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AUTOMATIC RECOVERY DEVICE FOR PNEUMATIC SUSPENSIONS

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Fig.1.

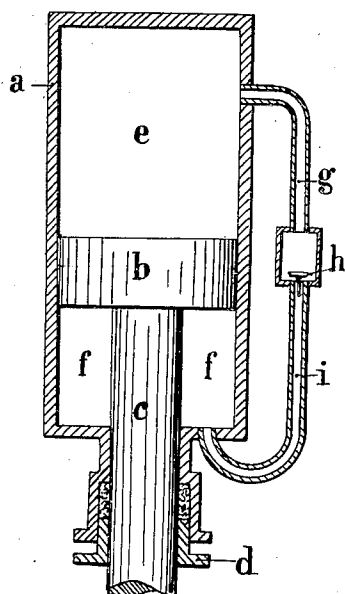


Fig.2.

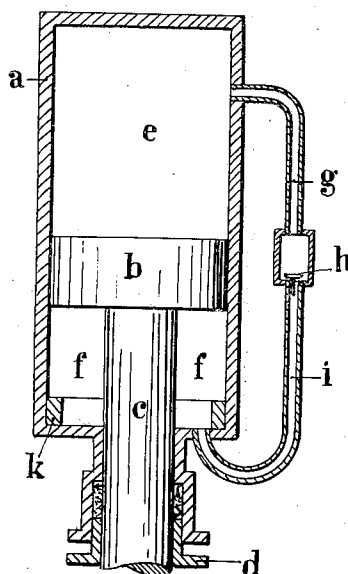


Fig.3.

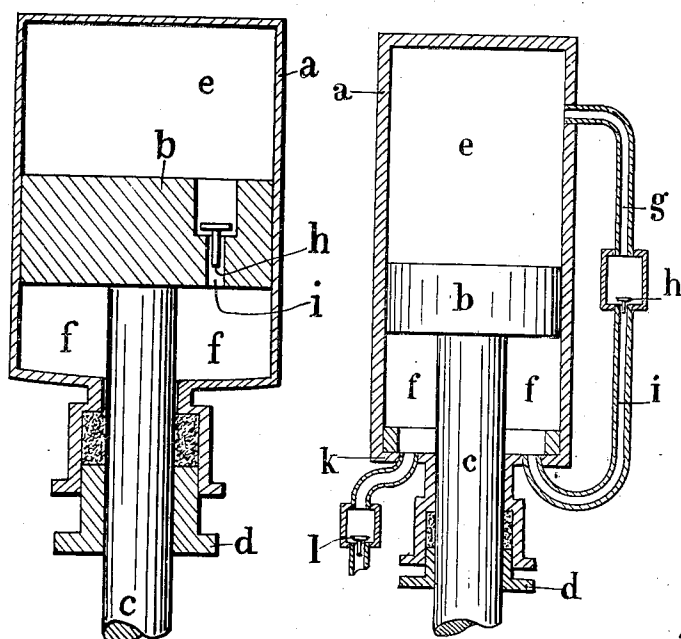


Fig.4.

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AUTOMATIC RECOVERY DEVICE FOR
PNEUMATIC SUSPENSIONSGeorge Louis René Jean Messier, Montrouge,
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1 Claim. (Cl. 267—64)

The present invention has for object an automatic recovery device for pneumatic or oleo-pneumatic suspension of the undercarriage of an airplane.

5 In fact it is known that the pistons of pneumatic or oleo-pneumatic suspension of airplanes, as fluid-tight as they may be, let the fluid under pressure escape in the long run.

10 The device forming the subject-matter of the present invention is adapted to ensure the automatic recovery of these losses.

Reference is made to the accompanying drawing illustrating the invention, wherein similar reference letters designate similar elements and wherein:

15 Fig. 1 illustrates a vertical section of the pneumatic suspension device with automatic recovery of the losses according to the invention.

20 Fig. 2 illustrates a vertical section of the device with an abutment on the bottom of the cylinder.

Fig. 3 illustrates a vertical section of the device with the abutment and an inlet valve in the bottom of the cylinder.

25 Fig. 4 illustrates a modification of Fig. 1 as to the placement of the valve between the spaces of the cylinder.

30 The suspension apparatus for airplanes is constituted by a cylinder *a*, integral with the fuselage and in which moves a piston *b*; this piston carries a rod *c* rigid with the axle of the landing chassis or undercarriage; this rod passes through the lower wall of the cylinder through a stuffing-box *d*.

35 The pressure of an initial load of fluid in the cushioning space *e*, above the piston, is regulated in such a manner that the piston occupies normally, when the airplane is on the ground, such an intermediate position in the cylinder, (for instance that shown in Fig. 1) that the air filling the closed space *f*, below the piston *b*, is then at substantially atmospheric pressure.

45 After a time, a portion of the fluid under pressure which fills the space *e* (or of the oil which covers the piston in the case of an oleo-pneumatic suspension), passes about the piston and is stored in the space *f* below the piston. The pressure in the space *f*, it being of course understood that the leakage about the piston is reduced by the use of suitable packings, will reach a high value only after a very long time as it will be easy to maintain through the stuffing-box *d* a perfect fluid-tightness.

55 The invention essentially consists in connecting the spaces *e* and *f* by pipes *g* and *i* and a

valve *h* provided therebetween capable of opening which is to allow the circulation of the lost compressed fluid or of the oil from *f* towards *e*, but not in the reverse direction.

60 In these conditions, when the airplane is in flight, the reaction of the ground on the wheels being eliminated, the piston moves downwardly, compressing the air situated under its lower face, until the total pressure exerted on this lower face balances the total pressure exerted on its upper face, to which is added the weight of the suspended undercarriage: axle, wheels, etc.

65 Even when the supplementary weight corresponding to the suspended parts is not taken into consideration, it will be seen that the surface on which the air compressed in the space *f* exerts its pressure, is less than that of the upper face of the piston, owing to the presence of the rod *c*.

70 The air, occupying the space *f*, reaches therefore, at the end of each taking-off, a unitary pressure greater than that of the fluid in the space *e*; hence the valve *h* opens and, through the medium of the pipes *g* and *i*, the fluid lost in the space *f* is carried by said compressed air above the piston, into the space *e*.

80 Upon landing, the valve *h* being closed again, the piston, by rising, tends to create a vacuum in the space *f*, but all the fluid or all the oil which had been able to flow under the piston has been brought in the space *e*.

85 The losses have therefore been wholly recovered in an automatic manner.

90 It may happen, at the end of a long period, that additional atmospheric air enters the space *f* through the stuffing-box *d* and that this air is delivered with the recovered fluid, upon flying off, into the space *e*.

95 If this phenomenon is repeated a number of times, the quantity of air contained in the space *e* may become too great and give to the piston *b* a balancing position which is too low. This may be prejudicial to the operation of the apparatus.

100 For avoiding this inconvenience, use may be made of the device diagrammatically illustrated in Fig. 2.

105 This apparatus is of the same general arrangement as that of Fig. 1, but a ring forming abutment *k* limits the downward movement of the piston at a predetermined distance from the lower bottom of the cylinder.

110 This distance is so computed that, assuming the space *f* being filled with air at atmospheric pressure in the position of the piston corresponding to the apparatus on the ground, the down-

ward stroke of the piston, upon flying off, is stopped by the abutment *k* when the compression of the air of the space *f* is approximately equal to that of the air at the same moment in the space *e*.

It will then be understood that if the initial pressure in the space *f* is greater than atmospheric pressure (case of losses through the periphery of the piston), the pressure in the same space, when the piston abuts against the abutment *k*, will be greater than that existing at the same moment in the space *e* and the valve *h* by opening will ensure the recovery of the said losses.

The automatic adjustment of the position of the piston can also be ensured, even in the case of loss or leakage between the piston and the inner wall of the cylinder, for instance by providing the lower bottom of the cylinder with an inlet air valve *l*, opening from the exterior towards the interior (Fig. 3).

In these conditions, a raising of the initial balancing position of the piston causes a vacuum in *f* and hence an admission of air through the valve *l*; the delivery of this air in the space *e* will take place at the time of flying off, considering that, when the piston abuts against the abutment *k*, the pressure in the space *f* will then be greater than that existing at the same moment in the space *e*.

The device thus completed ensures therefore the recovery of the losses in all conditions of leakage of fluids or of entrance of air, and at the

same time, the automatic adjustment of the position of the piston.

The valve *h* instead of being placed outside the cylinder *a*, as shown in Figs. 1, 2 and 3, may be arranged in the body of the piston *b*, as shown in Fig. 4, the pipe or conduit *i* is then also provided in said piston *b*, thus greatly simplifying the construction of the device.

What I claim is:—

A pneumatic or oleo-pneumatic suspension device for supporting an aeroplane body with respect to its under carriage, comprising in combination, a substantially vertical cylinder rigid with one of said two parts of the aeroplane and adapted to contain a predetermined constant quantity of fluid under pressure, a piston rigid with the other of said two parts and adapted to slide freely within said cylinder, a mass of fluid located above said piston forming a supporting cushion when the aeroplane is resting on the ground, a conduit solely and directly interconnecting the upper portion of said cylinder through the side wall thereof with the lower portion of the cylinder directly through the bottom thereof and extending wholly outside of said cylinder in exposed position, and a single non-return valve disposed in an accessible position in the exposed portion of said conduit located adjacent the side of said cylinder for the purpose of allowing the fluid to flow solely from the lower end of the cylinder directly toward the upper end thereof.

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