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Filed May 21, 1937

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UNITED STATES PATENT OFFICE

2,168,397

TEMPERATURE COMPENSATOR

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Application May 21, 1937, Serial No. 143,949

3 Claims. (Cl. 60—54.5)

This invention pertains to remote control apparatus of the hydraulic type as shown broadly in my Patent No. 1,804,212, dated May 5, 1931.

That patent discloses a pair of Sylphons forming a driving unit, another pair of Sylphons forming a driven unit, and a floating link associated with either one of said units in order to compensate for changes of temperature.

Another of my patents, No. 1,881,266, dated October 4, 1932, discloses a modified arrangement of the above in which the temperature compensating device is not associated directly with either the driving or driven units, but comprises a third pair of Sylphons with the floating link between them, these compensating Sylphons being in a pipe line forming a choke-controlled bridge or by-pass between the two transmission pipe lines which interconnect the driving and driven units.

An object of the present invention is to improve the arrangement of Patent 1,881,266 by placing the Sylphons of the compensating unit directly in the transmission lines between the driving and driven units instead of placing those Sylphons in a by-pass line. This arrangement means that the Sylphons of the temperature compensating unit are subjected to all changes of pressure in the main pipe lines. Some of these changes make sudden surges of pressure which might cause temporary buckling of the Sylphons and "folding" of the compensating linkage if the arrangement of parts were of the familiar previous types.

In previous arrangements of the compensating Sylphons they were sometimes in direct axial alignment as in Patent 1,804,212, in which case the connections from the single floating arm to the Sylphons were off the axial line of the Sylphons and therefore axially unbalanced forces were placed on the Sylphons, which might, under certain conditions, cause the Sylphons to temporarily buckle sidewise. Another arrangement was to place the compensating Sylphons on offset but parallel axes (as in Patent 1,881,266) so that the studs connected to the floating link were on the center lines of respective Sylphons, thus preventing offset axial loads on the Sylphons.

An object of the present invention is to provide a linkage for the compensating unit which will prevent offset axial loads on the Sylphons, which will not fold up even under sudden surges of pressure, and which will permit the Sylphons to be placed in axial alignment.

These features enable the invention to accomplish another of its objects, i. e., a temperature compensating unit of the least possible over-all diameter, thereby permitting the unit to be passed

through small openings, and to be drawn through comparatively small pipes, thereby greatly facilitating installation in difficult locations, as, for instance, in submarines, where these instruments are used extensively.

Further and other objects and advantages will be apparent from the specification and claims and from the accompanying drawing which illustrates what is now considered the preferred embodiment of the invention.

Fig. 1 is a diagrammatic representation of the invention.

Fig. 2 is a longitudinal sectional view of a commercial embodiment of the invention.

Fig. 3 is a view on line 3—3 of Fig. 2.

Fig. 4 is a view on line 4—4 of Fig. 2.

Referring to Fig. 1 of the drawing, the invention is shown diagrammatically but with sufficient detail to enable the invention to be fully understood.

The unit at one end of the system is designated A and the one at the other end B. Movement may be transmitted from A to B or from B to A.

Each unit comprises a pair of similar fluid-tight containers of variable capacity. These containers are preferably in the form of Sylphons 30 and 32 in unit A and 34 and 36 in unit B. The Sylphons of each pair are supported in axial alignment, the outer ends of the Sylphons being rigidly mounted on frame plates 40, 42, 44 and 46, while the free ends of each pair are interconnected by bars 50 and 52.

A pointer 54 in unit A, fulcrumed on the frame at 56 and pivoted on bar 50 at 58 serves to indicate on chart 60 any horizontal movement of bar 50. Arcuate movement of pivot 58 is permitted by the flexibility of the Sylphons.

In similar manner a pointer 64 in unit B serves to indicate on chart 70 any horizontal movement of bar 52.

Between units A and B is a compensating unit C comprising a pair of similar Sylphons 76 and 78 arranged on the same axial line. Their outer ends are fixed to frame plates 80 and 82, while their adjacent ends, instead of being rigidly interconnected as in units A and B, are connected by studs 84 and 86 to the ends of rock-arms 88 and 90, respectively. Arms 88 and 90 are pivoted on a fixed axis at 92. The free end of arm 88 is connected by link 94 to Sylphon 78 and the free end of arm 90 is connected by link 96 to Sylphon 76. In other words, the upper ends of arms 88 and 90 are connected to Sylphons 76 and 78, respectively, by studs 84 and 86, while the lower ends of arms 88 and 90 are connected by links 94

and 96 to Sylphons 78 and 76, respectively. This arrangement insures that any axial pressure on Sylphon 76 is transmitted to or from that Sylphon equally through stud 84 and link 96, while any axial pressure to or from Sylphons 76 is transmitted through studs 86 and link 94. Since studs 84 and 86 and links 94 and 96 are at equal distances radially from the axial line of Sylphons 76 and 78, there can be no unbalanced axial forces transmitted from one of those Sylphons to the other and consequently there can be no force couple tending to buckle the Sylphons sidewise.

As shown in Fig. 1, the fixed end of Sylphon 30 is connected by pipe or tube 100 to the fixed end of Sylphon 78, which in turn is connected by pipe 102 to the fixed end of Sylphon 34. In like manner the fixed end of Sylphon 36 is connected by pipe 104 to the fixed end of Sylphon 76, which in turn is connected by pipe 106 to the fixed end of Sylphon 32.

With the above structure in mind, operation of the apparatus will be readily understood. If, for instance, pointer 54 of unit A be moved to the left, Sylphon 30 will be forcibly contracted axially, and Sylphon 32 forcibly expanded axially by bar 50 through the instrumentality of pivot 58. Contraction of Sylphon 30 will force oil from Sylphon 30 through tube 100, through Sylphon 82 and through pipe 102 into Sylphon 34 of unit B, expanding Sylphon 34. At the same time, Sylphon 32 will be expanded axially, drawing oil from Sylphon 36 through pipe 104, Sylphon 76 and pipe 106 and cause Sylphon 32 to lengthen axially in proportion to the axial shortening of Sylphon 30. Briefly, then, the free ends of Sylphons 30 and 32 move a certain distance to the left and synchronously the free ends of Sylphons 34 and 36 move to the right, causing pointer 64 to move to the right the same distance that pointer 54 has moved to the left.

When a change of temperature occurs, the volume of oil contained in the system will expand or contract and this change of volume of the fluid causes Sylphons 76 and 78 of unit C to both expand or both contract equal amounts axially, both pipe lines containing the same amount of liquid and there being no other place in the system to accommodate the volume change. The expansion or contraction of Sylphons 76 and 78 simply causes arms 88 and 90 to swing idly about their fulcrum point 92 without having any effect on the functioning of the system or the relative positions of pointers 54 and 64.

In the commercial embodiment of the expansion unit illustrated in Figs. 2, 3 and 4, a frame 110 is provided having brackets 112, 114 at its ends to support Sylphon end plates 80, 82, respectively, and having brackets 116, 118 for supporting fulcrum pin 92. The outer surface of frame 110 is cylindrical, to fit snugly within tube

120, passages being provided in frame 110 for tubes 100 and 104 (Fig. 4). Frame 110 is held in place within tube 120 by internal caps 122, 124 (Fig. 2) having central openings for wires 100 and 106 at one end of the device and for wires 102 and 104 at the other end.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. A movement transmitting apparatus comprising, in combination, a pair of movable devices remote from each other, a hydraulic transmission system comprising two pipe lines interconnecting said devices whereby movement of one device will cause synchronous movement of the other, a Sylphon directly connected in each of said pipe lines and subjected to all changes of pressure in said pipe lines, said Sylphons being in adjacent axial alignment and being operatively interconnected through a pair of pivoted arms and linkage whereby means is provided for preventing offset axial loads on said Sylphons and for preserving accuracy of the apparatus when change of temperature occurs.

2. A movement transmitting apparatus comprising, in combination, a pair of movable devices remote from each other, a hydraulic transmission system comprising two pipe lines interconnecting said devices whereby movement of one device will cause synchronous movement of the other, a Sylphon directly connected in each of said pipe lines and subjected to all changes of pressure in said pipe lines, said Sylphons being in adjacent axial alignment and being operatively interconnected through a pair of pivoted arms, each arm being connected at its ends to one of said Sylphons whereby means is provided for preserving accuracy of the apparatus when change of temperature occurs.

3. A movement transmitting apparatus comprising, in combination, a pair of movable devices remote from each other, a hydraulic transmission system comprising two pipe lines interconnecting said devices whereby movement of one device will cause synchronous movement of the other, a Sylphon directly connected in each of said pipe lines and subjected to all changes of pressure in said pipe lines, said Sylphons being in adjacent axial alignment with their remote ends fixed and their adjacent ends interconnected through a pair of pivoted arms and linkage for preventing offset axial loads on said Sylphons, and whereby all points of connection between the arms and Sylphons are equidistant from the axial line of said Sylphons.

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