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RETRACTABLE LANDING GEAR FOR AIRCRAFT

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Fig. 1

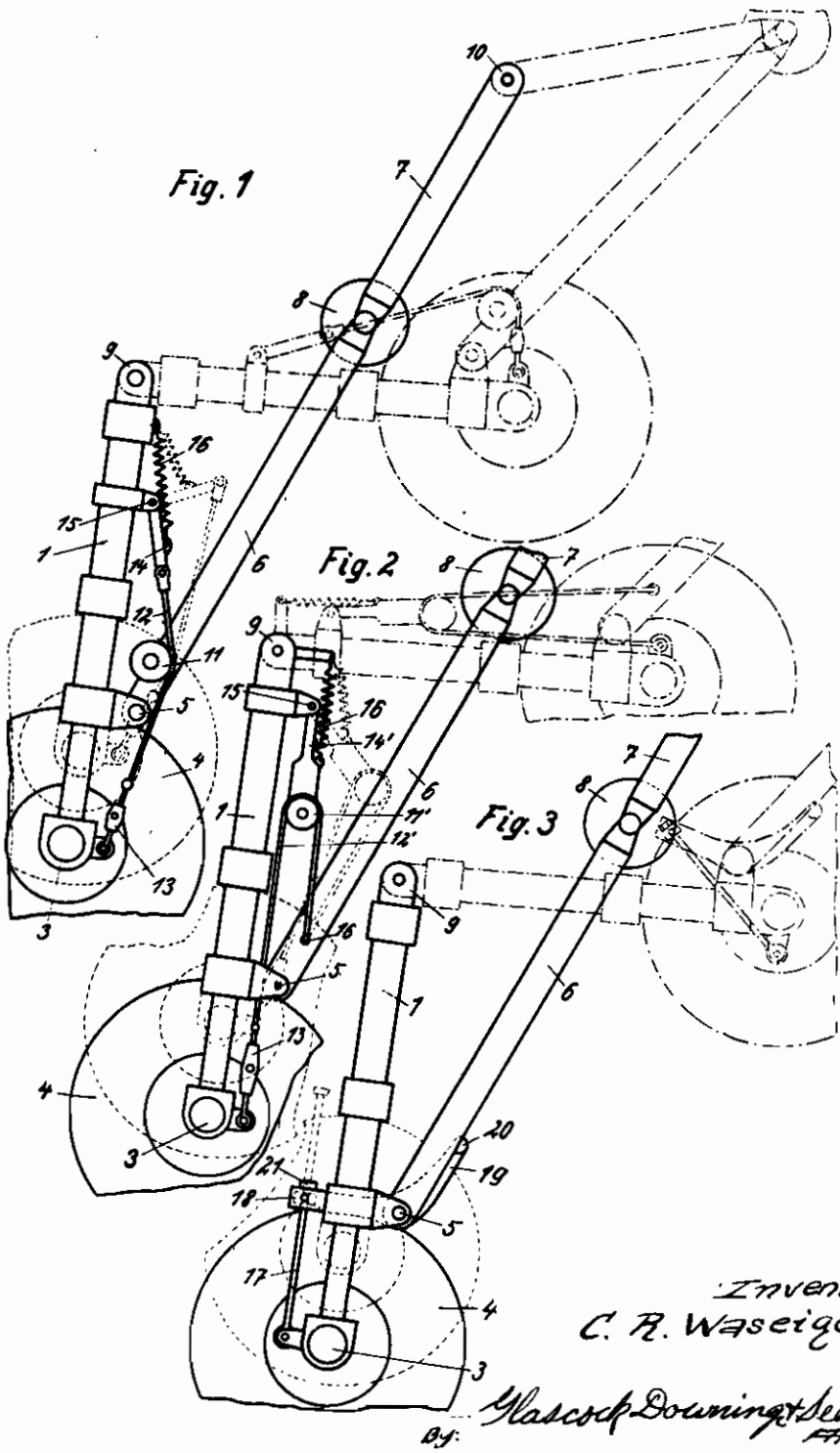

Fig. 2

Fig. 3

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RETRACTABLE LANDING GEAR FOR AIRCRAFT

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My present application which is a division from my co-pending application Serial No. 226,569 relates to mechanisms for operating retractable landing gears for aircrafts.

By landing gear, is to be understood herein the assembly formed by any element which is intended to come into contact with the ground, such as a single wheel or a train of wheels, a ski, a float, its supporting frame and its shock-absorber or shock-absorbers, which will hereinafter be called landing shock-absorbers. It has already been proposed to provide the operating mechanisms in question with means which, during at least a part of the operation of the landing gear, tension a resilient element, for example by using for tensioning said resilient element the relative movement, during this part of the operation, of two parts of the supporting frame, the energy thus stored in said resilient element being restored by the latter during another part of the operation or the reverse operation in order to assist these latter.

The present invention has essentially consists in constituting said resilient element by the landing shock-absorber itself, which is preferably pneumatic or oleo-pneumatic, of the landing gear.

By thus using a pre-existing element for a novel function in addition to its usual function, instead of having recourse to a novel element, in addition to a substantial saving in weight, a considerable decrease in the bulk of the landing gear is obtained during the retraction and in its retracted position which is particularly advantageous for modern aeroplanes. On the other hand, the landing shock-absorbers are very reliable elements which are constructed to absorb considerable energy that is superabundant for the requirements of lowering the gear. Furthermore as they are provided with a device for braking their expansion, said shock-absorbers assist the lowering of the landing gear more gently than unbraked resilient members that require the addition of powerful shock-absorbers called lowering shock-absorbers.

In order to prevent this novel function of the landing shock-absorber from in any way impairing its usual action, a unidirectional kinematic connection is preferably provided between the lower movable part of the shock-absorber and one of the members of the supporting frame of said shock-absorber, between which member and the shock-absorber a relative movement occurs during the operating of the landing gear.

Owing to said way of providing said unilateral connection, it is advantageous to provide the landing gear wtih an independent lowering shock-absorber which may be of the type described in my patent 2,148,972, and the power of which is less than for the usual landing gears.

In order that said power required by the lowering shock-absorber be reduced to a minimum, and this is an important characteristic feature of the invention, the aforesaid landing shock-absorber, which is preferably pneumatic or oleo-pneumatic, is advantageously arranged in such a manner that the braking which it produces during the expansion will greatly increase at the end of the stroke of said expansion. This braking may be obtained hydraulically by known means such as small orifices, or by throttling liquid passageways.

In an advantageous embodiment of my invention, said kinematic connection is obtained by means of a substantially inextensible bond having three bearing points, at least one of which is formed by a loose pulley, and which are respectively distributed over three members viz.: the two parts of the shock-absorber which are movable relatively to each other and the said member of the supporting frame, at least one of said bearing points being movable relatively to the member which supports it and being urged by a spring in such a manner as to keep said bond always taut in whatever position it may be.

By way of non limitative examples, various embodiments of my invention applied to the same type of landing gear have been shown in the accompanying drawing.

In said drawing, Figs. 1 to 3 are diagrammatical side elevations of the landing gear.

In the three exemplary embodiments shown, the landing gear of a known type comprises two oleo-pneumatic landing shock-absorbers 1 disposed in parallel relationship to each other on each side of a wheel 2 carried thereby, cross-braced together and pivoted at their end to a stationary stud 3. On the movable lower part of each shock-absorber 1 is pivoted at 4 one of the arms 6 of a folding strut the other arm 7 of which is pivoted to a stationary stud 8. When the folding strut 6, 7 is extended, the landing gear is in its landing position illustrated in full lines. When the folding strut is being folded the landing gear gets retracted and comes to the position shown in dot-and-dash lines.

The extension and the folding of the folding strut are produced by any known means, herein shown as a driving joint 9 of the type described in my patent 2,148,972.

In the exemplary embodiment of my invention shown in Fig. 1, each bar 6 of the folding strut carries a loose pulley 11 over which passes a flexible bond 12, a chain or a cable, which is connected on the one hand to the lower movable part of the corresponding shock-absorber 1, preferably by means of a tightener 13, and on the other hand to a connecting rod 14 which is pivoted at 15 on the upper part of the shock-absorber and is constantly urged to rotate by a spring 16.

The operation of this device is as follows:

During its movement when the aeroplane comes into contact with the ground, or while it is rolling along the ground, and the shock-absorber 1 shortens under an impact, the lower point of connection of the bond 12 moves towards the pulley 11 but said bond 12 remains taut owing to the fact that the spring 16 causes the connecting rod 14 to rotate on its pin 15 and pulls the whole of the bond upwards; this movement of the bond 12 as a whole has the sole effect of rotating the loose pulley 11. When the shock-absorber expands, it causes the bond 12 to move back downwards and to thereby rotate the connecting rod 14 against the action of the spring 15.

On closing of the folding strut 6, 7 to retract the landing gear, a relative movement of the lower arm 6 of the folding strut and of the shock-absorber 1 occurs, said arm 6 tending to move away from the shock-absorber. Thus causes the pulley 11 to bear on the bond and compels it to bend, moving its two points of connection towards each other therefore tensioning the shock-absorber 1. It can be readily seen that during the retracting, an instant occurs from which the arm 6 tends to move towards the shock-absorber 1 so that said shock-absorber partially expands and pulls the bond 12 which then presses against the pulley 11 and so helps to complete the retraction of the landing gear. When the landing gear is being lowered, the previous operation is repeated in the reverse direction; the shock-absorber begins to brake the lowering by tensioning itself to the extent it had been tensioned during the retracting, then expands thereafter, thereby helping the end of the lowering.

In the exemplary embodiment of Fig. 2, the loose pulley 11' is carried by the connecting rod 14' instead of being fixed on the lower arm 6 of the folding strut, as in the example of Fig. 1, and the bond 12' is attached to said arm at 16 after passing over the pulley 11' instead of being fixed to the connecting rod 14'. The operation is absolutely similar to that of the device of Fig. 1, but it will be observed that the pull of the bond on the movable lower part of the shock-absorber is effected along directions which deviate much less from a line parallel with the axis of the shock-absorber than in the case of Fig. 1. On the other hand, it can easily be seen that according to the position of the connecting point 16 of the bond on the lower arm 6 of the folding strut, the movement of the movable part of the shock-absorber during the retracting or the lowering will or will not have a dead centre which divides its total travel into two successive sections: one resisting and the other driving.

In the exemplary embodiment of Fig. 3, a rigid rod 17 is pivoted on the movable part of the shock-absorber and extends parallel with the axis of the latter; its upper end passes freely through a guiding sleeve 18 which is carried by a finger 19 in such a manner that it can rotate about a horizontal axis. Said finger 19 carries an extension 20 which is in contact with the rear face of the lower arm 6 of the folding strut, and, beyond said sleeve, an abutment 21 is fixed on said rod 17. When the shock-absorber oscillates under the impact during the landing or while the aeroplane is rolling along the ground, the rod 17 slides freely in the sleeve 18 and the usual operation of the shock-absorber is in no way modified. When the folding strut 6, 7 closes to retract the landing gear, the finger 19 which is displaced by its extension 20 participates in the relative rotary movement which occurs between the arm 6 and the shock-absorber 2 and bears on the abutment 21, thereby causing the movable part of the shock-absorber to slide by means of the rod 17 and tensioning the shock-absorber. In this case again, the travel of the movable part of the shock-absorber during the retracting and the lowering of the landing gear may or may not have a dead centre, a fact which depends on the position of the finger 19.

CHARLES RAYMOND WASEIGE.