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(54) Electrohydraulic actuator for generating test loads.

(57) An actuator substantially comprising a hydraulic cylinder (5), the piston rod (6) of which is connected to a mechanical test part; a connecting plate (8) secured to a test apparatus and connected, by means of a hinge (9), to the casing of the hydraulic cylinder; and a solenoid valve (13) for supplying hydraulic fluid to the cylinder and connected to a supply pipe (14) and a drain pipe (15); the actuator also comprising two fittings (16) connected respectively to the supply and drain pipes; the axis (a) of each fitting being located close to the hinge, and each fitting being connected mechanically, by means of a rigid restraint, to the casing of the hydraulic cylinder, and being connected hydraulically to the solenoid valve by means of a respective pipe section (17).

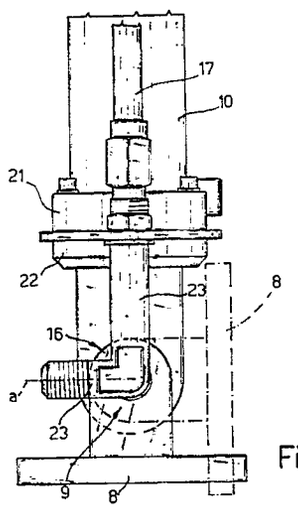

Fig.2

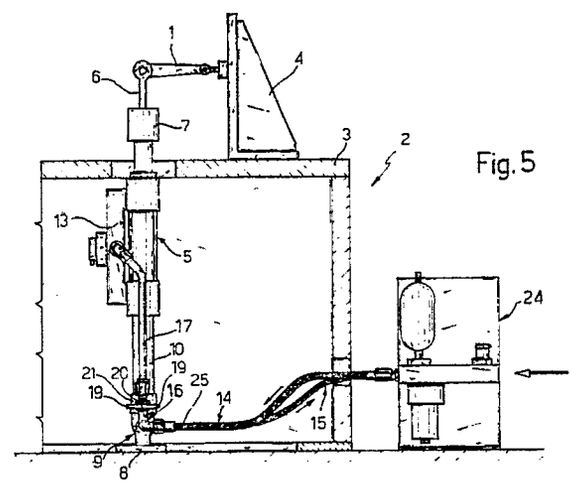

Fig.5

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ELECTROHYDRAULIC ACTUATOR FOR GENERATING TEST LOADS

The present invention relates to an electrohydraulic actuator for generating test loads, particularly on a mechanical part mounted on an experimental test apparatus.

Actuators of the aforementioned type usually comprise a hydraulic cylinder, the pislon rod of which is normally connected to the test part via a load cell and a connecting plate secured to the apparatus and connectable in hinged manner to the hydraulic cylinder casing. Such actuators also comprise a solenoid valve for supplying hydraulic fluid to the cylinder, and which is secured to the cylinder casing and connected to a fluid supply and drain pipe. The supply and drain pipes are usually connected to the solenoid valve by means of a fitting on the valve body, and usually consist of hoses connecting the fittings to a pressurized hydraulic fluid source, usually a hydraulic system.

A major drawback of known actuators of the aforementioned type is that the loads applied on the test part (to which the piston rod of the actuator cylinder is connected) are not directed along the piston rod axis, and are generated by the loads transmitted by the pipes connecting the pressurized fluid source to the solenoid valve. Said loads are substantially due to the pressure force acting on the pipe sections between the fittings and pressurized fluid source, and to the flexural rigidity of the pipe sections. These loads usually present a fairly high component perpendicular to the actuator axis, the line of action of which is located a considerable distance from the axis of the hinge connecting the hydraulic cylinder casing to the connecting plate. As a result of said loads, therefore, the actuator is subjected to forces and moments which, combined with the forces generated by the hydraulic cylinder, severely affect lhe required overall test load. Such a drawback is particularly serious when the loads generated by the actuator are fairly small, i.e. either equal to or even smaller than said additional external loads.

The aim of the present invention is to provide an electrohydraulic actuator of the type briefly described above, designed to overcome the above drawback.

With this aim in view, according to the present invention, there is provided an electrohydraulic actuator for generating test loads, particularly on a mechanical part mounted on an experimental test apparatus, said actuator substantially comprising a hydraulic cylinder, the piston rod of which is connected to said test part; a connecting plate secured to said apparatus and connected via a hinge to the casing of said hydraulic cylinder; and a solenoid valve for supplying hydraulic fluid to said cylinder and connected to a supply pipe and a drain pipe for supplying and draining said hydraulic fluid; characterised by the fact that it comprises two fittings connected respectively to said supply and drain pipes; the axis of each said fitting being located close to said hinge, and each said fitting being connected mechanically, via a rigid restraint, to said casing of said hydraulic cylinder, and being connected hydraulically to said solenoid valve via a respective pipe section.

A number of non-limiting embodiments of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Fig.s 1 and 2 show respective perpendicular side views of the bottom portion of a first embodiment of the actuator according to the present invention;

Fig.s 3 and 4 show side views of a second embodiment of the actuator according to the present invention;

Fig.5 shows a schematic side view of a test apparatus employing an electrohydraulic actuator in accordance with the present invention.

The electrohydraulic actuator according to the present invention is designed to generate test loads, particularly on a mechanical part 1 (Fig.5) mounted on an experimental test apparatus 2 substantially comprising a base 3 having a connecting bracket 4 to which one end of part 1 is connected as shown in Fig.5.

The electrohydraulic actuator according to the present invention substantially comprises a hydraulic cylinder 5, the pislon rod 6 of which is connected to part 1, e.g. to the other end of the same, and conveniently comprises a load cell 7 for measuring the load exerted by the actuator; a connecting plate 8 secured to apparatus 2 and connected by a hinge 9 (Fig.s 1, 2, 3 and 4) to the bottom end of actuator casing 10; and a solenoid valve 13 (Fig.5) for supplying hydraulic fluid to cylinder 5 and connected to a supply pipe 14 and a drain pipe 15.

As shown clearly in Fig.s 1 to 4, the actuator according to the present invention comprises two fittings 16 connected respectively to supply pipe 14 and drain pipe 15. According to the present invention, the axis (indicated "a" in Fig.s 2 and 4) of each said fitting 16 is located close to the axis of hinge 9 and is connected rigidly to casing 10 of hydraulic cylinder 5. Moreover, each said fitting 16 is connected hydraulically to solenoid valve 13 via a respective pipe section 17 (Fig.5).

In the case of a cylindrical hinge 9 connecting plate 8 to casing 10 of hydraulic cylinder 5, as

shown in the Fig.1 and 2 embodiments, axis "a" of each fitting 16 intersects the axis of hinge 9.

In the case of a spherical hinge 9, on the other hand, as shown in the Fig.3 and 4 embodiments, distance "d" (Fig.4) of axis "a" of each fitting 16 from the center O of hinge 9 is so selected as to prevent fitting 16 from interfering with connecting plate 8 during oscillation of hydraulic cylinder 5 about any axis through center O of hinge 9. As such, distance "d" may be very small, equal to to two or three times the diameter of pin 18 (Fig.3) constituting hinge 9.

Each fitting 16 is secured to a tab 19 connected to the bottom end of casing 10 of cylinder 5, which two tabs 19 conveniently form part of a single plate 20 locked between the end flange 21 and cover 22 of casing 10.

Each of said pipe sections 17 connecting each fitting 16 to solenoid valve 13 conveniently presents its axis substantially parallel to the cylinder axis, as shown in the accompanying drawings, and is preferably a rigid pipe section.

Each fitting 16 comprises two cylindrical, substantially perpendicular portions 23, one secured to one end of respective pipe section 17, and the other to supply pipe 14 or drain pipe 15.

The actuator according to the present invention operates as follows.

Connecting plate 8 is secured to an appropriate part of apparatus 2, while the end of piston rod 6 of cylinder 5 is connected to test part 1 as shown, for example, in Fig.5. Pressurized fluid is then supplied by an appropriate hydraulic system 24 along supply pipe 14 to respective fitting 16 and, from there, along pipe section 17 to solenoid valve 13. In the case of an actuator as shown in Fig.s 1, 2 and 5, the resultant transmitted by end 25 of supply pipe 14 to fitting 16 obviously in no way affects cylinder 5, by virtue of the line of action of said resultant intersecting the axis of hinge 9 and being discharged entirely on connecting plate 8, thus transmitting to cylinder 5 no transverse load which might affect the load generated by piston rod 6 on test part 1. The same also applies to drain pipe 15, which thus in no way affects hydraulic cylinder 5. The loads exerted by the ends of each pipe section 17 to tab 19 and solenoid valve 13 form part of a fully balanced internal load system which in no way affects, either in terms of direction or absolute value, the load generated by piston rod 6 on the actuator.

In the case of the Fig.2 and 3 embodiment, wherein axis "a" of fitting 16 is not incident with the axis of hinge 9, the line of action of the resultant transmitted by end 25 of pipe 14 to fitting 16 obviously presents an extremely short arm (distance "d") from center O of spherical hinge 9, so that the moment generated by said resultant on hydraulic cylinder 5 is entirely negligible and such as to generate no undesired additional load on test part 1.

To those skilled in the art it will be clear that changes may be made to both the design and arrangement of the component parts of the actuator as described and illustrated herein without, however, departing from the scope of the present invention.

Claims

1) - An electrohydraulic actuator for generating test loads, particularly on a mechanical part (1) mounted on an experimental test apparatus (2), said actuator substantially comprising a hydraulic cylinder (5), the piston rod (6) of which is connected to said test part (1); a connecting plate (8) secured to said apparatus (2) and connected via a hinge (9) to the casing (10) of said hydraulic cylinder (5); and a solenoid valve (13) for supplying hydraulic fluid to said cylinder (5) and connected to a supply pipe (14) and a drain pipe (15) for supplying and draining said hydraulic fluid; characterised by the fact that it comprises two fittings (16) connected respectively to said supply (14) and drain (15) pipes; the axis (a) of each said fitting (16) being located close to said hinge (9), and each said fitting (16) being connected mechanically, via a rigid restraint, to said casing (10) of said hydraulic cylinder (5), and being connected hydraulically to said solenoid valve (13) via a respective pipe section (17).

2) - An actuator as claimed in Claim 1, wherein said hinge (9) is cylindrical; characterised by the fact that the axis (a) of each said fitting (16) intersects the axis of said hinge (9).

3) - An actuator as claimed in Claim 1, wherein said hinge (9) is spherical; characterised by the fact that the distance (d) of the axis (a) of each said fitting (16) from the center (O) of said hinge (9) is so selected as to prevent said fittings (16) from interfering with said connecting plate (8) during oscillation of said hydraulic cylinder (5) about an axis through the center of said hinge (9).

3) - An actuator as claimed in one of the foregoing Claims, characterised by the fact that each said fitting (16) is secured to a tab (19) connected to the end of said casing (10) located on the side of said connecting plate (8).

4) - An actuator as claimed in one of the foregoing Claims, characterised by the fact that each said pipe section (17) connecting each said fitting (16) to said solenoid valve (13) presents its axis substantially parallel to that of said cylinder (5).

5) - An actuator as claimed in Claim 4, characterised by the fact that each said pipe section (17) is rigid.

6) - An actuator as claimed in one of the foregoing Claims, Chdracterised by the fact that each said fitting (16) comprises two cylindrical, substantially perpendicular portions (23), one secured to one end of said pipe section (17), and the other connected to said supply pipe (14) and drain pipe (15).

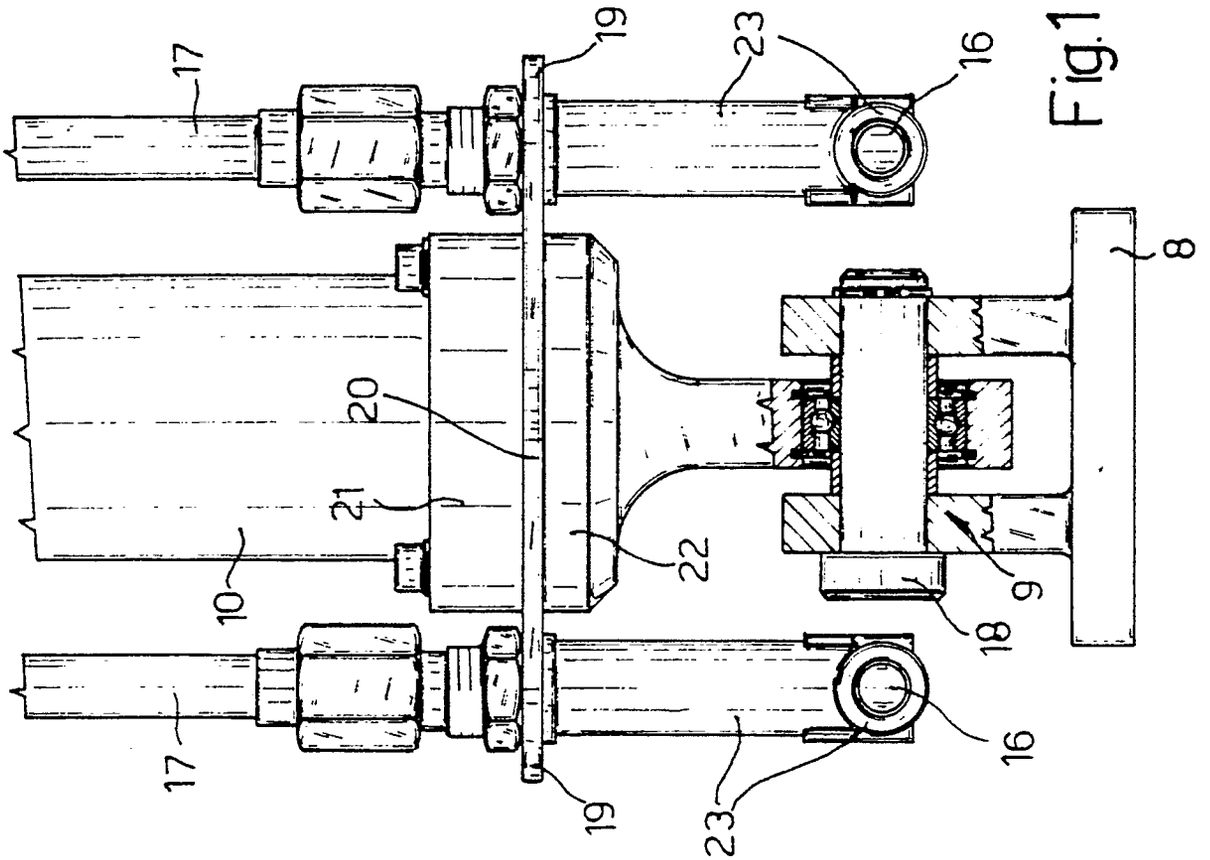

Fig.1

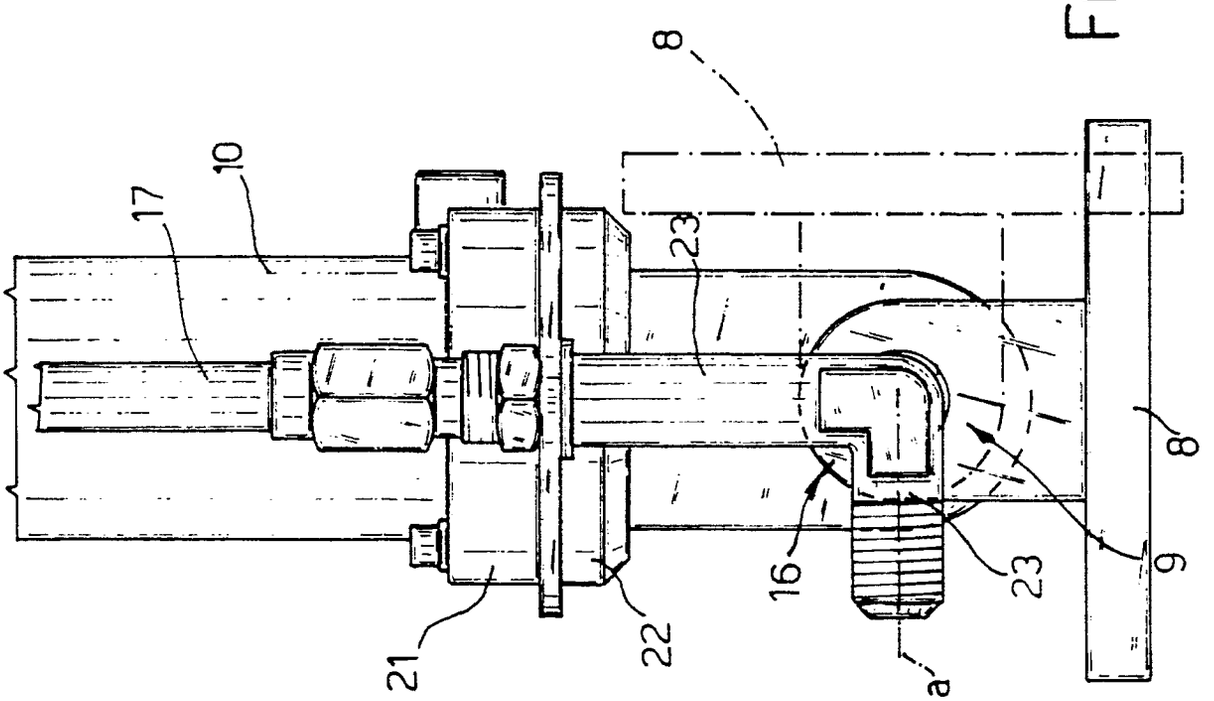

Fig.2

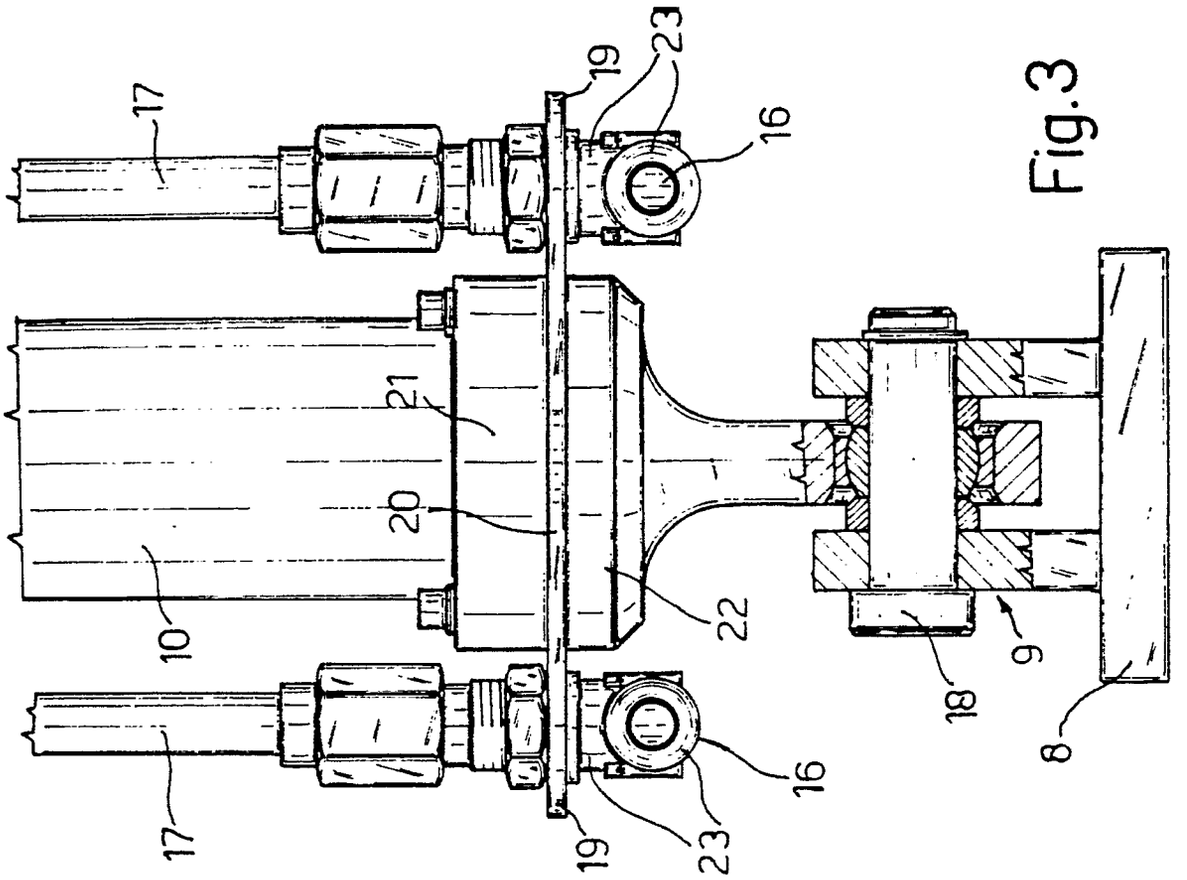

Fig.3

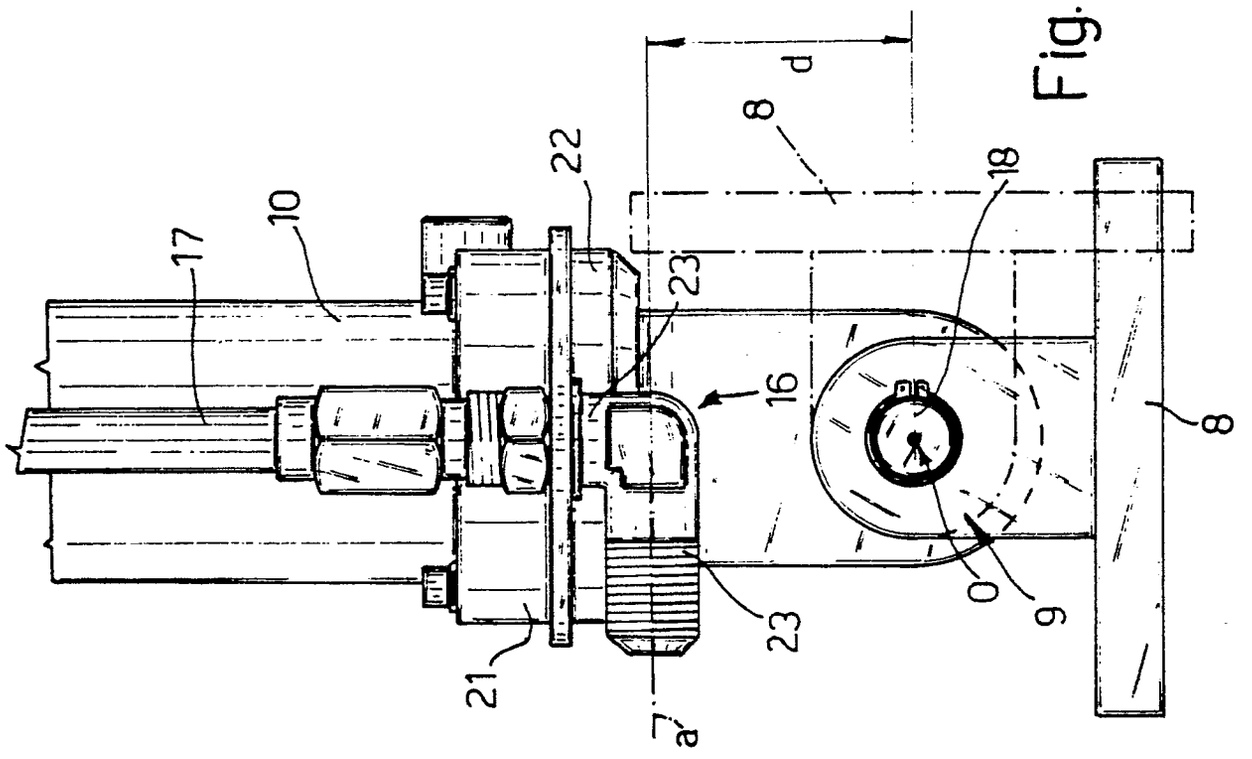

Fig.4

Fig.5