

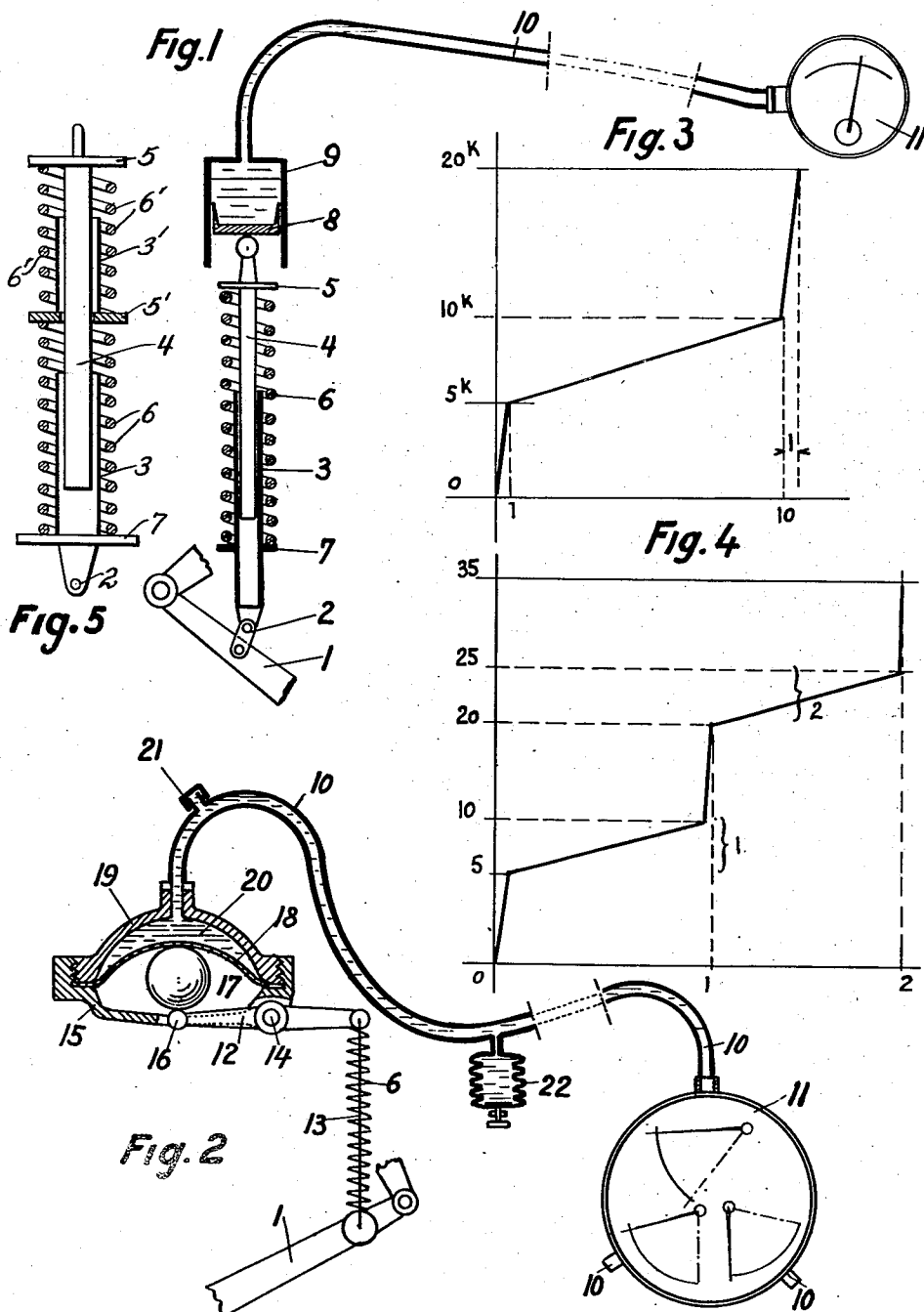
Feb. 10, 1942.

J. MERCIER

2,272,950

APPARATUS FOR THE DISTANT INDICATION OF DISPLACEMENTS OR DEFORMATIONS, AND THEIR APPLICATIONS

Filed Feb. 21, 1938



JEAN MERCIER
INVENTOR

By *Otto Munk*
His Atty.

UNITED STATES PATENT OFFICE

2,272,950

APPARATUS FOR THE DISTANT INDICATION OF DISPLACEMENTS OR DEFORMATIONS, AND THEIR APPLICATIONS

Jean Mercier, Neuilly-sur-Seine, France

Application February 21, 1938, Serial No. 191,580
In Great Britain February 26, 1937

11 Claims. (Cl. 116—124)

The present invention has for its object improvements in apparatus for the distant indication of displacements or deformations.

Methods and mechanisms are already known, which permit of indicating, upon a dial, the position of a movable member, or the deformation of an element when said member or said element are not directly visible.

In certain cases, and chiefly for aviation purposes, it is necessary to indicate to the pilot at each instant, the position of certain elements, such as the retractable landing gear of an aeroplane. In this case, only the extreme positions need be indicated with great accuracy, and the intermediate positions may be shown with a certain degree of approximation.

The object of the present invention is to provide an apparatus of the type above described which is better adapted to meet the requirements of practice than those made for the same purpose up to the present time.

According to the essential feature of the present invention, the indicating means are operative in response to variations of the pressure of a fluid enclosed in a container, these variations being produced by the action of transmission means interposed between said container and the element the displacements of which are to be indicated, said transmission means including both an elastic portion and a rigid portion, in series together at the beginning of the displacement of said element, but arranged in such manner that the elastic portion is mechanically short-circuited, that is to say brought out of action and replaced by the solid portion as soon as the deformation of said elastic portion exceeds a given value.

In this manner, the initial and the final small increments of movement, say 0.1 inch, of the element in question, may be made to cause relatively great changes in pressure as indicated on the pressure-gauge, while the intermediate portion of its travel causes only a small movement of the pressure indicator, thus enabling the use of a much smaller dial than could be used with other indicating devices.

Further characteristics of the invention will be set forth in the following description.

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

Fig. 1 is a diagrammatic view showing an apparatus according to the invention, which utilizes an elastic device operating by compression;

Fig. 2 is a like view of an apparatus utilizing an elastic device operating under tensile stresses;

Fig. 3 is a diagrammatic view indicating the variations of pressure according to the displacements or deformations;

Fig. 4 is an analogous view, for the case in which use is made of two springs disposed in series;

Fig. 5 shows an embodiment belonging to case of Fig. 4.

In the embodiment shown in Fig. 1, the movable element 1, whose deformations or movements are to be indicated, is connected at a point 2 to a tube 3 which is slidable on a rod 4. The said rod is provided with a stop 5 which is in contact with one end of a spring 6, whose other end bears against a stop 7 provided on the tube 3. Beyond the stop 5, the said rod carries a piston 8 slidable in a cylinder 9 containing a liquid of any kind and connected by a pipe 10 to a pressure-gauge 11. The spring 6 may be an ordinary coil spring.

It is advantageous, in order to obtain exact readings on the pressure-gauge for the two extreme positions of the movable element (at the beginning and at the end of the deformation or the movement), to employ spring means which will act, at low pressures, practically as a rigid member, and will thus faithfully transmit the initial movements; and which spring means will then deform as the movement continues, until the tube 3 contacts the stop 5.

The operation of the said device is as follows: When element 1 moves for instance upwardly, its initial movement produces a relatively great increase of pressure in the fluid system, from zero to the point at which the spring begins to flex; then the relatively light spring is gradually compressed until the upper end of tube 3 makes contact with stop 5, resulting in a further relatively small movement of the piston in the cylinder. This movement of the piston will effect a certain further compression of the liquid in the circuit 9—10—11, and this is manifested by a further deflection of the pointer of pressure-gauge 11.

When the upper end of tube 3 makes contact with stop 5, the movements of element 1 are no longer transmitted to the piston by means of the elastic device, but in a direct and practically rigid manner. It may be said that the elastic device located between element 1 and the fluid circuit can no longer be subject to deformation. Consequently, all movements of element 1 are transformed, directly and with great precision, into variations of the pressure of the liquid contained in cylinder 9 and pipe 10, and these are accu-

rately indicated by the pressure-gauge, which will show a relatively great increase in pressure at this point.

The embodiment shown in Fig. 2 differs from the one shown in Fig. 1 by the use of an elastic tensile device. In this case, the movable element 1 is connected with a rocking lever 12 by a traction spring 6. The same connection is made by a flexible wire 13 of a given length which is attached to element 1 and to rocking lever 12. This latter is pivotally mounted on a suitable pin 14 mounted in a support 15, and it carries at its other end, at 16, a ball 17 or the like, which bears against a diaphragm 18 or like member. The said diaphragm is held in place by a cap 19 which forms a chamber 20, and this latter is connected by a pipe 10 to a pressure-gauge or the like 11. One wall of the said chamber is formed by the diaphragm 18, and is hence flexible. The pipe 10 may be provided with a lubricating inlet 21 which serves for the filling of the liquid system. A device 22 may also be provided, for adjusting the initial position of the pressure-gauge. Obviously, the circuit may be provided with a device for the evacuation of air, if necessary.

The pressure-gauge shown in Fig. 2 is of the type having three dials and three pointers, and thus the casing of the pressure-gauge may be divided into three chambers, each of which is connected with a pipe similar to the pipe 10, in order to indicate different movements, for instance, the movements of the back flap, of the right hand landing gear, and of the left hand landing gear.

The operation of the said apparatus is similar to that of the apparatus shown in Fig. 1. Spring 6 may have an initial tension, and the beginning of the movement of element 1 will produce no appreciable deformation of the spring, which now acts as a rigid member. The subsequent movement of element 1 will stretch spring 6, thus subjecting it to deformation, and will cause a certain movement of rocking lever 12 and a slight deformation of diaphragm 18. According as spring 6 becomes stretched, the deformation of the said diaphragm will gradually increase, and at a certain time, wire 13 will get stretched. From this time on, as the spring no longer acts, the movements of element 1 are entirely imparted to the rocking lever, and the deformation of the diaphragm abruptly increases, sharply increasing the pressure of the contained liquid.

Fig. 3 represents a curve which shows by way of example, the operation of the apparatus indicated in Fig. 2. In this diagram, the ordinates represent the pressures, and the abscissae the displacements of the movable element 1. It will be observed that in the first place, in the region corresponding to the initial tension, the displacements are very small compared to the increase in pressure that they subsequently increase at a much greater rate, and that they fall to a minimum rate when the transmission device becomes rigid.

Figures 4 and 5 show the case in which use is made of two springs mounted in series and acting upon each other, and are adapted to flex, respectively, at about 5 and 20 kilograms pressure, and to go solid, respectively, at about 10 and 25 kilograms. The device consists (Fig. 5) of one tube 4 and of two telescopic tubes 3 and 3'. Tube 4 has a collar 5, while tubes 3 and 3' have respective collars 7 and 5'. A spring 6 is located between collars 5' and 7, and spring 6' is located

between 5' and 5. This latter spring is somewhat stronger than spring 6, so that spring 6 is first compressed and then spring 6'.

The liquids to be employed in the circuit are preferably of the non-freezing type, so as to prevent any bursting of the pipes, and to ensure the operation of the apparatus whatever be the surrounding temperature.

In the case in which an apparatus according to the invention is used upon aircraft, the dial or dials will be mounted on the instrument board, so that the pilot, sitting on his place, can exactly determine the moment when the back flap, the landing gear, or other movable part, have reached their maximum positions. He will also observe the intermediate positions of these parts, but as the indications for these latter positions are only of secondary importance, they will only be given with a certain degree of approximation.

Obviously, the said invention is not limited to the forms of construction herein described, which are given solely by way of example. Thus without departing from the spirit of the invention, use may be made of means for the transmission of the movements of the movable elements to the fluid system, other than a piston or a diaphragm. In like manner, as many apparatuses as desired may be combined around a single dial.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An apparatus for the distant indication of displacements, deformations or like variations of position and shape of bodies of any kind, chiefly adapted for use on aircraft, comprising an elastic means directly subjected to said variations, a fluid circuit acted upon by said elastic means and the fluid pressure whereof is determined by the action resulting from said variations and transmitted thereto through the intermediary of said elastic means, a measuring and indicating device connected with said circuit and responsive to the variations of pressure occurring therein, and means for rendering the transmission of said variations of shape and position to the fluid circuit practically rigid when said variations attain a nearly extreme value, whereby further variation results in a relatively great change in condition of said indicating device.

2. An apparatus for the distant indication of displacements, deformations or like variations of position and shape of bodies of any kind, chiefly adapted for use on aircraft, comprising an elastic means directly subjected to said variations, a fluid circuit acted upon by said elastic means and the fluid pressure whereof is determined by the action resulting from said variations and transmitted thereto through the intermediary of said elastic means, a measuring and indicating device connected with said circuit and responsive to the variations of pressure occurring therein, and means for rendering the transmission of said variations of shape and position to the fluid circuit practically rigid when said variations attain a nearly extreme value, whereby further variation results in a relatively great change in condition of said indicating device, said elastic means being combined with said latter means rendering the assembly rigid and consisting of a compression spring element and of two stop members which are brought into contact after the spring element has been duly compressed.

3. An apparatus according to claim 2, wherein the spring element has a substantial initial re-

sistance to compression, whereby it acts as a rigid member at low pressures.

4. An apparatus according to claim 1, further comprising a piston-like member acting upon said fluid circuit and in turn actuated by said elastic means, and transforming the effects of the said variations of shape and position transmitted by said elastic means into pressure effects in said circuit.

5. An apparatus for indicating from a distance the displacements of an element comprising indicating means, a fluid circuit connected thereto, a cylinder in said circuit, a piston slidably mounted in said cylinder, a rod connected to said piston, a tube wherein said rod is adapted to slide, elastic means between said rod and said tube, and a connection between said tube and the element the displacement of which is to be indicated, said tube being adapted to make contact with a stop member on said rod upon deformation of said elastic means to a predetermined extent, whereby further displacement of said element results in a relatively great change in condition of said indicating means.

6. An apparatus for indicating from a distance the displacements of an element, which comprises, in combination, a closed container filled with a fluid, indicating means responsive to the fluid pressure in said container, and a transmission, between said element and one wall of said container, for varying the fluid pressure therein in response to displacements of said element, said transmission including two rigid portions having shoulders thereon, and elastic means interposed between said portions and bearing against said shoulders, said rigid portions being arranged to cooperate directly together for a deformation of said elastic means exceeding a predetermined value, whereby further displacement of said element results in a relatively great change in condition of said indicating means.

7. An apparatus for indicating from a distance the displacements of an element, which comprises, in combination, a closed container filled with a fluid, indicating means responsive to the fluid pressure in said container, and a transmission between said element and one wall of said container for varying the fluid pressure therein in response to displacements of said element, said transmission including two rigid parts having shoulders thereon and elastic means interposed between said parts and bearing against said shoulders, and stops carried by said parts respectively, adapted to cooperate together as soon as the deformation of the elastic means exceeds a given value, whereby further displacement of said element results in a relatively great change in condition of said indicating means.

8. An apparatus for indicating from a distance the displacements of an element, which comprises, in combination, a closed container filled with a liquid, said container including a cylindrical part and having one wall constituted by a piston slidable in said cylindrical part, indicating means responsive to the fluid pressure in said container, and a transmission between said ele-

ment and said piston, said transmission including two rigid parts having shoulders thereon and elastic means interposed between said parts and bearing against said shoulders, said rigid parts being arranged to cooperate directly together for a deformation of said elastic means exceeding a predetermined value, whereby further displacement of said element results in a relatively great change in condition of said indicating means.

9. An apparatus for indicating from a distance the displacements of an element, which comprises, in combination, a closed container filled with a fluid, indicating means responsive to the fluid pressure in said container, and a transmission between said element and one wall of said container for varying the fluid pressure therein in response to displacements of said element, said transmission including two rigid portions and elastic means interposed between said portions, said elastic means comprising a relatively weak spring and a relatively strong spring arranged in series, said springs being so constructed and arranged as to act separately throughout spaced ranges of pressure, said rigid portions being arranged to cooperate directly together for a deformation of said elastic means exceeding a predetermined total value, whereby displacement of said element results in relatively great changes in condition of said indicating means under conditions of pressure below, between and above said spaced ranges.

10. An apparatus for indicating from a distance the displacements of an element, which comprises, in combination, a closed container filled with a fluid, indicating means responsive to the fluid pressure in said container, and a transmission between said element and one wall of said container for varying the fluid pressure therein in response to displacements of said element, said transmission including two rigid portions, a tension spring connecting said portions, and a substantially non-stretchable tension member connecting said portions and adapted to be stressed upon relative movement of said portions beyond a predetermined limit, whereby further displacement of said element results in a relatively great change in condition of said indicating means.

11. An apparatus for indicating from a distance the displacements of an element, which comprises, in combination, a closed deformable elastic container filled with a fluid, indicating means responsive to the fluid pressure in said container, and a transmission between said element and one wall of said container for varying the fluid pressure therein in response to displacements of said element, said transmission including elastic means subjected to said displacements, and means cooperating to render said transmission substantially rigid when said elastic means has been deformed to a predetermined extent, whereby further displacement of said element results in a relatively great change in condition of said indicating means.

JEAN MERCIER.