

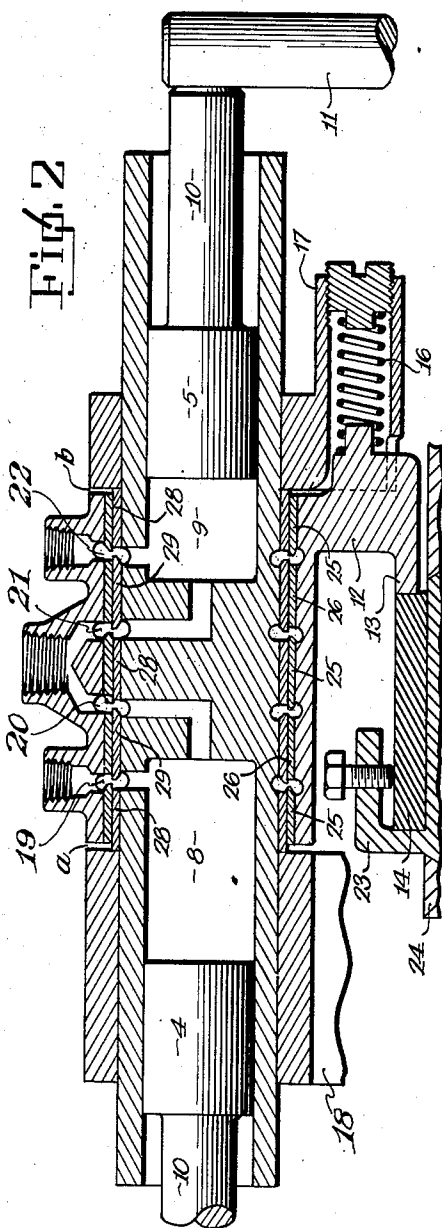
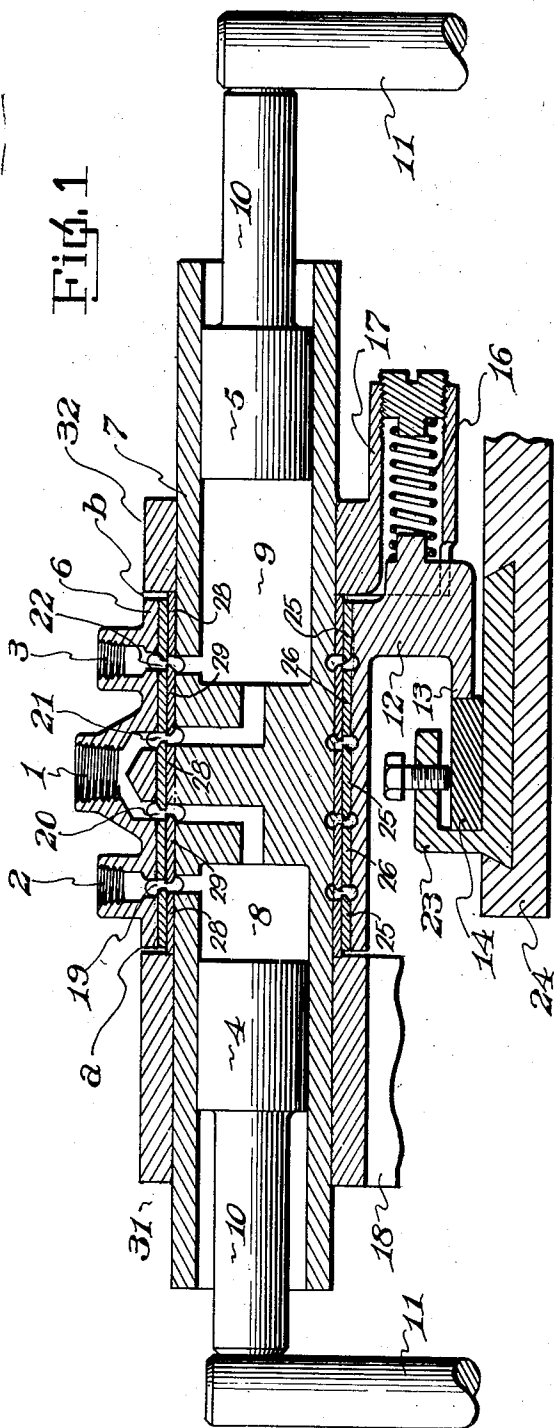
July 25, 1950

A. P. WATERSON
HYDRAULIC TOOL CONTROL UNIT

2,516,495

Filed June 10, 1946

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

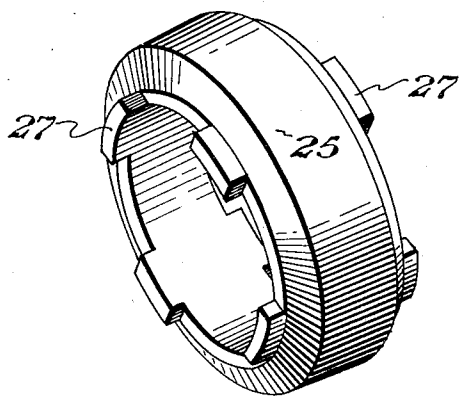
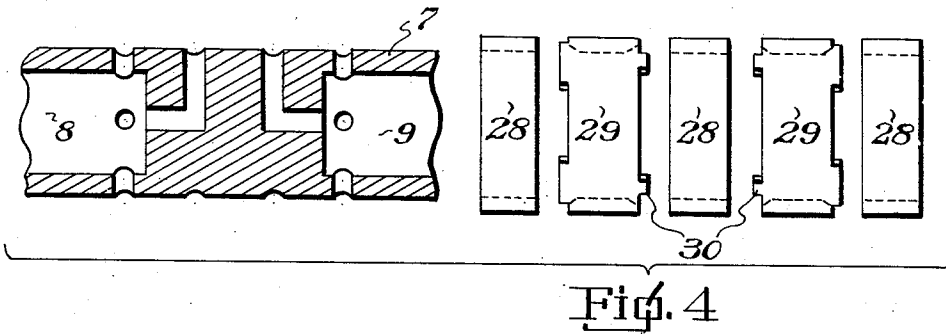
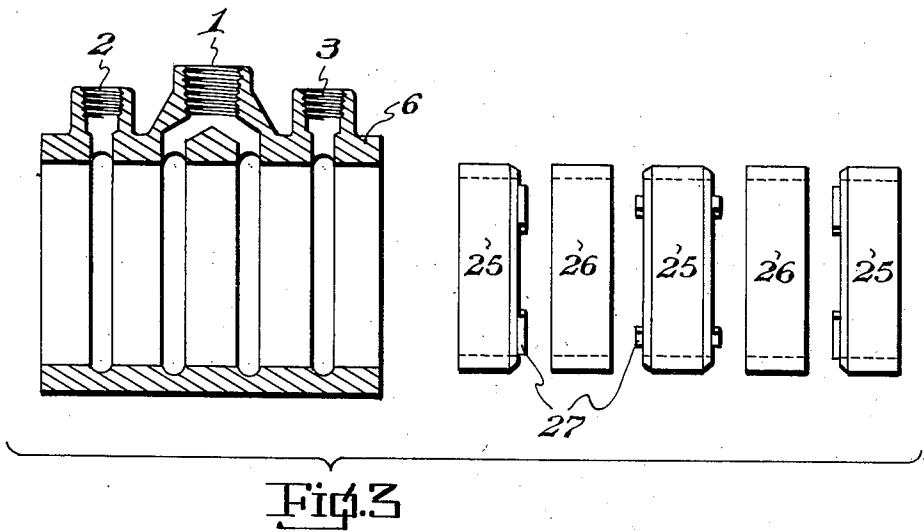


Fig. 5

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HYDRAULIC TOOL CONTROL UNIT

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Application June 10, 1946, Serial No. 675,523

16 Claims. (Cl. 121-45)

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The invention relates to hydraulic tool control units, particularly adapted for use in connection with metal working machines, such as lathes, and adapted for use in connection with the duplicating attachment set forth in my application Serial No. 675,522, executed and filed June 10, 1946. It is to be understood the device may be used in connection with any metal or wood working machinery, or anywhere it is desired to duplicate the contour of a template.

A further object is to provide a template contour duplicating device, hydraulically operated, comprising a movable cylinder having stationary pistons in opposite chambers thereof, and a template controlled slide valve on the cylinder, and controlling intake and exhaust ports to the chambers of the cylinder, for moving a tool carried by the cylinder to duplicate the shape of the template.

A further object is to so proportion the intake and exhaust ports whereby they will be of equal area when the feeler finger, carried by the slide valve, is going over a straight surface, and will be of unequal area when going over outwardly and inwardly changing surfaces of the template to apply additional pressure in the opposite chambers of the cylinder to properly hold the tool against movement and chattering during direction changes of the tool.

A further object is to build up the ports within the sleeve valve and on the cylinder by press fitting therein and thereon a plurality of rings, some of which are provided with spacing lugs.

With the above and other objects in view the invention resides in the combination and arrangement of parts as hereinafter set forth, shown in the drawings, described and claimed, it being understood that changes in the precise embodiment of the invention may be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawings:

Figure 1 is a vertical longitudinal sectional view through the hydraulic control device, showing the cylinder moved to the left for applying additional pressure in the right hand chamber of the cylinder.

Figure 2 is a view similar to Figure 1, but showing the cylinder moved to the right for applying additional pressure in the left hand cylinder.

Figure 3 is an exploded view showing the method of assembling the port forming rings in the template controlled sleeve valve.

Figure 4 is an exploded view showing the

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method of assembling by press fit the rings on the cylinder for forming the ports therein.

Figure 5 is a perspective view of one of the port forming rings, shown in Figure 3.

In operation, the liquid is forced into the unit through the intake 1 by a high pressure pump, located at a remote place, and the exhaust liquid is returned to a gathering vessel through the exhaust connections 2 and 3, where it is again picked up by the pump and circulated through the system. A very heavy oil is used, almost in a solidified state, and with the close tolerances used on the pistons 4 and 5, and the sleeve valve 6, slidable on the cylinder 7, leakage will not occur, therefore sealing rings are not used.

The cylinder 7 has piston chambers 8 and 9 in opposite ends thereof, and the cylinder is slidably mounted on the pistons 4 and 5, which pistons remain stationary relative to each other at all times, and held stationary by piston rods 10, the outer ends of which engage stationary posts 11, which posts are anchored to any device on which the control is used. It will be noted that sleeve valve 6 is slidably mounted on the cylinder 7, and in the present instance the movement is relatively slight, for instance .006 of an inch. The lower side of the sleeve valve is provided with a depending member 12 having a template feeler finger 13, which slides over the outer side of the template 14, to move the sleeve valve according to the outer contour of the template. The sleeve valve is normally forced towards the template by an expansion spring 16 carried in a chamber 17 below one end of the cylinder 7.

The slide valve 6 moves so slightly, that is .006 of an inch, the various ports hereinafter set forth have been exaggerated for purposes of illustration, however it is obvious that this close working tolerance makes the action between the template, and the tool which may be carried by the member 18, carried by the cylinder, more accurate, and tolerance of the work can be held much closer.

Referring to Figure 1, the registering exhaust ports 19 are $\frac{2}{3}$ open, whereas the registering intake ports 20, leading to the chamber 8, are $\frac{1}{3}$ open, hence the fluid will exhaust through ports 19 quicker than the intake at 20, and the cylinder 7 will move to the left; at the same time the registering intake ports 21, leading to the chamber 9 will be $\frac{2}{3}$ open, thereby allowing additional hydraulic pressure to pass to the chamber 9, while the exhaust from chamber 9, at 22, is one third open, hence additional pressure is applied on the cylinder 7 to the left. This is caused by

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the feeler finger 13, following the contour of the template 14, within the template holder 23. Template holder is stationary and carried by an adjustable and stationary part 24 mounted on the machine on which the device is used. During the operation the device is always urged towards an equalization of pressure in cylinder chambers 8 and 9 when the feeler finger 13 is moving over a straight surface. When the feeler finger is moved inwardly on the template by the spring 16 in following the contour of the template, the parts move to the position shown in Figure 1. In moving outwardly, the parts assume the position shown in Figure 2, and at which time the port 19 is $\frac{1}{2}$ open, port 20 $\frac{3}{4}$ open, intake port 21, $\frac{1}{2}$ open and the exhaust port 22, $\frac{3}{4}$ open. In this figure the device is at its extreme right position. The above operation continues while the device is being moved laterally along the contoured outer edge of the template 14, for instance on a lathe carriage, or across carriage.

The hydraulic control not only accurately moves the device to follow the contour, but rigidly holds the cylinder in any position to which it may be moved against the non-compressible oil, and obviates any chattering of a tool carried by the cylinder. It is understood the tool may be on a rigidly guided slide, and the tool may be a conventional cutting tool, milling tool or other metal or wood working tool.

The tendency at all times is to maintain equal pressure in both chambers 8 and 9, and the unit feels itself one way and then the other trying to accomplish this condition, and in doing so has followed the contour of the template and has actuated similarly any tool attachment that may be carried by the cylinder 7. If the feeler is traveling along the template on a straight line, the pressure in each cylinder will be identical, and the cylinder unit will be held rigid between both upright posts. The spring 16 is strong enough to slide the sleeve valve 6, and hold the feeler in contact with the template at all times.

In operation the movement of the sleeve on the cylinder is limited to .006 of an inch. In Figure 1, at *a*, there is a .002 clearance and at *b*, .004 and in Figure 2 the situation is reversed.

It has been found exceedingly difficult to form the relatively small ports 19, 20, 21 and 22, and to accomplish this result the ports in the slide valve 6 are formed from a plurality of spaced rings 25 and 26, pressed into the sleeve valve 6. The rings 25 are provided with circumferentially arranged lugs or ribs 27, properly spaced for proper area and the lugs 27 are preferably .006 long, so that when they are brought together and pressed to position the ports formed between the lugs and the spacer rings 26 will have the desired area. To form the proper ports on the cylinder 7, a plurality of rings 28 and 29 are pressed into position over the cylinder 7, and the spaced circumferentially arranged lugs 30 on the rings 29 engage the spacer rings 28 and also form ports .006 of an inch, hence it will be that a simple method is provided for forming the ports, and that all of the parts can be pressed into position. After the ports have been formed, the tool carrying collar 31 is pressed onto or otherwise fixed to one end of the cylinder 7, then with the sleeve valve in place on the cylinder 7, and following this operation the collar 32 is pressed into position and suitably fixed on the other end of the cylinder to leave the clearance at *a* and *b* which amounts, for practical purposes to .006 of an inch.

From the above it will be seen that a tool con-

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trol device is provided, of the hydraulic type, which is controlled by a slide valve mounted on a cylinder, and said slide valve controls ports in the cylinder according to the contour of the template, so a similar movement will be imparted to the cylinder according to the contour of the template.

The invention having been set forth what is claimed as new and useful is:

1. In a template controlled tool actuating hydraulic servomotor, a template, said servomotor comprising a double chambered piston cylinder adjacent the template, pistons in the chambers of said cylinder, pistons being stationary relative to each other, a sleeve valve mounted on the cylinder and having intake and exhaust ports in communication with the chambers of the cylinder for applying hydraulic pressure within said chambers, a feeler finger carried by said sleeve valve and adapted to follow the contour of said template, spring means for forcing said feeler finger towards the template, said sleeve valve forming means whereby the cylinder will be axially moved on the pistons as the cylinder and sleeve valve are laterally moved with the feeler finger in engagement with the template thereby translating a similar movement to the cylinder to which a tool may be attached.

2. A device as set forth in claim 1 wherein the spring means for normally forcing the feeler finger towards the template is interposed between the sleeve valve and cylinder.

3. A device as set forth in claim 1 wherein the intake ports to both chambers are between the exhaust ports to each chamber.

4. A device as set forth in claim 1 wherein the intake ports to each cylinder chamber are between the exhaust ports to each chamber, said slide valve forming means whereby the exhaust port from one cylinder chamber will have a larger exhaust opening and the intake port will have a reduced one in the direction of movement of the cylinder and additional hydraulic pressure will be applied to the other chamber of the cylinder opposite the direction of movement of the cylinder.

5. A device as set forth in claim 1 wherein the supply of fluid to the cylinder chamber in the direction of movement of the cylinder will be reduced and the exhaust from said chamber increased and additional pressure fluid applied to the other chamber of the cylinder during said movement.

6. A device as set forth in claim 1 wherein the pressures in both chambers of the cylinder will normally urge the cylinder to a position where the pressure in both chambers are equalized.

7. A device as set forth in claim 1 wherein the sleeve valve has limited movement on the cylinder.

8. A device as set forth in claim 1 including spaced stops adjacent the ends of the cylinder and piston rods carried by the pistons and engaging the stops.

9. A device as set forth in claim 1 wherein when the cylinder moves in one direction the intake port in the direction of movement is reduced in size and the exhaust port in the direction of movement increased, and the intake port away from the direction of cylinder movement is increased in size and the other exhaust port reduced in size, thereby allowing additional pressure on the cylinder in the direction of movement.

10. A device as set forth in claim 1 wherein

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the ports within the slide sleeve and on the cylinder are formed from a plurality of rings pressed to position, some of said rings having spacer lugs for engaging adjacent rings.

11. In a tracer controlled tool actuating servomotor, a combined actuating cylinder and control valve, a sleeve, a piston reciprocable in a bore in said cylinder arranged for relative reciprocation of said cylinder on said piston, a sleeve valve axially slidable on the outside diameter of said cylinder, a tracer finger connected to said sleeve valve, and a template to actuate said tracer finger, fluid pressure and exhaust conduits connected to said sleeve valve, and interconnecting ports between said sleeve valve and said cylinder for regulating the application of fluid pressure and discharge from said cylinder.

12. In a hydraulic tracer controlled servomotor, a cylinder, piston means in said cylinder arranged for relative reciprocation of said cylinder and said piston, a sleeve valve axially slidable on said cylinder, an actuable tracer to move said sleeve valve, interrelated port means between said cylinder and sleeve valve, and means for applying fluid pressure to and receiving discharge from said cylinder through said sleeve valve.

13. A hydraulic tracer control valve for controlling fluid pressure to a hydraulic servomotor comprising a cylinder, piston means in said cylinder, a series of rings pressed together axially on said cylinder, spacing means formed on some of said rings to provide slotted ports therebetween, a valve body sleeve, a plurality of rings pressed in a bore in said valve body sleeve including spacing means on some of said rings to form ports therebetween, and fluid conducting passageways connected to both sets of ports in said cylinder and in said sleeve, and means for effecting relative axial movement of said valve body sleeve and said cylinder to regulate the flow through said ports.

14. A hydraulic tracer control valve structure for a hydraulic servomotor comprising, two relatively movable members, one of said members comprising a cylinder, piston means in said cylinder, a series of rings carried on each of said members and having spacing means to form radial passageways between some of said rings, means for effecting relative movement between said members, and fluid conducting passageways in said members connected to said ring passageways whereby fluid pressure may be applied to and received from said cylinder member to control said hydraulic motor through passageways connected thereto from the other of said members.

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15. In a tracer controlled tool actuating hydraulic servomotor unit, a cylinder, piston means in said cylinder, and means connecting said cylinder and piston means to actuate a tool feeding device, a series of spaced rings mounted on the outside of said cylinder and having radially disposed ports therebetween, fluid conducting passageways in said cylinder interconnecting piston chambers behind said piston means to said radially disposed ports between said sleeves, a valve body reciprocable axially relative to said cylinder including a series of matching rings mounted therein cooperating with said first mentioned rings and having radially disposed ports therebetween connected to pressure and discharge supply lines, and a template for relatively reciprocating said valve body to cause said cylinder to move relative to said piston means to position said cylinder in a predetermined relationship to said template.

16. In a tracer controlled tool actuating hydraulic servomotor unit, a cylinder, piston means in said cylinder, and means connecting said cylinder and piston means to actuate a tool feeding device, a series of spaced rings mounted on the outside of said cylinder and having radially disposed ports therebetween, fluid conducting passageways in said cylinder interconnecting piston chambers behind said piston means to said radially disposed ports between said sleeves, a valve body reciprocable axially relative to said cylinder including a series of matching rings mounted therein cooperating with said first mentioned rings and having radially disposed ports therebetween connected to pressure and discharge supply lines, and a template for relatively reciprocating said valve body to cause said cylinder to move relative to said piston means to position said cylinder in a predetermined relationship to said template.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
313,445	Price	Mar. 3, 1885
948,649	Koelkebeck	Feb. 8, 1910
1,016,167	McCulloch	Jan. 30, 1912
1,642,193	Banning	Sept. 13, 1927
2,016,931	Richard	Oct. 8, 1935
2,401,422	Hamilton	June 4, 1946
2,437,570	Von Zelewsky	Mar. 6, 1948