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J. MERCIER
DEFORMABLE SYSTEMS
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2 Sheets-Sheet 1

Fig. 1

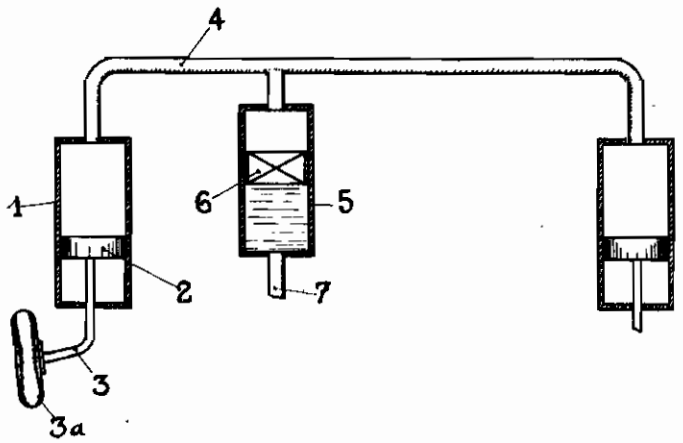
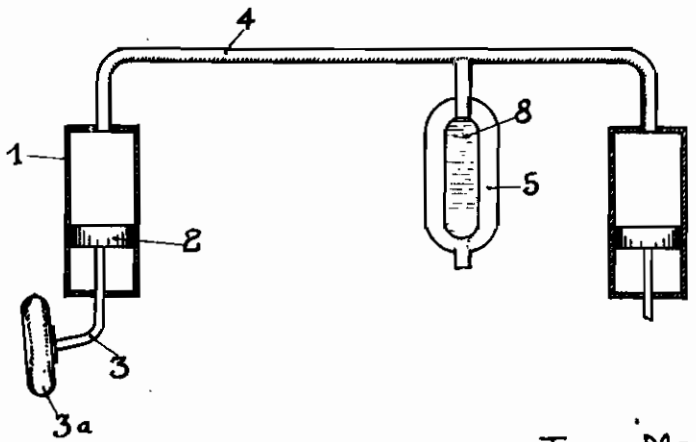


Fig. 2



Jean Mercier
INVENTOR.
By
his ATT'Y.

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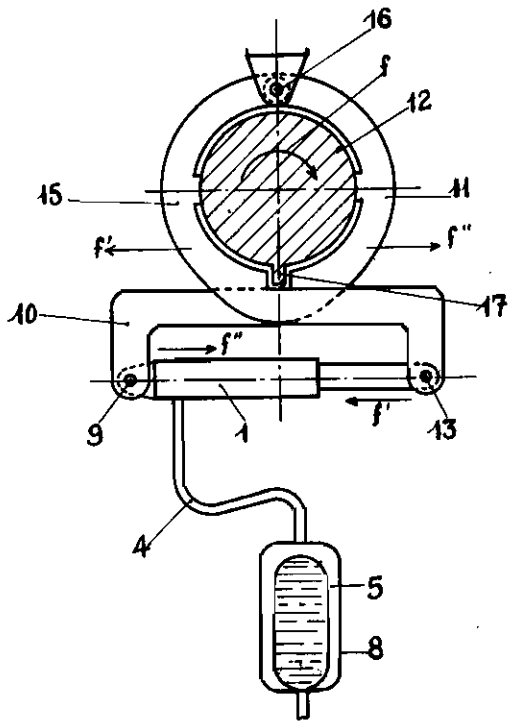
Fig. 3



Jean Mercier
INVENTOR
By Otto Schmidt
his ATTY.

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ALIEN PROPERTY CUSTODIAN

DEFORMABLE SYSTEMS

Jean Mercier, Neuilly-sur-Seine, France; vested in the Alien Property Custodian

Application filed January 18, 1940

The present invention relates to deformable systems of the kind including mechanical parts movable relatively to one another and forming between them at least one fluidtight chamber filled with a fluid (liquid, gas, or both) acting as a cushion of any suitable arrangement.

The main object of the present invention is to provide a system of this kind which is better adapted to meet the requirements of practice than those used up to the present time.

The invention is especially, although not exclusively, concerned with pneumatic or oleo-pneumatic suspension systems for terrestrial or aerial vehicles and in this case a particular object of the invention is to provide means for either maintaining a constant height of the vehicle above the ground despite variations of the load of said vehicle, or varying this height according to the needs.

Such a system is particularly interesting when applied to aircrafts the landing gear of which (of the pneumatic or hydro-pneumatic type) is to be of variable length, either, for instance, for permitting of fitting the landing gear into a reduced housing of the airplane body, during retraction, or for giving the landing gear the necessary height when the airplane is taxiing on the ground prior to taking off or after landing, or again in order to reduce the total height of the airplane resting upon the ground so as to permit or to facilitate displacements thereof inside places of limited height (in airplane carriers or underground sheds, for instance).

In this particular case, an object of the invention is to provide means for varying the length of the landing gear which call for the application of a relatively low force for producing either the retraction or the expansion of the deformable system.

Another object of the invention, in the same case, is to devise said means so that the weight of the machine can be employed for starting the retraction of the deformable system, that is to say for reducing the length of the landing gear.

The present invention is also concerned, among the deformable systems above mentioned, with those for producing a variable pressure in a device for returning one or several elements to a predetermined position, for instance a device for constantly urging toward a median position the front wheel of a tricycle airplane landing gear.

The invention further relates, among these deformable systems, to pneumatic or oleo-pneumatic coupling devices or railway vehicle buffers, and in this case, an object of the invention is to make it possible to vary their length at will, so as to permit of assembling or detaching vehicles, and to ensure the desired elasticity of said devices under the effect of the stresses they have to undergo.

According to the essential feature of the present invention, the fluidtight chambers with which the deformable systems are provided, as above stated, are connected with variable volume reservoirs of fluid.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 diagrammatically shows, in section, an embodiment of the present invention as applied to a landing gear for an aircraft;

Fig. 2 is a view, similar to Fig. 1, showing a modification;

Fig. 3 is a plan view, partly in section, of a device for elastically urging toward its middle position the front wheel of the tricycle landing gear for an airplane.

In the embodiment of Fig. 1, the support of each wheel of the landing gear is constituted by a shock absorber including a cylinder **1** in which can move a piston **2** connected to the axle **3** of wheel **3a**. The two cylinders corresponding respectively to the two wheels of the landing gear communicate together through a conduit **4** and they are filled with a fluid under pressure. A variable volume reservoir **5** is also connected to conduit **4**. This reservoir includes a piston **6** adapted to be displaced by the inflow or the outflow of a fluid under pressure, such as oil, at **7**.

The arrangement disclosed by Fig. 2 is similar to that of Fig. 1, except for the variable volume reservoir, which is of different construction.

This reservoir includes a deformable bag or pocket **8**, which constitutes a fluidtight partition separating reservoir **5** into two chambers the relative volumes of which are determined by the deformations of bag **8**. The latter may be constitutes by an elastic matter, such as rubber, or by a merely flexible material or any other material which is sufficiently fluidtight and deformable. The inside of bag **8** is connected to conduit **4**.

The systems above described will work in the following manner:

It will be supposed that the length of the land-

ing gear is to be increased in order to permit taxiing of the airplane on the ground.

In this case, a fluid under pressure, such as oil, is admitted at 7 into reservoir 5, which pushes piston 6 inwardly (in the case of Fig. 1) or compresses bag 8 (in the case of Fig. 2) and drives out the fluid under pressure (compressed air, oil, etc.) present above piston 8 (Fig. 1) or inside bag 8 (Fig. 2) into conduit 4.

Consequently, pistons 2 are pushed downwardly and the elastic supports of the wheels assume their maximum length.

When, on the contrary, it is desired to retract or reduce the length of the supporting means constituted by cylinder 1 and piston 2, for instance in order to facilitate the displacements of the airplane inside a shed of limited height, oil is withdrawn from reservoir 5 under piston 8 (case of Fig. 1) or on the outside of bag 8 (case of Fig. 2). Under the effect of the weight of the airplane, pistons 2 then drive the fluid from cylinders 1 into reservoir 5, and the length of the elastic supports of the wheels is reduced.

The example of Fig. 3 relates to the case in which an element, such for instance as the front wheel of a so-called "tricycle" landing gear is to be constantly urged toward the median position. In this case, reference character 1 designates the deformable system constituted by a cylinder and a piston and connected through a pipe 4 to a reservoir 5, of variable volume, for instance containing an elastic bag 8, of the same type as in the embodiment of Fig. 2. The cylinder of deformable system 1 is hinged at one of its ends, at 9, to a piece 10 which is rigid with a semi-annular member 11 surrounding the rod 12 which constitutes the support of the landing gear wheel which is to be constantly urged toward the intermediate angular position. On the other hand, the end of the piston rod of the deformable system 1 is hinged at 13 to a piece 14 which is rigid with a semi-annular member 15 surrounding the other half of rod 12. These two semi-annular members 11 and 15 are both pivoted at 16 to a part of the airplane body. Rod 12 is provided with a projection 17 engaged in a notch formed between respective shoulders of members 11 and 15. Thus, when rod 12 is turned about its axis, it acts either on member 15 and piece 14, which is rigid therewith, or on member 11 and piece 10 which is rigid therewith.

This device will work in the following manner:

When rod 12 turns about its axis, for instance in the direction of arrow *f*, it pushes pieces 15 and 14 in the direction of arrow *f'*. This displaces the point of articulation 13 of the piston rod of the deformable system 1 in the same direction *f'* and causes said piston to be driven into the corresponding cylinder. The fluid present in this deformable system, in reservoir 5 and in conduit 4 is compressed. On the other hand, as semi-annular member 11 is provided with a cylindrical projection 11*a* fitting against the cylindrical side of rod 12, neither member 11 nor piece 10, which is rigid therewith can move in the direction of arrow *f'*. Therefore, by reaction, the compression produced in the cylinder of the deformable system tends to expel the piston from said cylinder and therefore to bring back rod 12 into its initial position.

Likewise, when rod 12 turns about its axis in the opposite direction, its projection 17 moves pieces 10 and 11, and pushes articulation point 9 in the direction of arrow *f''*. This movement also produces a compression of the liquid present in the cylinder, and as, in this case, the piston cannot move, the system tends, by reaction, to return the parts to their initial positions.

Therefore, in this case, I obtain a system which is brought back, when moved in one direction or the other, to its initial position under the effect of a compression of the fluid present in the deformable system 1.

The system above described will therefore constantly tend to urge back the wheel supported by rod 12 toward the desired position thereof. Through a suitable adjustment of the initial pressure in system 1—4—5, it is possible easily to determine the resistance of the wheel to lateral stresses.

On the other hand, the plant according to the invention permits of adjusting at will the magnitude of the deformations undergone by the deformable system or systems. This result is obtained by varying the pressure in the spaces between pistons 2 and 6 (or between piston 2 and elastic bag 6). It is thus possible to obtain, at will, a soft or hard working of a shock absorber.

Of course, I may employ any desired number of variable volume reservoirs and of deformable systems and these reservoirs and systems may be either all connected together or, on the contrary, connected by groups.

JEAN MERCIER.