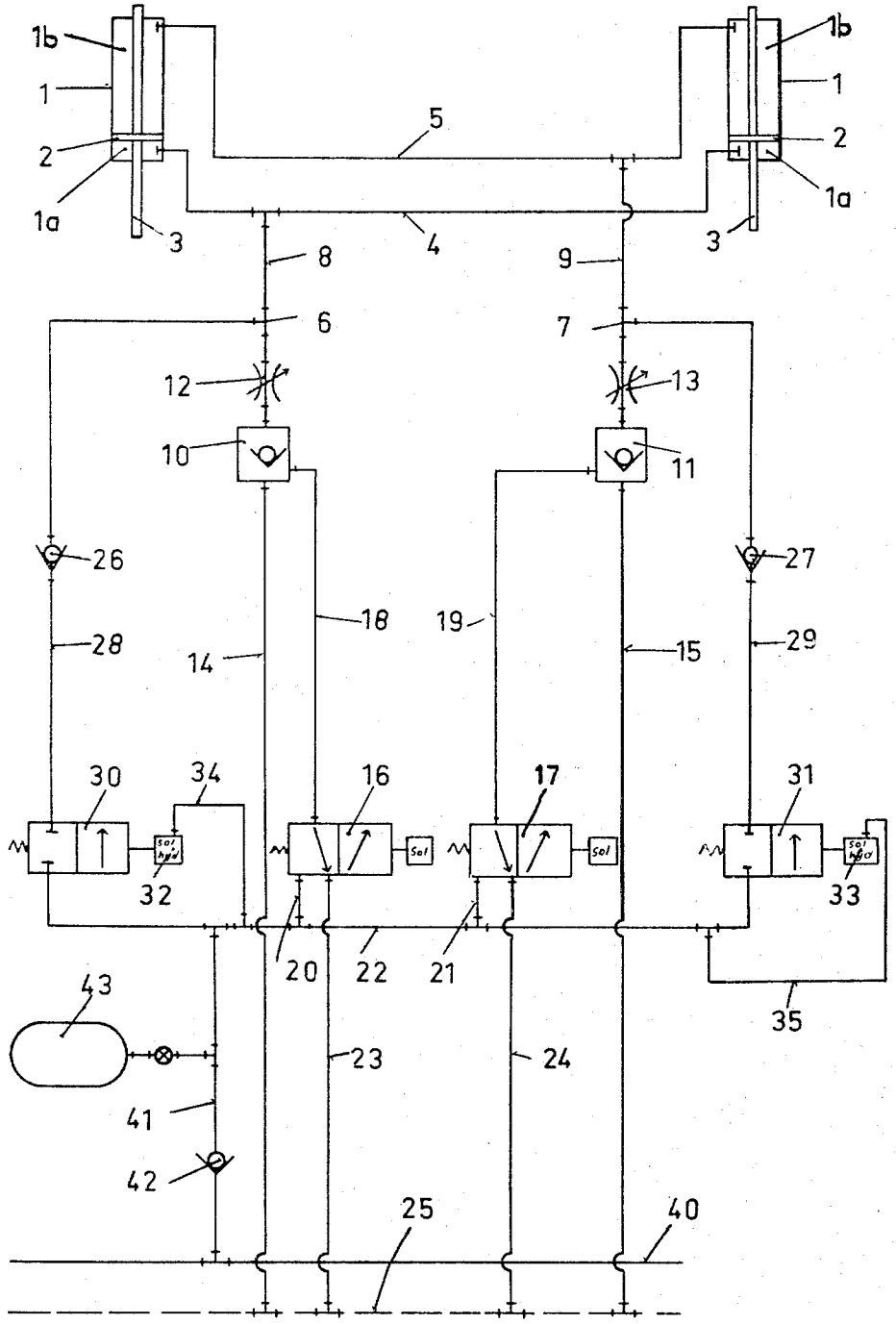
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VALVE CONTROL FOR RECIPROCATING PISTON DRIVE
WITH RAPIDLY STARTING PISTON STROKE
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VALVE CONTROL FOR RECIPROCATING PISTON DRIVE WITH RAPIDLY STARTING PISTON STROKE

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ABSTRACT OF THE DISCLOSURE

A valve control for a fluid pressure actuated cylinder in which the stroke of the cylinder piston in at least one direction is rapidly started by suddenly unloading the cylinder chamber on one side of the piston only after the cylinder chamber on the other side of the piston is pre-pressurized to obtain a rapid piston stroke in the direction of the unloaded cylinder chamber.

This invention relates to a valve control for reciprocating piston drives with a rapidly starting piston stroke, especially for miscut devices on flying shears, in order to bring one cutting knife during the operation of the shears into and out of the operating position relative to the other cutting knife. This control arrangement may further be applied advantageously to all piston drives in which the amount of switching time required by a slide valve may constitute a problem. Furthermore, the invention is not limited to a particular pressure medium since the piston drive may be operated hydraulically or penumatically. It may also comprise a straight-through piston shaft or a shaft of smaller length.

This invention incorporates the principle of pre-energization which is in common use in electrical engineering, and proposes a valve control for reciprocating piston drives in which at least one cylinder chamber, in particular the cylinder chamber which is to be unloaded or relieved to execute a rapid starting piston stroke, is associated with a return line including a relief valve which may be opened at will, and a feeding valve arranged parallel to the relief valve and connected to the pressure line, and that the other cylinder chamber may be put independently under pressure over a slide valve. This slide valve, through which the pressure medium flows during the fast piston stroke, may now be opened already before the piston stroke is to be started if the controlled relief valve in the return line associated with the cylinder chamber to be unloaded and the parallel connected feeding valve in the pressure line are closed.

The piston drive is thus pre-energized in the desired direction by means of the driving pressure because the cylinder chamber to be unloaded is still closed. The switching time of the pre-opened slide valve lies within the period before the desired starting of the piston stroke. The pressure line is under pressure so that the influence of the expansion of the pressure line to provide the speed at the start of the piston stroke is eliminated.

The piston stroke is started or actuated in that the controlled relief valve in the return line of the cylinder chamber to be unloaded is opened. While normally a piston stroke is initiated by opening a valve on the pressure side when the return line is already open or is opened simultaneously, this is carried out in the valve control of the invention by opening the previously closed return line in the presence of pressure in the cylinder chamber to be supplied, and this is done by opening the relief valve because this type of valve has a substantially shorter switching time, e.g. 60 milliseconds as compared to 150 milliseconds for a given amount of flow per second.

If piston drive is to be actuated in both directions as fast as possible it is to be understood that each cylinder chamber must have an associated controlled relief valve in the return line besides the parallel-connected feeding valve in the pressure line. To influence the piston speed an adjustable quantity limiting valve may be built into the line or lines which serve only for the return travel. In the case of a piston drive which has a piston rod that does not go straight through thus having unequal piston surfaces, it is recommended to design the drive in such a way that the cylinder chamber associated with the smaller piston surface is to be pre-energized, and the cylinder chamber having the larger piston surface is to be switched to return travel over the controlled relief valve in the case of a piston stroke to be rapidly started. Otherwise the pressure medium which is under tension from the pressure of the pre-energization would receive a higher pressure than necessary due to the different size of the piston surface.

An embodiment of the valve control according to the invention for two parallel-connected work cylinders with straight-through piston rods is shown in the accompanying drawing and is to be applied in a miscut device of flying shears where the piston stroke is to be carried out as rapidly as possible in both driving directions.

In reference to the drawing it will be seen that both piston drives consist of the cylinders **1**, the pistons **2** which are to be pressure contacted or actuated on both sides and of the straight-through piston rods **3**. In the piston illustrated in the drawing the cylinder chambers **1***a* are to be pre-energized hydraulically according to the principle of the invention, and the cylinder chambers **1***b* are to be unloaded or relieved for the purpose of starting the piston strokes. The piston chambers **1***a* are connected to each other through a line **4** and the cylinder chambers **1***b* are connected to each other through a line **5**, and from T-elements **6** and **7** lines **8** and **9** feed into the lines **4** and **5** respectively. The lines **4**, **8** or **5**, **9** constitute pressure lines as well as return travel lines, depending on the work direction of the piston rods **3**. In front of the T-elements **6**, **7** two similar valve controls are associated with the cylinder chambers **1***a* or **1***b* according to the invention. In a straight continuation of the lines **8** or **9** are located the controlled relief valves **10** and **11** in the lines **14** and **15** serving exclusively for the return travel while the adjustable quantity limiting valves **12** and **13** are connected ahead of the relief valves are of the type shown in U.S. Patent 551,370 and the relief valves may be opened in a known manner by means of three-way valves **16** and **17** hydraulically independently of each other, the three-way valves being connected at the outlet side over the lines **18** and **19** to the relief valves **10** and **11**, and at the input side over the lines **20** and **21** to the common pressure line **22**, and the lines **23** and **24** to the common return travel line **25**.

The uncontrolled relief valves **26** and **27** safeguard the lines **28** and **29** which serve exclusively as pressure lines leading from the T-elements **6** or **7** to feeding slide valves **30** and **31**, which are preferably two-way valves. These independently adjustable feeding valves are connected at the input side to the common pressure line **22** and are of a known type including a hydraulic-electrical servo control represented by the solenoids **32** and **33** and the lines **34** and **35** which are constantly under pressure. This servo control is only necessary in connection with heavy two-way valves **30** and **31** in the case of large amounts of through-flow.

A main pressure line **40** is provided in front of the common pressure line **22**. Both lines are connected over the line **41** in which a relief valve **42** is provided. A disconnectable air-loaded tank **43** which is mounted parallel

to line **41** is provided to furnish additional pressure fluid at the moment when the piston movements are started and absorb any knocks in the pressure lines.

The operation of the valve control according to the invention will now be described in reference to the drawing in which all the valves **10**, **11**, **30** and **31**, which lie in the main flow of the pressure fluid, are closed. When it is desired that the piston rods **3** should be moved upwardly the two-way valve **30** is first opened. In this way the cylinder chambers **1***a* are put under pressure through the lines **28**, **8** and **4** while the piston rods cannot carry out any movement due to the fact that the cylinder chambers **1***b* to be relieved are closed over lines **5**, **9** and **29** by the closed relief valve **11** and the closed two-way valve **31**. The pre-pressure in line **28** is also safeguarded by means of the closed relief valve **10**. The piston drives are in the "pre-energization" state or condition.

To start the piston stroke the relief valve **11** is released by opening the three-way steering slide valve **17**. In this way the connection line **5** between the two piston drives is connected to return flow so that the piston rods **3** are driven forward abruptly under the pre-pressure which is present in the cylinder chamber **1***a*.

After the working cycle is terminated the valves **30** and **11** are closed again. The reversed working cycle is carried out in the same manner by making use of the valve **31** for providing the pre-energization of the cylinder chamber **1***b* and of the valves **10** and **16** for relieving the cylinder chambers **1***a*.

What is claimed is:

1. A valve control for a reciprocating fluid pressure actuated piston drive with a rapidly starting piston stroke in at least one direction comprising, in combination, a fluid pressure actuated cylinder having a piston positioned therein for reciprocating sliding movement, a piston rod on said piston arranged to be connected to an associated driven device, said cylinder having a pair of chambers on opposite sides of said piston, conduit means including valve means connected to said cylinder chambers for alternately communicating one of said chambers with an associated source of fluid pressure and the other of said chambers with associated fluid pressure return means, said valve means including at least one normally closed relief valve for communicating one of said chambers with said associated fluid pressure return means and means for selectively opening said normally closed relief valve subsequent to the communication of said other chamber with said associated fluid pressure source and the pre-pressurizing of said other chamber for suddenly unloading said one chamber to effect a rapid stroke of said piston towards said unloaded one chamber, said means for opening said normally closed relief valve include auxiliary conduit means having a three way valve for communicating said relief valve selectively with said associated source of fluid and said associated fluid pressure return means and means for selectively moving said three way valve into one position for communicating said relief valve with said associated fluid pressure return means to permit said relief valve to normally close and into a second position for communicating said relief valve with said associated fluid pressure source for opening said normally closed relief valve.

2. A valve control in accordance with claim **1** including an adjustable quantity limiting valve in said conduit means in association with said normally closed relief valve for regulating the unloading rate of fluid pressure through said relief valve.

3. A valve control in accordance with claim **1** wherein said rod is connected to one side of said piston and wherein said cylinder chamber on the other side of said piston communicates through said one normally closed relief valve with said fluid pressure return means.

4. A valve control in accordance with claim **1** wherein a pair of said normally closed relief valves are provided in said conduit means, each of said relief valves being associated with one of said cylinder chambers for alternately communicating said cylinder chambers with said fluid pressure return means and wherein means for opening said normally closed relief valves are provided for each of said relief valves for alternately opening said relief valves to suddenly unload one of said chambers subsequent to the communication of the other of said chambers with said associated fluid pressure source and the pre-pressurizing of said other chamber to effect a rapid stroke of said piston in both directions of said reciprocating movement.

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