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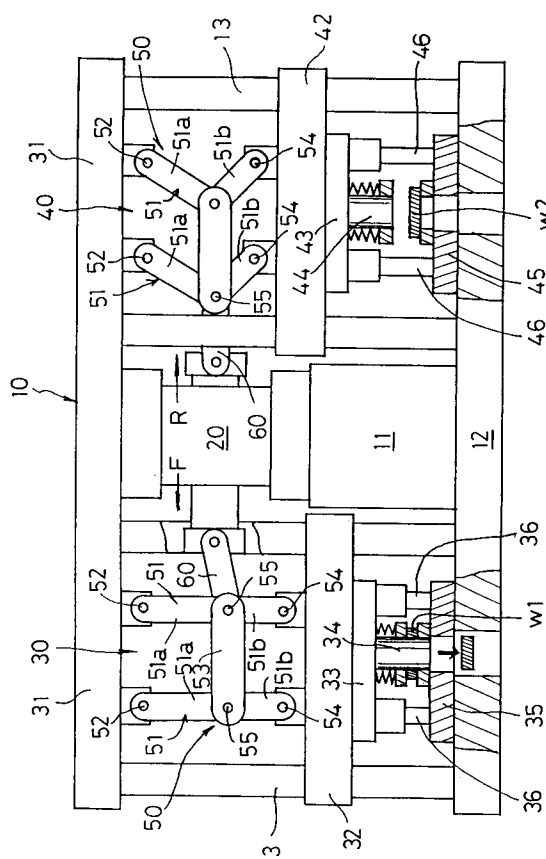
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W-8000 München 71 (DE)(54) **Hydraulic actuator.**

(57) A hydraulic actuator includes a single hydraulic cylinder device having a reciprocally movable piston, first and second working devices connected to opposite ends of the piston, and a stationary support which supports the first and second working devices. Each of said first and second working devices is provided with a working member and a linkage which is provided between the stationary support and the working member and which is connected to the piston to reciprocally move the working member in a predetermined direction in accordance with the reciprocal movement of the piston.

Fig. 1

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a hydraulic actuator which can be advantageously used, for example, in a press or the like.

2. Description of Related Art

Generally speaking, a hydraulic actuator is comprised of a pressing member, such as a pressing die or punch, and a cylinder device for actuating the pressing member. In a known hydraulic actuator, one pressing member is usually actuated by one cylinder device.

Consequently, to carry out more than one operation, (pressing operation), it is necessary to provide the number of pressing members corresponding to the number of the operations, or it is necessary to exchange the pressing die for each operation, thus resulting in a large press equipment or an increased manufacturing cost.

Furthermore, in a recent metal machining technology, there has been a need for extremely high precision. Nevertheless, in conventional metal machining apparatuses, since a workpiece is pressed at one point by the pressing member, the workpiece tends to receive an eccentric load from the pressing member, depending on the pressing point, thus resulting in a deterioration of the quality of products.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a hydraulic actuator in which two operations (working steps) can be carried out by a single cylinder device with a very high precision.

To achieve the object mentioned above, according to the present invention, there is provided a hydraulic actuator comprising a single hydraulic cylinder device having a reciprocally movable piston, first and second working devices connected to opposite ends of the piston, and a stationary support which supports the first and second working devices, each of said first and second working devices being provided with a working member and a linkage which is provided between the stationary support and the working member and which is connected to the piston to reciprocally move the working member in a predetermined direction in accordance with the reciprocal movement of the piston.

The cylinder device has a pair of piston rods connected to opposite ends of the piston, so that the linkages are connected to the respective piston rods.

Preferably, each of the linkages is comprised of a pair of collapsible levers and an intermediate connecting lever connecting the collapsible levers.

The direction of the movement of the working members is perpendicular to the direction of the reciprocal movement of the piston. Namely, the intermediate connecting levers of the linkages are translated always in parallel during the movement of the respective linkages.

In an embodiment, the working members are punchers to punch a workpiece.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described below in detail with reference to the accompanying drawings, in which:

Figure 1 is a side elevation view of a die drawing apparatus using a hydraulic actuator according to the present invention; and,

Figure 2 is a sectional view of a hydraulic cylinder used in the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In Figure 1 which shows a die drawing apparatus to which a hydraulic actuator 10 of the present invention is applied, the drawing apparatus is comprised of a cylinder device 20 having a piston 24 (Fig. 2) and a pair of first and second pressing devices 30 and 40 which are connected to opposite ends of the piston 24 of the cylinder device 20. In the illustrated embodiment, the first pressing device 30 is connected to the forward side F (left side in Fig. 1) of the piston, and the second pressing device 40 is connected to the rearward side R (right side) thereof, respectively.

The cylinder device 20 is supported by and on a base 11 which is provided on a substrate 12 on which the first and second pressing devices 30 and 40 are supported.

The second pressing device 40 is identical in construction to the first pressing device 30, and accordingly, internal components of the second pressing device 40 corresponding to those of the first pressing device 30 are designated with like reference numerals, and no explanation therefor will be given.

As can be seen in Fig. 2, the cylinder device 20 is comprised of a cylinder body 21 having end plates 23 connected to opposite ends thereof and a piston unit 22 which is reciprocally moved in the cylinder body 21. The piston unit 22 has a piston 24 which is provided with first and second piston rods 25 and 26 connected thereto. The outer ends of the first and second piston rods 25 and 26 project outward from the associated end plates 23

and are connected to connecting levers 60 of the first and second pressing devices 30 and 40 through connecting plates 27, respectively. The connecting levers 60 are pivoted to the respective connecting plates 27 through pivot pins 61.

The first (left in Fig. 2) and second (right) end plates 23 have fluid passages (e.g., oil or air passage) 28 and 29 through which a pressurized oil (or pressurized air) is introduced into or discharged from the cylinder body 21.

For example, when the pressurized oil is introduced into the cylinder body 21 through the oil passage port 28, the piston 24 is moved in the left direction, and when the pressurized oil is introduced into the cylinder body 21 through the oil passage port 29, the piston 24 is moved in the right direction, respectively to reciprocally move the first and second piston rods 25 and 26. As a result, pressing members (movable plates) 32 and 42 of the first and second pressing devices 30 and 40 are alternately moved up and down, as will be discussed below.

The first pressing device 30 has a stationary frame 31 which constitutes a stationary support and the pressing member 32 which is movable along vertical guide frames 13. The pressing member 32 has a pressing plate 33 secured thereto, which has a puncher (working member) 34 secured to the pressing plate 33. A workpiece W1 to be punched is located on a bed 35 provided on the substrate 12. The bed 35 has guide rods 36 connected to the pressing plate 33, so that the pressing plate 33, and accordingly, the puncher 34 can be moved up and down along the guide rods 36.

The pressing member 32 is connected to the stationary frame 31 by a parallel linkage 50 so as to move up and down. The linkage 50 is comprised of a plurality of (e.g., two) collapsible levers 51, and an intermediate connecting lever 53 which connects the collapsible levers 51 to synchronize the movement of the latter. Each of the collapsible levers 51 consists of upper and lower lever elements 51a and 51b pivoted to each other at one end thereof through a pivot pin 55. The upper lever element 51a is pivoted at an upper end thereof to the stationary frame 31 through a pivot pin 52, and the lower lever element 51b is pivoted at the lower end thereof to the pressing member 32 through a pivot pin 54, respectively.

The connecting lever 53 connects the connections (pivot pins 55) of the upper and lower lever elements 51a and 51b of the two collapsible levers 51, so that the connecting lever 53 can be translated in the vertical direction while maintaining the horizontal posture, regardless of the angle of the upper and lower lever elements 51a and 51b, i.e., the level of height of the pressing member 32.

The linkage 50 is connected to the cylinder device 20 by the connecting lever 60 which connects the connection (pivot pin 55) of the upper and lower lever elements 51a and 51b of one of the collapsible levers 51 (right collapsible lever 51 in Fig. 1) and the connecting plate 27 which is in turn connected to the second piston rod 26, so that when the reciprocal movement of the piston 24 in the vertical direction in the cylinder body 21 takes place, the pressing members 32 and 42, and accordingly, the punchers 34 and 44 of the first and second pressing devices 30 and 40 are alternately moved up and down, as mentioned above.

The second pressing device 40 is provided with the pressing member 42 which is connected to the stationary frame 31 through the linkage 50, similar to the first pressing device 30. The linkage 50 is connected to the cylinder device 20 by the connecting lever 60 which connects the connection (pivot pin 55) of the upper and lower lever elements 51a and 51b of one of the collapsible levers 51 (left collapsible lever 51 in Fig. 1) and the connecting plate 27 which is in turn connected to the second piston rod 26.

Numerals 43 designates the pressing plate, 44 the puncher, 45 the bed on which the workpiece W2 is located, and 46 the guide rods, respectively, similar to the first pressing device 30.

In the first and second pressing devices 30 and 40, the pressing members 32 and 42 (punchers 34 and 44) are alternately moved up and down by the reciprocal movement of the piston 24 of the cylinder device 20, as mentioned above.

Namely, one reciprocal movement of the piston 24 causes the two pressing operations by the punchers 34 and 44, and accordingly, a double productivity can be thus expected, in comparison with the prior art.

Furthermore, according to the present invention, a uniform pressure is applied to the punchers 34 and 44 owing to the parallel translation of the pressing members 32 and 42 which is ensured by the linkages 50, with respect to the stationary frame 31, and accordingly, high quality products can be mass-produced.

One of the pressing devices 30 and 44 can be detached from the cylinder device 20, if unnecessary.

Although the punchers 34 and 44 are provided in the illustrated embodiment, the kind of the machining is not limited thereto.

As can be seen from the above discussion, according to the present invention, two operations (steps) can be performed substantially at one time by one reciprocal movement of the piston of the single cylinder device (hydraulic actuator).

Consequently, for example, when two products are used as one pair, such as automobile parts, the

pairs of products can be successively produced by each reciprocal movement of the piston, and accordingly, the parts can be successively assembled without stocking same, thus resulting in an increased efficiency of operation.

Furthermore, according to the present invention, since a uniform pressure is applied to each working member by the associated parallel linkage, the pressing operation can be precisely effected to obtain high quality products.

Furthermore, according to the present invention, the equipment requires a small space for accommodation thereof and can double the productivity at the same energy consumption as the prior art and can reduce the manufacturing cost.

Claims

1. A hydraulic actuator comprising;
 - a single hydraulic cylinder device having a reciprocally movable piston;
 - first and second working devices connected to opposite ends of the piston; and,
 - a stationary support which supports the first and second working devices;
 - each of said first and second working devices being provided with a working member and a linkage which is provided between the stationary support and the working member and which is connected to the piston to reciprocally move the working member in a predetermined direction in accordance with the reciprocal movement of the piston.
2. A hydraulic actuator according to claim 1, wherein the cylinder device has a pair of piston rods connected to opposite ends of the piston, so that the linkages are connected to the respective piston rods.
3. A hydraulic actuator according to claim 2, wherein each of the linkages is comprised of a pair of collapsible levers and an intermediate connecting lever connecting the collapsible levers.
4. A hydraulic actuator according to claim 3, wherein each of the working devices comprises a movable plate which connects the linkage to the associated working member.
5. A hydraulic actuator according to claim 4, further comprising guide members along which the movable plates can be moved.
6. A hydraulic actuator according to claim 5, wherein each of the collapsible levers includes a first lever element pivoted to the stationary support and a second lever element pivoted to the first lever element and the associated movable plate.
7. A hydraulic actuator according to claim 6, further comprising connecting levers which connect the connection of the first and second lever elements and the respective piston rods, so that the reciprocal movements of the piston rods are transmitted to the linkages through the connecting levers.
8. A hydraulic actuator according to claim 7, wherein the direction of the movement of the working members is perpendicular to the direction of the reciprocal movement of the piston.
9. A hydraulic actuator according to claim 7, wherein the intermediate connecting levers of the linkages are translated always in parallel during the movement of the respective linkages.
10. A hydraulic actuator according to claim 1, wherein the working members are punchers.

Fig. 1

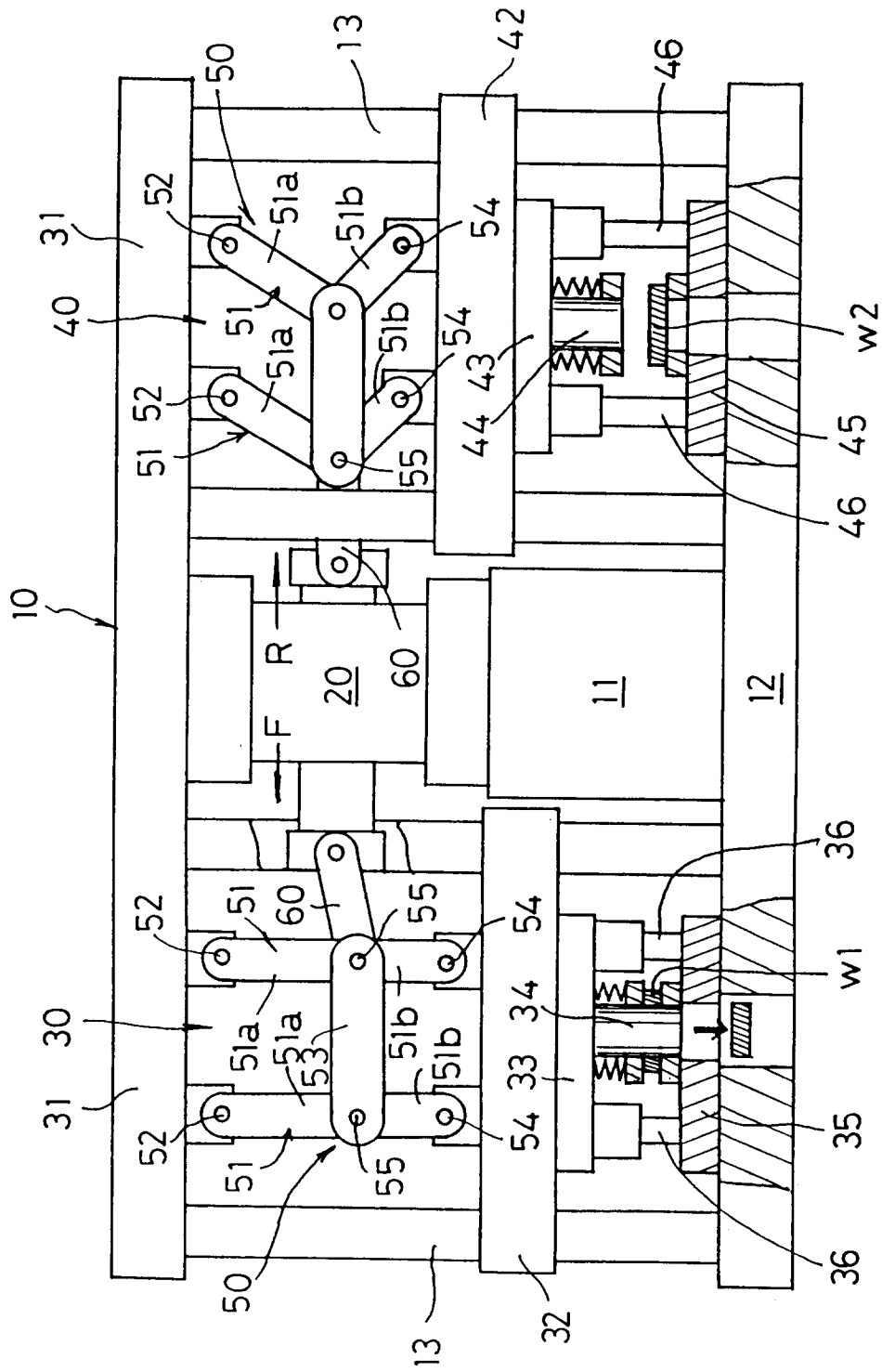
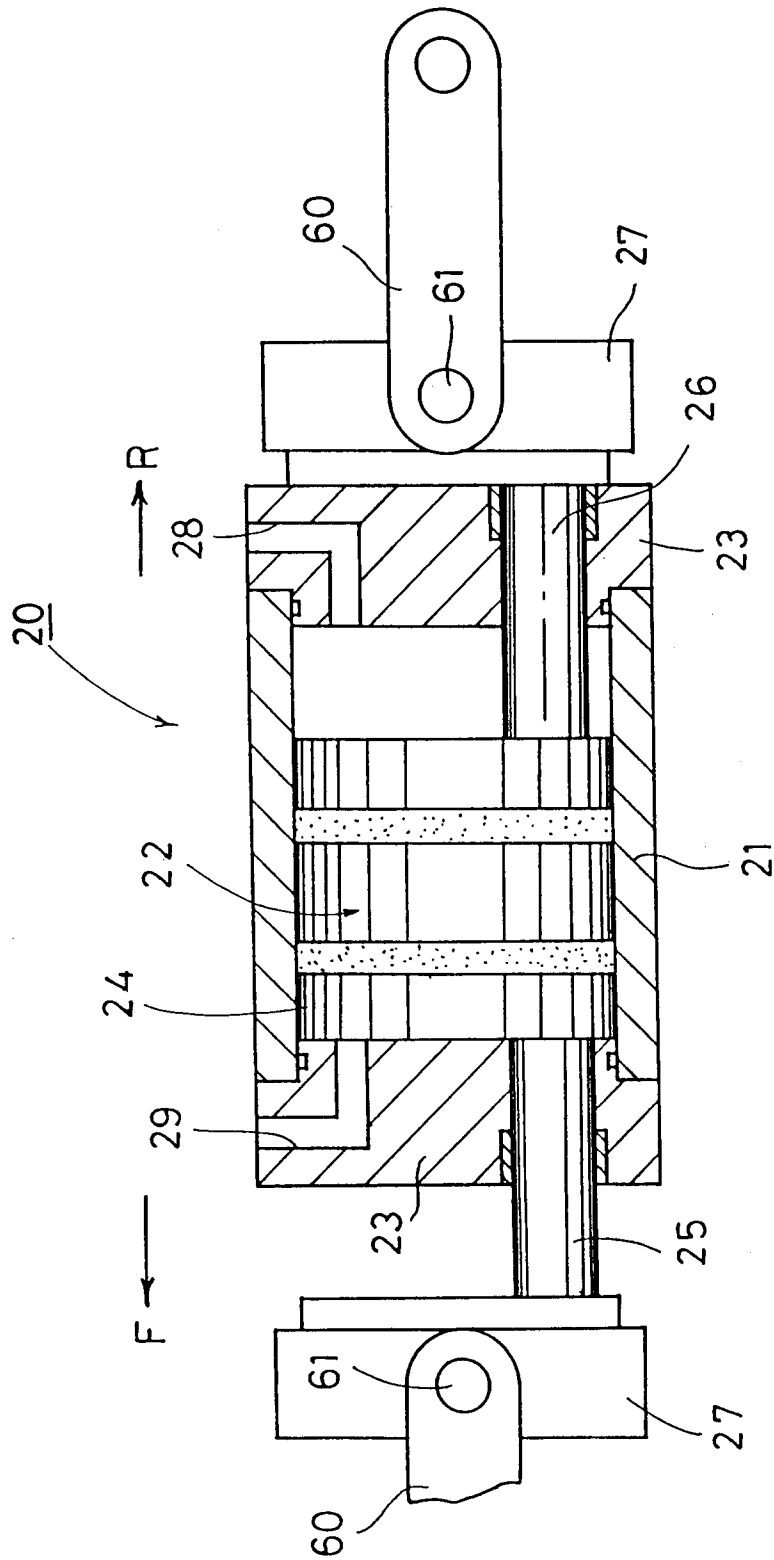


Fig.2





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EUROPEAN SEARCH REPORT

Application Number

EP 92 11 7335

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	US-A-2 633 765 (GLASNER) * claim 1; figures 1,5,6 * ---	1-10	F15B15/02 B30B1/16
Y	FR-A-863 285 (FRANZ BRAUN AKT. GES.) * claim 1; figures 1,2 * ---	1-10	
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 22 (M-786)(3370) 19 January 1989 & JP-A-63 235 098 (ISHIKAWAJIMA HARIMA HEAVY IND CO LTD) 30 September 1988 * abstract * ---	1-10	
A	DE-A-1 812 860 (THÖLEN & CO, MASCHINENFABRIK) * claim 1; figure 1 * ---	1-10	
A	EP-A-0 320 667 (LOUDA) * claim 1; figure 1 * -----	1-10	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B30B F15B B21D B29C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15 FEBRUARY 1993	Examiner KIRSTEN K.R.M.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	