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Nowak et al.

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[54] HYDRAULIC MULTISTAGE CONTROL SLIDE VALVE

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[58] **Field of Search**.....137/624.18, 624.13, 624.15, 137/624.16, 624.17, 624.2; 251/229

[56] **References Cited**

FOREIGN PATENTS OR APPLICATIONS

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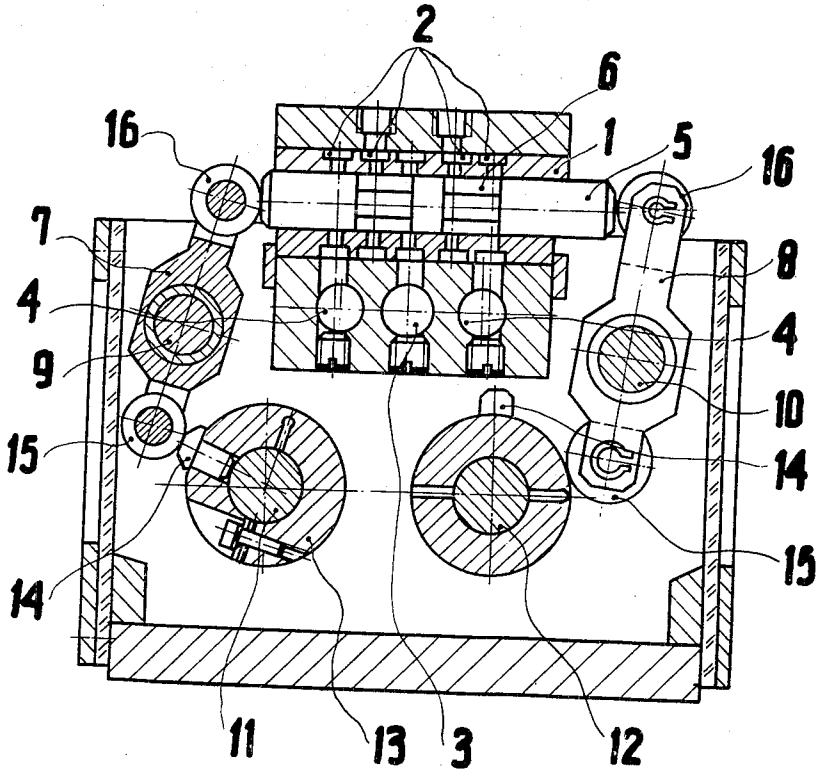
[57] **ABSTRACT**

A hydraulic spool-type control valve has a slide shiftable in opposite directions to connect hydraulic devices with a source of fluid, and a drive for the slide including a pair of levers bearing on opposite ends of the slide in opposing directions and controlled by respective cams synchronously driven by a controlled-flow hydraulic motor.

5 Claims, 3 Drawing Figures



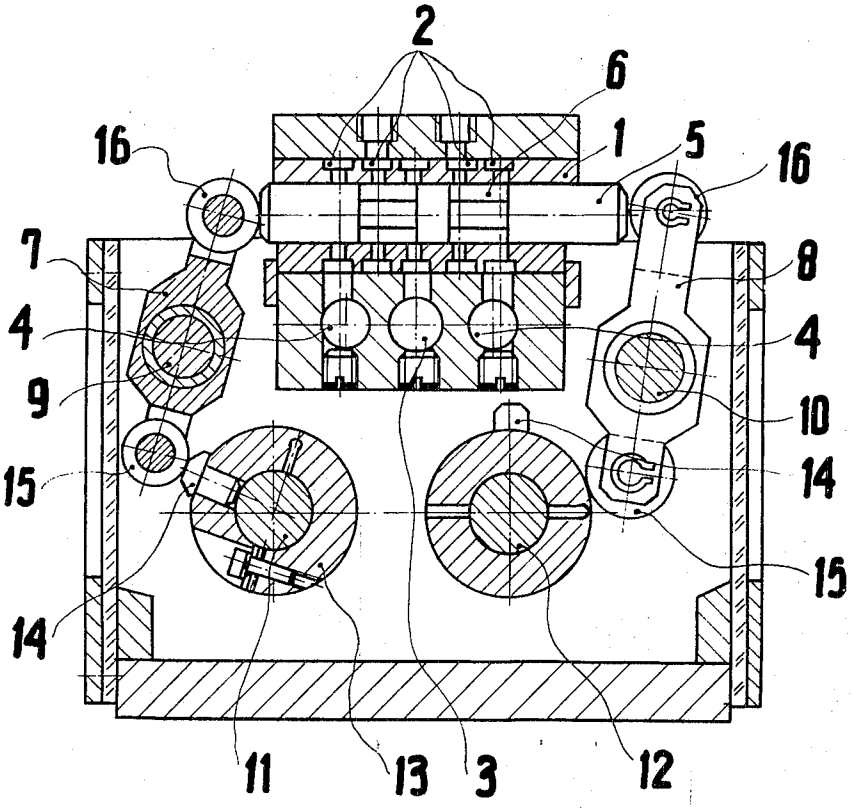


Fig. 1

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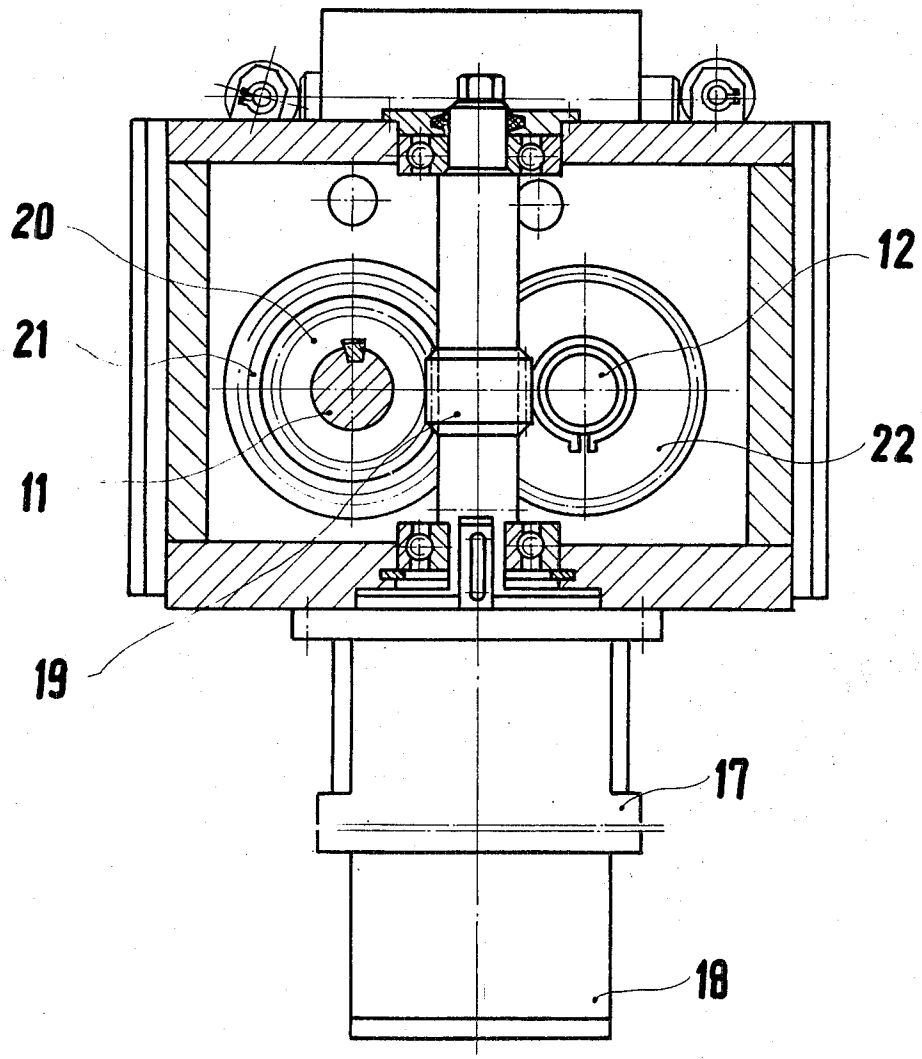

Fig. 2

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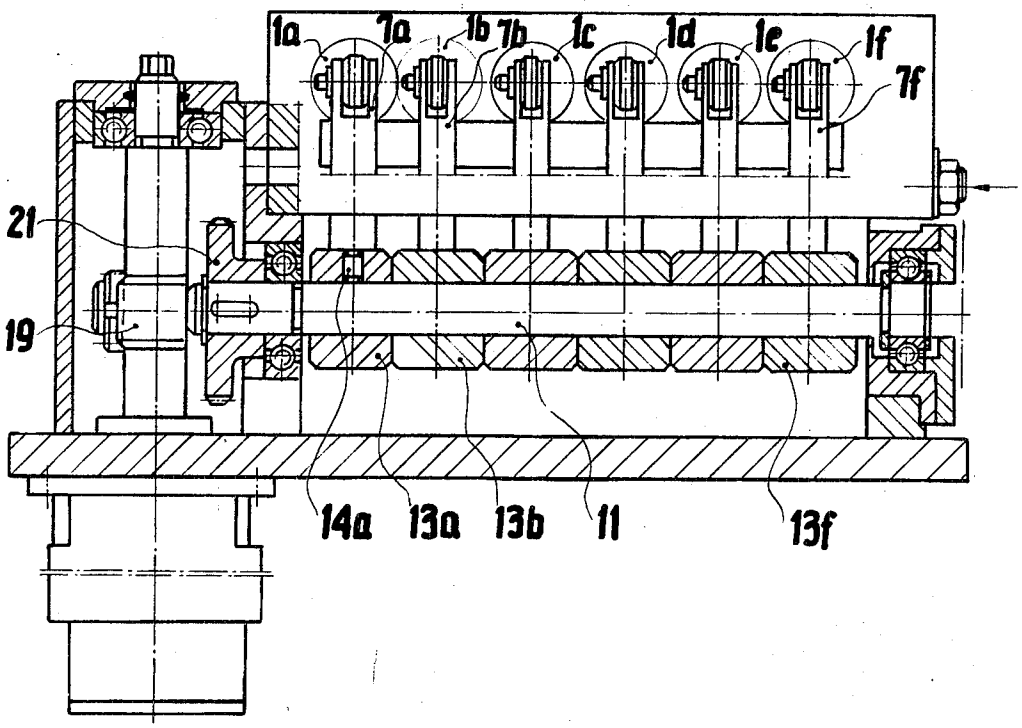

Fig. 3

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HYDRAULIC MULTISTAGE CONTROL SLIDE VALVE

FIELD OF THE INVENTION

This invention relates to a hydraulic multiple-stage control slide valve provided with a ram-drive unit, composed of two alternately, acting pressure levers on opposite sides of the ram, controlled by means of one or more coupled shafts provided with adjustable cam rings.

BACKGROUND OF THE INVENTION

For hydraulic control of machines, hydraulic control slide valves or spool valves are employed. Among the types of such hydraulic control slide valves which enable a synchronized control of units being driven by boosters or servomotors, there are hydraulic multistage control slide valves.

The main unit of such a hydraulic control slide valve is the ram or plunger which is shifted in a reciprocating manner in the cylinder thus opening and closing the appropriate flow conduits.

For driving the hydraulic control slide valves known to date are electric systems consisting of electromagnets switched on by means of current pulses emitted by an appropriate electric distributor or a limit switch and causing the ram to reciprocate.

The main drawback of control slide valves of this kind is poor reliability of operation of the coupling of the electric system with the hydrauiic system, the system being limited to a switching rate not exceeding three to five thousand switch operations per hour and the relatively high costs connected with the installation of complex electric appliances.

There are also known multistage hydraulic control slide valves with a unit having an electric motor which drives by means of a gear the cam that moves the ram; the return movement of the ram is effected by the action of a previously compressed spring.

The disadvantage of control slide valves of this latter type is the lack of reliability of operation, since in a case of jamming of the ram, e.g., due to impurities in the oil, the force of the restoring spring is too small to overcome the resistance to the ram movement.

Besides, the force exerted on the ram in its movement overcoming the resistance of the spring must be, by many times, greater than the force of the travel of the ram.

There are also known control slide valves whose rams are shifted by means of small hydraulic or pneumatic servomotors controlled, consequently, by means of electric distributors and having, in this connection, all the drawbacks connected with the application of electric systems.

OBJECT OF THE INVENTION

The object of this invention is the elimination of the above-mentioned disadvantages and the provision of a multistage hydraulic control valve, which is distinguished by a high reliability of operation and, at the same time, by a relatively simple and compact design and the easy setting up and changing of the working cycle controlled by the hydraulic control slide valve.

SUMMARY OF THE INVENTION

This task has been solved, according to the invention by providing a drive unit for the hydraulic control slide valve with a system of two pressure levers alternately acting on both sides of the valve ram spool or plunger, controlled by one or more mutually coupled shafts having adjustable cam rings being clamped on them.

For driving the shaft or coupled shafts preferably should be employed a hydraulic or hydraulic-mechanical system, for instance a hydraulic motor with a governor for the flow speed of fluid, enabling a stepless change of rotational speed of the shaft or shafts.

Owing to this, in the hydraulic control slide valve, according to the invention, it is possible to completely eliminate the electric control and drive systems, and thus remove all drawbacks connected with it, and to increase the reliability of operation of the device.

Besides, the system of two alternately operating levers, of which one shifts the ram in one direction while the other shifts the ram in the opposite direction, removes the disadvantages of control slide valves provided with return springs.

The multistage control slide valve, according to the invention, is characterized by a simple design and, moreover, enables setting up of any control program of the working process being regulated by the ram.

Such a setting up consists, namely, in an appropriate adjustment of the cam rings on the shaft or coupled shafts, which enables any arrangement of the beginning and the termination of the working cycle to be established.

DESCRIPTION OF THE DRAWING

The invention is explained by way of example in the drawing, in which:

FIG. 1 shows the hydraulic control slide valve according to the invention in a section along the axis of the ram;

FIG. 2 shows a drive having coupled shafts; and

FIG. 3 the multistage hydraulic control slide valve in a section along the axis of one of the coupled shafts.

SPECIFIC DESCRIPTION

The hydraulic control slide valve, according to the invention, consists of a cylinder **1** provided with a set of ports or conduits **2** connected to a feed conduit or port **3** and to outflow conduits or ports **4** and of the ram, spool or plunger **5** slidably mounted inside this cylinder **1**, provided with connecting chambers **6**.

The slide or ram **5** is shifted in appropriate moments of the working cycle in a reciprocating way, thus establishing a connection of appropriate ports **2**, **4** by means of chambers **6**.

For shifting the ram a mechanism is used consisting of two pressure levers **7** and **8**, rotatably mounted on the axles or fulcrum shafts **9** and **10** or on one shaft, which levers act in an alternating way on the ram on its both opposite ends or sides.

For controlling these levers one, a single shaft or two mutually coupled shafts **11** and **12** are employed, driven within rotary movement with controllable, preferably stepless turning speed and provided with rings **13** with cams **14** clamped on these shafts.

The cams **14** cooperate preferably with disks **15** (cam-follower rollers) rotatably mounted on ends of the levers **7** and **8**, which are provided on their other ends with similar rotatably mounted disks or rollers **16** cooperating with end surfaces of the ram **5**.

For driving the shaft or coupled shafts **11** and **12**, we may use in the exemplary design shown in FIG. **2**, a mechanism consisting of a hydraulic motor **17**, with a speed governor for the liquid flow **18** which enables a stepless change of turning speed of the motor; the worm **19** mounted on the shaft of the motor **17** meshes with a worm wheel **20** carrying a gear **21**,**22**, whose wheel **21** is keyed on the shaft **11**, and the wheel **22** on the shaft **12** coupled with the latter.

The multistage control slide valve as illustrated by way of example in FIG. **3** consists of a set of six cylinders **1***a*, **1***b*, **1***c*, **1***d*, **1***e*, **1***f* with appropriate rams (not shown) which are moved in a reciprocating way by means of a set of levers **7***a*, **7***b*, **7***c* and oppositely acting levers (not shown).

For controlling these levers are used clamping rings **13***a*, **13***b*, **13***c* with cams **14***a*, **14***b*, mounted on shafts **11** and **12**, only the former being illustrated.

The operation of the hydraulic multistage control slide valve, described above by way of example, is as follows.

In order to set up a controlled program of the working cycle, we should, according to the timing of to the initial and final moment of the cycle of particular elements (loads) controlled by means of cylinders **1***a*, **1***b*,...**1***f*, set the rings **13** with cams **14** on the shaft or coupled shafts (cam shafts) **11** and **12**

so, that the levers **71**, *7b...7f* etc., controlled by these cams involve a properly synchronized reciprocating movement of the rams **5**.

The setting up of the proper length of the working cycle is obtained by proper regulation of the liquid flow through the hydraulic motor **17** by means of the speed governor **18**.

After setting in motion the control slide valve, the levers **71**, *7b...7f* etc., controlled by cams **14***a*, **14***b*...**14***f* cause the appropriately synchronized shifting of rams **5** in the cylinders **1***a*, *1b*...*1f*, and thus, the controlling of working elements, according to the required program. The holding of the ram in a reversed position is obtained by a pressure generated in the flow chamber.

Owing to the absence of electric units there has been obtained not only a high reliability of operation of the control slide valve, according to the invention, but also a considerable increase of the number of cycles per time unit, e.g., to 60 thousand cycles per hour.

Besides, the control slide valve, according to the invention, is characterized by a simple and compact design and, thus, small dimensions. It can be employed particularly in controlling hydraulic units of various machines and technical installations.

What we claim is:

1. A hydraulic control valve, comprising a valve housing formed with a cylinder having ports connectable in hydraulic circuit; a linearly axially shiftable elongated slide receivable in said cylinder and shiftable in opposite directions to control the flow of fluid in said hydraulic circuit; respective levers pivotal about mutually parallel axes transverse to said slide and engageable with one extremity of each lever against a respective end of said slide; shaft means including at least one shaft journaled in said housing; and respective cams mounted on said shaft means and angularly adjustable relative thereto and acting upon other extremities of the respective levers for displacing same to shift said slide in alternately opposite directions, said cams being synchronized with one another.

2. The valve defined in claim **1** wherein said shaft means includes a respective shaft assigned to each of said levers and the respective cam associated with each lever is mounted on one of said shafts, said valve further comprising transmission means coupling said shafts for synchronous rotation.

3. The valve defined in claim **1**, further comprising a hydraulic motor operatively connected to said shaft means for driving same; and fluid flow rate control means maintaining an adjustable constant rate of flow of fluid through said motor.

4. The valve defined in claim **1** wherein said slide is so constructed and arranged that it is held in position by fluid pressure within said cylinder in the absence of a force applied thereto by one of said levers.

5. The valve defined in claim **1** wherein each of said levers is journaled on a respective fulcrum shaft intermediate its extremities, said fulcrum shafts being mutually parallel and parallel to said shaft means, each of said levers being provided at its one extremity with a roller bearing upon a respective end of said slide and at its other extremity with a cam-follower roller, said shaft means comprises a pair of mutually parallel transversely spaced cam shafts parallel to said fulcrum shafts, said cams each include a respective ring surrounded and adapted to be tightened against the respective cam shaft, each of said rings being provided with a projection adapted to displace the respective cam follower roller, and said valve further comprising a gear transmission operatively connecting said cam shafts for synchronous rotation, a worm drivingly connected with said gear transmission, a hydraulic motor connected to said worm for rotating same, and adjustable flow-control means connected to said motor for setting a selected rate of operation thereof.

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