractable landing gear including a wheel movable laterally into said opening, means for retracting the landing gear and causing the wheel to substantially fill the opening, whereby the lateral face of the wheel will substantially coincide with the surface of the fuselage of the aeroplane.

5. In retractable landing gear for airplanes an upright reciprocating supporting member, a landing wheel mounted at the lower end of said reciprocatory supporting member and movable therewith, means for retracting the reciprocatory supporting member in a substantially vertically disposed path of travel and shock absorbing means against the tension of which the upright supporting member is capable of reciprocatory movement at any point in its range of adjustment.

6. In an airplane, a rotatable drive shaft, a worm shaft, means for transmitting motion from the drive shaft to the worm shaft, a threaded sleeve mounted upon the worm shaft, a wheel carrying supporting member yieldingly attached to the sleeve for reciprocatory movement in unison therewith, whereby when the worm shaft is rotated the wheel carrying supporting member is extended or retracted through a substantially vertical reciprocatory movement and capable of limited movement independent thereof to compensate for shock, by the resiliency of its yielding attachment to the sleeve.

7. In an airplane, a retractable landing gear comprising land wheels, circular pockets in the fuselage, means for withdrawing the landing gear to cause the wheels to enter laterally into and form covers for the pockets.

8. In retractable landing gear for airplanes having a rotating worm shaft for causing the retraction of the landing gear, an anti-friction thrust bearing for receiving the thrust upon retraction of the gear and a friction thrust bearing for receiving the landing

thrusts resisting relative adjustment of the parts under the force of impact, but permitting free adjustment thereof during retractive operation.

9. A retractable landing gear for airplanes, comprising wheels, normally substantially upright, main weight supporting struts on which the wheels are pivotally mounted, said struts having vertically reciprocatory pivotal connections, means for retracting the pivotal connections of said struts in substantially straight paths of travel and simultaneously oscillating the struts transversely to the line of flight about their pivotal connections, to lift the wheels and supporting struts into the fuselage.

10. The combination with an aeroplane, a fuselage, retractable alighting means, operating means therefor, by which the alighting means may be retracted, and means for transmitting motion in relation with the fuselage from said operating means to actuate the alighting means, said alighting means being operable in various intermediate positions thruout its range of movement, and shock absorbing means within the fuselage operable to compensate for shock to said alighting means in any position to which it may be adjusted.

11. In a folding landing gear for airplanes a pair of frames adjustable vertically and laterally into outspread relation beyond the limits of the airplane fuselage, a carrying wheel mounted on each frame, substantially vertically disposed threaded shafts, internally threaded sleeves upon said shafts and adjustable axially upon the shafts by the rotation of the latter, said wheel carrying frames being pivotally connected with said sleeves, means for rotating the shafts to retract and extend the wheel carrying frames, and brace bars pivoted to the fuselage structure movable outwardly and downwardly in a plane transverse to the line of flight for supporting the wheel carrying frames when in extended position.

12. A retractable landing gear, comprising a retracting worm, a threaded sleeve upon the worm, a normally substantially upright, weight supporting member carrying at its lower end a landing wheel, the upper end being connected with the sleeve for reciprocatory movement thereby means for guiding the lower end of the wheel carrying member outwardly in a lateral direction transverse to the line of flight during its descending movement, by which the wheel will be spaced laterally away from the fuselage, and the carrying member will afford a lateral bracing effect, and for retracting the wheel inwardly toward the fuselage during the ascending movement of the wheel carrying member, and means for rotating the worm.

13. A retractable landing gear for air planes including a reciprocatory strut, a wheel carried by said strut, adjusting means for reciprocating the strut to extend and retract the wheel and a yielding coupling interposed between the wheel carrying strut and the adjusting means against the yielding resistance of which the strut is capable of limited reciprocatory movement independent of said actuating means in any position of adjustment of the strut and wheel.

14. In a retractable landing gear for aeroplanes, a retractable major weight supporting member, means for actuating said retractable supporting member, one end of the member being substantially vertically reciprocated, the other end of the member having swinging movement transversely to the line of flight, and a link having one end pivoted to a stationary support, the other end connected to said supporting member and controlling the swinging movement of the support in unison with its reciprocation.

15. In a retractable landing gear for aeroplanes, a retractable main weight supporting member, one end of which moves in a substantially vertical straight line the other end of which moves in an arcuate path of travel transversely to the line of flight, and means to actuate said retractable member into and out of operative position.

16. In a folding landing gear for airplanes, a pair of normally substantially upright, main weight supporting struts, a reciprocatory carrier to which each strut is pivoted, on an axis extending longitudinally of the fuselage, threaded shafts operatively connected with the reciprocatory carriers, means to rotate the threaded shafts to retract the carriers upward, and guide links connected with the supporting struts effecting a swinging movement of the struts on their pivotal axes in directions transverse to the longitudinal extent of the fuselage in unison with their reciprocatory movement and adapted to brace the struts when extended.

17. In a folding landing gear for airplanes, a pair of normally substantially upright, main weight supporting struts, reciprocatory supporting means for the struts movable in a substantially straight line to which the struts are pivoted on axes disposed longitudinally in relation with the fuselage, means for reciprocating the carrier, means to draw the struts upward, and guide links pivoted to the fuselage and connected with the supporting struts effecting a swinging movement of the struts transversely in relation with the fuselage in unison with their reciprocatory movement and bracing the struts when extended.

18. In a retractable landing gear for airplanes, an upright reciprocatory main weight supporting member having a pivotal connection at its upper end movable upward and downward in a substantial straight line, a landing wheel carried at the lower end of the

supporting member, means for retracting the supporting member upwardly and means for oscillating the supporting member about its pivotal connection in a plane angular to that of the wheel during its reciprocatory movement.

19. A retractable landing gear for airplanes including a wheel, a pair of angularly disposed interpivoted strut members movable in a plane transversely of the line of flight, by which the wheel is carried, adjusting means for varying the angular relation of the strut members to extend and retract said wheel, and resilient means against the yielding resistance of which one of the strut members is longitudinally movable independent of the adjusting means.

20. A retractable landing gear for airplanes including a wheel, a pair of angularly disposed interpivoted struts arranged transversely of the airplane fuselage, by which the wheel is carried in juxtaposition to their interpivotal point, from which point one of the arms extends upwardly and the other arm laterally when the wheel is extended, the laterally extending arm having a stationary pivotal connection in spaced relation with the interpivotal point of said struts, the upward extending strut having a lineally adjustable pivotal connection also in spaced relation with the interpivotal connection of the struts, and means for lineally adjusting the last mentioned pivotal connection to effect the extension and retraction of said wheel.

21. In an aeroplane, a retractable landing gear, disc wheels carried thereby, a fuselage having lateral openings therein, and means for retracting the landing gear to cause said disc wheels to form closure lids for said fuselage openings.

22. In a retractable landing gear for airplanes, a carrying wheel, an adjustable supporting structure by which the wheel is carried, means for adjusting the supporting structure to extend and retract the wheel relative to the fuselage, and thrust operated means set by the impact of the wheel in landing for resisting the retractive movement of the adjustable supporting structure.

23. In combination with an aeroplane, retractable alighting means, operating means therefor, means for transmitting motion from said operating means to the alighting means, and thrust controlled means operative by the landing impact for resisting retractive movement of the alighting means in any position to which it is adjusted.

24. In combination with an areoplane, retractable alighting means, operating means therefor, means for transmitting motion from said operating means to the alighting means, and clutch means permitting free adjustment of the alighting means toward extended position and operative by the landing impact to resist retractive movement of the alighting means under the influence of such landing impact from the position to which the alighting means may have been extended.

25. In combination with an aeroplane, retractable alighting means including normally substantially upright, main weight supporting struts having at one end substantially vertical reciprocatory movement in a straight line and lateral swinging movement at the opposite end into and out of operative position, operating means therefor and means for transmitting motion from the operating means to actuate said alighting means, and brace means for said alighting means movable therewith.

26. A retractable landing chassis for airplanes, a threaded adjusting shaft therefor and a nut co-acting therewith, the pitch of the screw and nut being such that the chassis will travel under influence of gravity to operative landing position, and thrust controlled means for resisting reverse movement of the screw under influence of the landing impact.

27. A retractable landing gear for airplanes, an adjusting screw therefor having an elongated thread pitch, the pressure angle of which is insufficient to resist the axial pressure of the landing gear and a nut co-acting therewith, permitting the landing gear to operate the screw idly during the movement of the landing gear into extended position, and means for actuating said screw to retract the landing gear.

28. A retractable landing gear for airplanes, a threaded adjusting shaft and coacting nut therefor, the value of the tangent of the angle of the shaft thread being less than the coefficient of friction between the thread and coacting nut whereby the shaft will not be self locking and permitting the free relative movement of the shaft and nut in one direction and means tending to resist the relative rotation of the nut and screw in the opposite direction to resist return movement of the landing gear under the influence of the landing thrust.

29. A retractable landing gear for airplanes including a substantially vertically adjustable normally upright, main weight supporting struts, a threaded adjusting shaft and coacting nut therefor for vertically retracting and extending said supporting struts and sustaining the landing thrust, and means controlled by the thrust for retarding relative movement of the nut and shaft, and means for relatively actuating the nut and shaft to adjust the landing gear.

30. A retractable landing gear for airplanes, a threaded adjusting shaft and coacting nut therefor, said shaft being capable of limited longitudinal adjustment, and a frictional thrust bearing operatively engaged by the longitudinal movement of the shaft under the influence of landing thrust

to temporarily lock the shaft and nut against relative adjustment.

31. A retractable landing gear for airplanes, a threaded adjusting shaft and coacting nut therefor, a thrust bearing, tending to resist relative adjustment of the nut and shaft to effect adjustment of the landing gear in one direction and permitting free relative rotation of the shaft and nut to adjust the landing gear in the opposite direction.

32. A retractable landing gear for airplanes, a threaded adjusting shaft and coacting nut therefor, an anti-friction thrust bearing and a frictional thrust bearing for said shaft opposed one to the other whereby the landing gear is freely adjusted in one direction in unison with the rotation of the shaft, but the retrograde movement of the landing gear is resisted by said frictional thrust bearing.

33. In a retractable landing gear for airplanes, a retractable wheel carrying member, one end of which is reciprocated upwardly in a substantially straight line, the other end of which is oscillated transversely to the line of flight in unison with the upward reciprocatory movement, a retracting screw engaging the wheel carrying member and a controlling link pivotally connected to said member and to the fuselage for imparting to said member said combined reciprocatory and oscillatory movements.

34. A retractable landing gear for airplanes including a wheel, a pair of angularly disposed interpivoted struts arranged transversely of the airplane fuselage, by which the wheel is carried in juxtaposition to their interpivotal point, from which point one of the arms extends upwardly and the other arm laterally when the wheel is extended, the laterally extending arm having a stationary pivotal connection in spaced relation with the interpivotal point of said struts, the upwardly extending strut having a lineally adjustable pivotal connection also in spaced relation with the interpivotal connection of the struts, and an adjusting screw for vertically adjusting the last mentioned pivotal connection to effect the extension and retraction of the wheel.

35. A retractable landing gear for airplanes comprising a substantially vertically disposed retracting worm, a threaded sleeve upon the worm, a substantially rigid strut member resiliently connected adjacent its upper end with the sleeve for reciprocatory movement therewith, means for guiding the lower end of the strut member outwardly in a direction transverse with the line of flight simultaneously with its reciprocatory movement and a ground engaging member carried by the lower end of said strut and projected laterally beyond the fuselage of the airplane to afford a lateral bracing effect simultaneously with its vertical adjustment, and means for actuating the worm.

36. The combination with a retractable landing gear for airplanes of a revoluble adjusting screw therefor capable of a limited degree of longitudinal movement, and frictional contact surfaces engaged by the longitudinal shifting movement of the screw under the influence of landing impact, to resist rotary motion of the screw, the weight of the landing gear during extension and retraction operating to hold the screw at the opposite limit of its longitudinal movement to maintain said frictional contact surfaces out of engagement with each other.

37. The combination with a retractable landing gear for airplanes of a revoluble adjusting screw therefor capable of limited degree of longitudinal movement, and clutch means for locking the screw against revoluble movement engaged and disengaged by longitudinal movement of the screw, the weight of the landing gear serving to shift the screw to unlock the clutch means, and the thrust impact of the gear in landing serving to shift the screw to engage the clutch means.

38. The combination with a retractable landing gear for airplanes, of adjusting means therefor permitting the landing gear a limited degree of lost motion, and locking means for said landing gear to maintain the gear in adjusted position controlled by said lost motion, whereby the locking means is released by the movement in one direction incident to the weight of the landing gear and is locked by the movement in the opposite direction incident to the impact of the gear in landing.

39. The combination with a retractile landing gear for airplanes, of a revoluble adjusting screw therefor, and pressure controlled retarding means for said screw operated by the weight of the landing gear to release the screw retarding means, and operated by the impact of the gear in landing to effect action upon the screw.

40. The combination with a retractable landing gear for airplanes, of a revoluble adjusting screw therefor having an acute pitch angle whereby the screw is revoluble in either direction under influence of pitch pressure, and retarding means effected by the thrust pressure of the gear in landing to prevent rotation of the screw under such landing pressure.

In testimony whereof I hereto affix my signature.

MILTON C. BAUMANN.