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(73) Proprietor: **FIAT AUTO S.p.A.**  
**Corso Giovanni Agnelli 200**  
**I-10135 Torino (IT)**

(72) Inventor: **Civiero, Mauro**  
**Via Barbera, 35**  
**10100 Torino (IT)**  
Inventor: **Filippi, Enrico**  
**Via Pacchiotti, 12**  
**10100 Torino (IT)**

(74) Representative: **Jorio, Paolo et al**  
**STUDIO TORTA Società Semplice**  
**Via Viotti 9**  
**I-10121 Torino (IT)**

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## Description

The present invention relates to an apparatus suitable for generating test loads, particularly on a mechanical part mounted on an experimental test machine, and of the type defined in the preamble of claim 1.

An apparatus of the aforementioned type is described in US 2,710,598, and comprises an electrohydraulic actuator which comprises a hydraulic cylinder, the piston rod of which is normally connected to the test part, a connecting plate secured to the machine and connectable in hinged manner to the hydraulic cylinder casing, and hydraulic means to connect the hydraulic cylinder to a hydraulic fluid source.

Normally, the hydraulic means comprise a solenoid valve which can be disposed in a fixed position with respect to the hydraulic cylinder and connected to the hydraulic cylinder by a swivel connection (said solenoid valve is not shown in US 2,710,598) or, alternatively, can be secured to the cylinder casing.

When the solenoid valve is secured to the cited casing, the supply and drain pipes usually consist of hoses, and the valve itself is usually connected to a supply pipe and to a drain pipe themselves by means of a fitting on the valve body.

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 the 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 apparatus suitable for generating test loads designed to overcome the above drawback.

With this aim in view, according to the present invention, there is provided an apparatus for generating test loads, particularly on a mechanical part mounted on an experimental test apparatus, as

defined in claim 1.

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 apparatus according to the present invention;

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

Fig.5 shows a schematic side view of the apparatus for generating test loads

The apparatus 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 apparatus for generating test loads comprises an electrohydraulic actuator, which, according to the present invention substantially, comprises a hydraulic cylinder 5, the piston 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 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 apparatus 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 Figs 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 which is defined by the claims.

## Claims

1. An apparatus suitable for generating test loads, particularly on a mechanical part (1) mounted on an experimental test apparatus (2), said apparatus for generating test loads 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 experimental test apparatus (2) and connected via a hinge (9) to the casing (10) of said hydraulic cylinder (5); a solenoid valve (13) for supplying hydraulic fluid to said cylinder (5); and a supply pipe (14) and a drain pipe (15) for supplying and draining said hydraulic fluid to the solenoid valve (13), characterised by the fact that the apparatus comprises two fittings (16) connected respectively to said supply (14) and drain (15) pipes; the axis (a) of a portion (23) of each of said fittings (16), which portion is secured to the supply and the drain pipe respectively, being located close to said hinge (9) between the connecting plate (8) and an end portion of the casing (10) of the hydraulic cylinder (5) faced to the connecting plate (8) itself, and each said fitting (16) being connected mechanically, via a rigid restraint (20), to said casing (10) of said hydraulic cylinder (15), and being connected hydraulically to said solenoid valve (13) via a respective pipe section (17).
2. An apparatus 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 apparatus 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).
4. An apparatus 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).
5. An apparatus 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).

6. An apparatus as claimed in Claim 5, characterised by the fact that each said pipe section (17) is rigid.
7. An apparatus as claimed in one of the foregoing Claims, characterised 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).

#### Patentansprüche

1. Vorrichtung, die zur Erzeugung von Testbelastungen geeignet ist, insbesondere an einem mechanischen Teil (1), das an einer experimentellen Testvorrichtung (2) befestigt ist, wobei das Gerät zur Erzeugung von Testbelastungen einen Hydraulikzylinder (5), dessen Kolbenstange (6) mit dem Testteil (1) verbunden ist; eine Verbindungsplatte (8), die an der experimentellen Testvorrichtung (2) befestigt und über ein Gelenk (9) mit dem Gehäuse (10) des Hydraulikzylinders (5) verbunden ist; ein Magnetventil (13) zum Zuführen eines hydraulischen Fluids zu dem Zylinder (5); und ein Zuführrohr (14) und ein Abführrohr (15) zum Zuführen und Abführen des hydraulischen Fluids zu und von dem Magnetventil (13), aufweist, dadurch gekennzeichnet, daß die Vorrichtung zwei Anschlußstücke (16) aufweist, die jeweils mit dem Zuführ- (14) und Abführ- (15) Rohr verbunden sind; wobei die Achse (a) eines Bereichs (23) jedes der Anschlußstücke (16), wobei der Bereich an dem Zuführ- und dem Abführrohr jeweils befestigt ist, dicht an dem Gelenk (9) zwischen der Verbindungsplatte (8) und einem Endbereich des Gehäuses (10) des Hydraulikzylinders (5) angeordnet ist, der zu der Verbindungsplatte (8) selbst hin gerichtet ist, und wobei jedes Anschlußstück (16) mechanisch über eine feste Zwangsführung (20) mit dem Gehäuse (10) des Hydraulikzylinders (15) verbunden ist und hydraulisch mit dem Magnetventil (13) über einen entsprechenden Rohrabchnitt (17) verbunden ist.
2. Vorrichtung nach Anspruch 1, wobei das Gelenk (9) zylindrisch ist; dadurch gekennzeichnet, daß die Achse (a) jedes Anschlußstücks (16) die Achse des Gelenks (9) schneidet.
3. Vorrichtung nach Anspruch 1, wobei das Gelenk (9) sphärisch ist; dadurch gekennzeichnet, daß der Abstand (d) der Achse (a) jedes An-

schlußstücks (16) von der Mitte (O) des Gelenks (9) so ausgewählt ist, um zu verhindern, daß die Anschlußstücke (16) mit der Verbindungsplatte (8) während einer Oszillation des Hydraulikzylinders (5) um eine Achse durch die Mitte des Gelenks (9) in Wechselwirkung tritt.

4. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß jedes der Anschlußstücke (16) an einer Lasche (19) befestigt ist, die mit dem Ende des Gehäuses (10) verbunden ist, das an der Seite der Verbindungsplatte (8) angeordnet ist.
5. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß jeder Rohrabchnitt (17), der jedes Anschlußstück (16) mit dem Magnetventil (13) verbindet, seine Achse im wesentlichen parallel zu derjenigen des Zylinders (5) besitzt.
6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß jeder Rohrabchnitt (17) steif ist.
7. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß jedes Anschlußstück (16) zwei zylindrische, im wesentlichen rechtwinklige Bereiche (23) aufweist, von denen einer an dem Ende des Rohrabchnitts (17) befestigt ist und der andere mit dem Zuführrohr (14) und dem Abführrohr (15) verbunden ist.

#### Revendications

1. Appareil prévu pour engendrer des charges d'essai, en particulier sur une pièce mécanique (1) montée sur une machine d'essai expérimental (2), ledit appareil de génération de charges d'essai comprenant un vérin hydraulique (5) dont la tige de piston (6) est connectée à ladite pièce en essai (1) ; une plaque de liaison (8) fixée à la dite machine d'essai expérimental (2) et reliée par une articulation (9) au cylindre (10) dudit vérin hydraulique (5) ; une électrovanne (13) pour fournir un fluide hydraulique audit vérin (5) ; et un tuyau d'alimentation (14) et un tuyau d'évacuation (15) pour amener le dit fluide hydraulique à l'électrovanne (13) et l'évacuer de celle-ci ; caractérisé en ce que l'appareil comprend deux raccords (16) connectés respectivement audit tuyau d'alimentation (14) et audit tuyau d'évacuation (15), l'axe (a) d'une partie (23) de chacun desdits raccords (16), ladite partie étant fixée au tuyau d'alimentation et au tuyau d'évacuation respectivement, étant situé près de ladite articulation

(9) entre la plaque de liaison (8) et une partie d'extrémité du cylindre (10) du vérin hydraulique (5) en regard de la plaque de liaison (8), et chacun desdits raccords (16) est connecté mécaniquement, par une fixation rigide (20), audit cylindre (10) dudit vérin hydraulique (5) et est connecté hydrauliquement à ladite électrovanne (13) par un élément de tuyau respectif (17).

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2. Appareil suivant la revendication 1, dans lequel ladite articulation (9) est cylindrique, caractérisé en ce que l'axe (a) de chaque raccord (16) rencontre l'axe de ladite articulation (9).

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3. Appareil suivant la revendication 1, dans lequel ladite articulation (9) est sphérique, caractérisé en ce que la distance (d) de l'axe (a) de chaque raccord (16) au centre (O) de ladite articulation (9) est choisie de façon à éviter l'interférence desdits raccords (16) avec ladite plaque de liaison (8) pendant l'oscillation dudit vérin hydraulique (5) autour d'un axe passant par le centre de ladite articulation (9).

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4. Appareil suivant une des revendications précédentes, caractérisé en ce que chacun desdits raccords (16) est fixé à une patte (19) connectée à l'extrémité du dit cylindre (10) située du côté de ladite plaque de liaison (8).

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5. Appareil suivant une des revendications précédentes, caractérisé en ce que chacun desdits éléments de tuyau (17) reliant chaque raccord (16) à ladite électrovanne (13) présente son axe sensiblement parallèlement à celui dudit vérin (5).

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6. Appareil suivant la revendication 5, caractérisé en ce que chaque élément de tuyau (17) est rigide.

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7. Appareil suivant une des revendications précédentes, caractérisé en ce que chaque raccord (16) comprend deux parties cylindriques sensiblement perpendiculaires (23) dont l'une est fixée à une extrémité dudit élément de tuyau (17) et dont l'autre est connectée audit tuyau d'alimentation (14) et audit tuyau d'évacuation (15), respectivement.

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