Aug. 15, 1967 C. W. TRIDGELL 3,336,022

POWERED WORK-CLAMPING DEVICES

Filed April 6, 1964 2 Sheets-Sheet 1

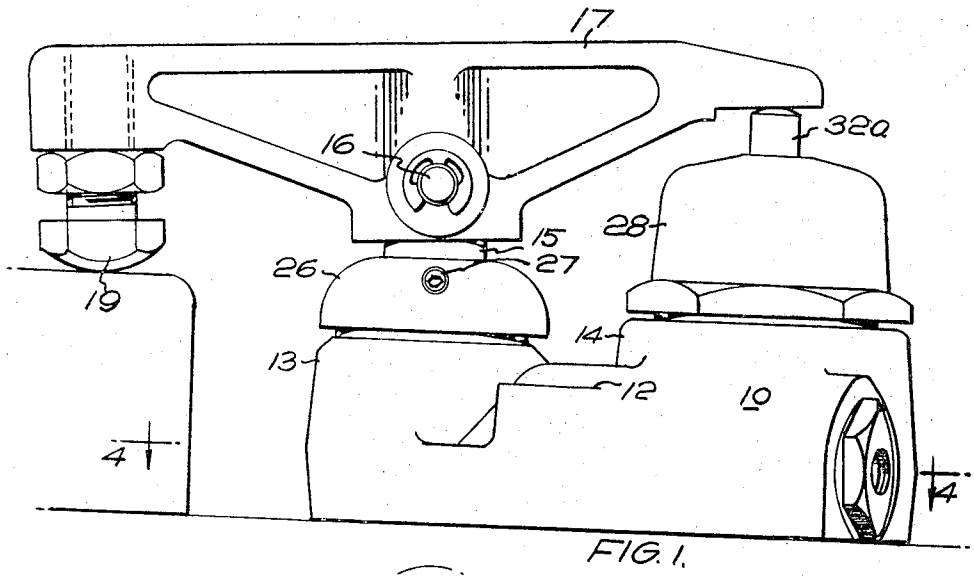

FIG. 1.

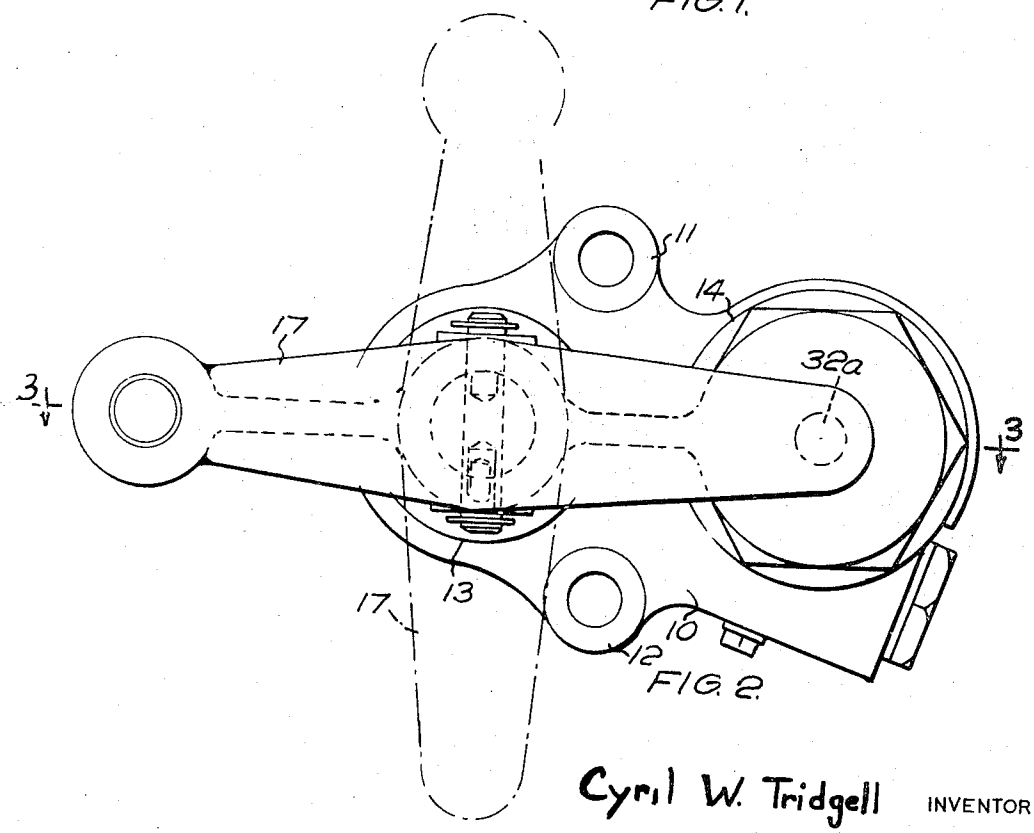

FIG. 2.

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Filed April 6, 1964 2 Sheets-Sheet 2

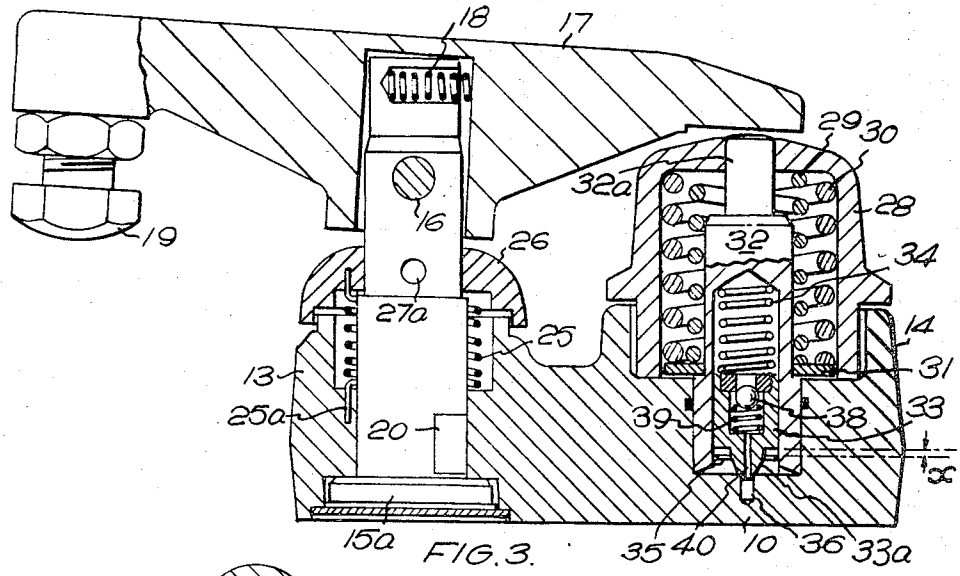

FIG. 3.

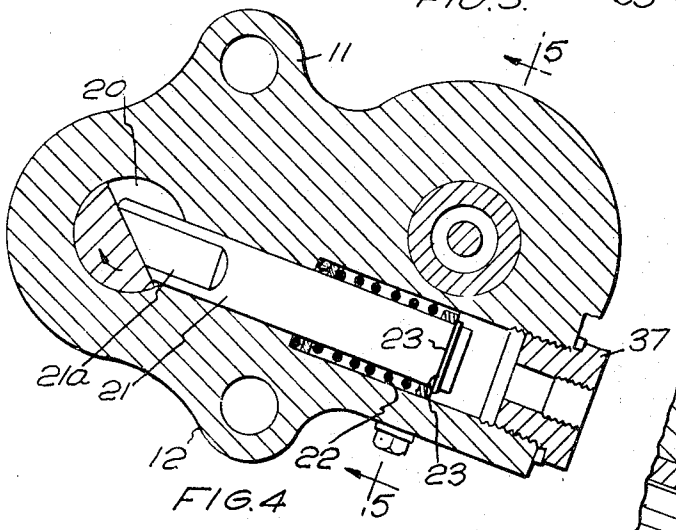

FIG. 4

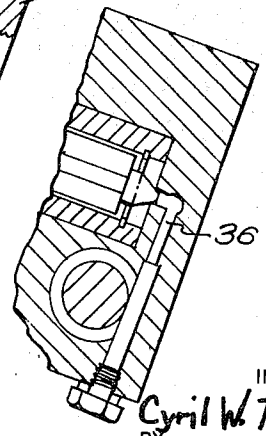

FIG. 5.

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POWERED WORK-CLAMPING DEVICES

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2 Claims. (Cl. 269—32)

This invention relates to powered work-clamping devices, such as are now frequently used on machine tools to hold a workpiece on to a table or jig while some mechanical operation, such as milling, drilling or grinding, is effected.

The invention relates particularly to powered work-clamping devices of the kind, hereinafter termed the kind referred to, in which the clamp is actuated by a fluid under pressure and has, in addition to the clamping movement, a work-clearing movement, such as a swinging movement, in a direction different from the clamping movement, both movements being actuated from the same source of fluid pressure.

A clamp of the kind referred to is the subject of my co-pending application for British Patent No. 40,048/60.

One of the problems associated with such work-clamping devices, is to arrange for the two movements to operate in a particular sequence so that for clamping it is ensured that the clamp shall move fully from its work-clearance position into its extended work-clamping position before the clamping movement commences; and equally for unclamping so that the clamp is fully lifted or otherwise retracted before the work-clearing movement of the clamp commences. This can be, and is, easily effected, where the movements are spring-loaded for return, by differential spring loading of such movements and by biasing the clamping movement by a control valve. Such bias loaded valve however introduces further problems in that, since time saving is an important factor, and since the work-clearing movement has some inherent inertia, the quicker the work-clearing movement the heavier must be the control valve bias loading in order to prevent premature clamping movement being caused by the pressures necessary to provide the acceleration against such inertia. Any bias loading of the valve, however, as at present provided, is in effect a bias loading of the ram chamber pressure, as such loading is subtracted from the available clamping pressure so that any such arrangement is necessarily a compromise to set off increased speed of movement against loss of clamping power.

The object of the present invention is to provide a powered work-clamping device having valve biased control with its known simplicity and advantages, but without the disadvantages aforesaid.

According to the invention a powered work-clamping device of the kind referred to having a hydraulic bias control valve is characterised by means responsive to the working movement of the clamp, so arranged as to remove the bias loading of the ram chamber pressure during an initial clamping movement and to restore the bias pressure loading during a final unclamping movement, whereby the full hydraulic pressure in the system is available for clamping without differential loss from such loading.

In the accompanying drawings:

FIG. 1 is a side elevation, and

FIG. 2 is a plan of one example of a powered work-clamping device made in accordance with the present invention.

FIG. 3 is a section on line 3—3 of FIG. 2.

FIG. 4 is a section on line 4—4 of FIG. 1.

FIG. 5 is a fragmentary section on line 5—5 of FIG. 4.

As shown in the drawings the powered work-clamping device comprises a base **10** having a pair of lugs **11** and **12** by which it is adapted to be bolted to a work table, the base being formed with upstanding bosses **13** and **14**. In the boss **13** is rotatably mounted a column **15** with head **15***a* located in a recess in the under side of the base. On the upper end of this column is pivotally mounted at **16** a clamping lever **17** fitted with a return spring **18** and having at one end an adjustable and renewable clamping anvil **19**. Relatively inclined to such clamping lever the column **15** is formed with a notch **20** (see in FIGS. 3 and 4) complementary to a bevelled end of a plunger **21**, with flats **21***a* to prevent rotation, the plunger having a return spring **22** held by a spring ring **23**. A return torque spring **25** is housed in the boss **13** around the column and has one end located at **25***a* in such boss and the other end similarly located in a cover ring **26** adapted to be secured to the column by a socket-headed screw **27** and complementary locating socket **27***a* in the side of the column.

In the boss **14** is secured a spring cover **28** enclosing concentric return springs **29**, **30** both engaging a common collar **31** abutting against a shoulder of a ram piston **32** the upper end **32***a* of which extends through such cover to engage the rear end of the clamping lever **17**. The ram piston **32** is recessed at its lower end to carry a bias control valve **33** loaded by a spring **34** and retained by a spring ring **35**. The valve **33** has a conical nose portion **33***a* adapted to seat as shown in FIG. 1 to close the end of a passage **36** communicating with the hydraulic space behind the plunger **21**. A junction nipple **37** enables a hydraulic power line to be connected to such hydraulic space. A pressure release valve **38** with loading spring **39** is located in the bias control valve **33** and a release passage **40** therefrom leads through the nose of the valve **33**. With the valve **33** normally seated as shown in FIG. 3 a clearance distance X exists between the retaining ring **35** and a shoulder at the lower end of the valve **33** surrounding the conical nose of such valve.

In operation, with no fluid pressure present, the clamping ram **32** and valve **33** will be in the position shown in FIG. 3 but for convenience the clamping arm **17** and swinging ram **21** are shown moved into position by an initial hydraulic pressure insufficient to open the valve **33** in readiness for work clamping. In order to swing the clamping lever from its work-clearing position to the work clamping position as quickly as possible the valve **33** must be loaded for example to 1000 p.s.i. for use with an available fluid pressure up to 1200 p.s.i. During movement of the ram **21** into the ready position for clamping, the pressures in the ram chamber and in the passage **36** will not normally reach the figure of 1000 p.s.i. but as soon as movement of this ram ceases the pressure will rise almost instantly to above that figure so as to raise the control valve **33** and admit fluid pressure to the chamber for the clamping action of the ram **32**. Such pressure however is only the differential pressure so long as the valve **33** is able to reach its seating and on the figures above given cannot exceed 200 p.s.i. This is sufficient however to move the ram **32** against the combined resistance of the springs **29** and **30** so that upward movement of the ram commences. As soon as the ring **35** engages the shoulder of the valve **33** it lifts the valve off its seating and thereafter the full hydraulic pressure enters the ram chamber below the ram **32** through the passage **36** and therefore full clamping pressure is available from the ram **32**.

To release the clamp the hydraulic pressure to the passage **36** is cut off and said passage vented and thereafter the pressure in the chamber below the ram **32** is determined momentarily by the springs **29** and **30** above the ram, which pressure in the passage **36** is also present behind the ram **21** and is sufficient to overcome its return

spring 22 and therefore to hold the ram 21 and lever 17 from moving to the work-clearing position. When the valve 33 reaches its seating the hydraulic pressure in the passage 36 drops rapidly allowing the spring 22 to withdraw the ram and the torque spring to swing the lever 17 clear of the work.

After the valve 33 closes onto its seat hydraulic fluid still below the ram is allowed to leak past the valve 33 and escape past the valve 38 and through the bleed hole 40 into the still vented passage 36 allowing the piston 32 to finish its downward movement and re-establish the clearance X. The action of the return spring 18 for the clamp and the use of the adjustable anvil 19 are so obvious as to require no explanation.

The swinging action of the lever is reversible so as to move clockwise or anti-clockwise and this change may be effected by releasing the screw 27, turning the cover ring 26 until the torque spring is loaded in the other direction and then re-fixing the screw. Also the plunger 21 requires turning on its axis through 180 degrees complementary to the change of direction of the slot 20 in the column.

The invention is not limited to the example above-described in which the bias loading of the valve is itself effectively removed by moving the valve beyond the effective range of movement of the loading spring. For instance, the movement of the ram could operate to open and close a by-pass to the ram cylinder from the passage 36.

What I claim is:

1. A fluid-actuated swing clamp comprising, a pivotally mounted clamping arm, a ram for moving the arm to a work-clamping position, said ram having a pressure chamber, a hydraulic bias control valve for the hydraulic fluid pressure for the ram, means responsive to the working movement of the arm to remove the bias loading of the ram pressure chamber during an initial clamping movement of the arm, said means being effective to restore the bias pressure loading during a final unclamping movement of the arm, whereby full hydraulic pressure in the system is available for clamping without differential loss from such unloading, said control valve being movable relative to its seat with the movement of the ram being such as to be unseated and reseated respectively with the initial or engaging movement and final return movement of the ram, the control valve being normally mounted on and coaxial with the ram with limited bias-loaded relative movement, a leak-away by-pass in the control valve fitted with a non-return valve and releasing residual pressure in the ram cylinder after the bias-valve has been reseated.

2. A fluid-actuated swing clamp comprising, a base, a column rotatively mounted in the base, a clamp arm pivotally mounted on the column, a swing ram arranged to turn the column from a clearance position for the clamp to working position, spring means for returning the column with the clamp to the clearance position, a clamping ram adapted to engage the clamp arm at its rear end to provide clamping pressure on work engaged by the arm, return spring means for the clamping arm, a connecting passage permanently connecting the pressure chambers of the two rams, a bias valve of substantially smaller seating area than the swing ram carried by the clamping ram and adapted to close the connecting passage when the clamping ram is in its returned position, spring means for loading said bias valve, and means on the clamping ram engageable with the valve to withdraw the valve out of reach of the connecting passage after a small initial movement of the clamping ram, the spring for the valve being of such strength as to provide resistance to valve opening less than the maximum available pressure but greater than that required to overcome the swing return springs, and the swing inertia of the clamp and its swing ram for movement from the clearance position to the working position.

References Cited

UNITED STATES PATENTS

2,335,917	12/1943	Cuthbert	91—412
2,616,259	11/1952	Quintilian	91—412
2,908,205	10/1959	Furman	269—134
2,967,464	1/1961	Marmillon	269—30
3,173,673	3/1965	Northern	269—32

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