

March 16, 1965

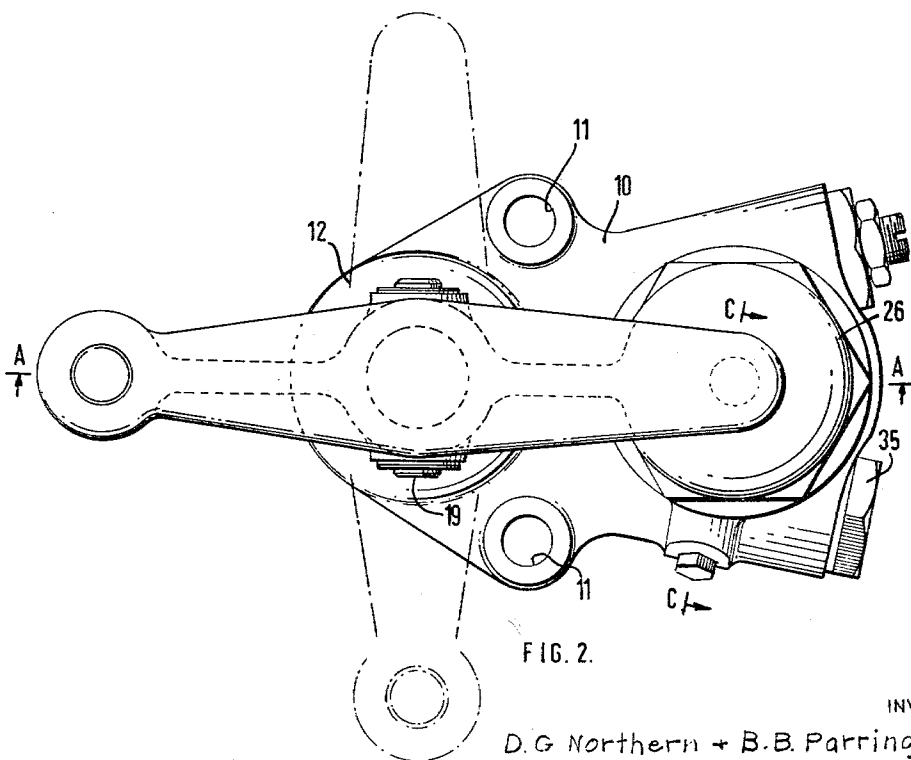
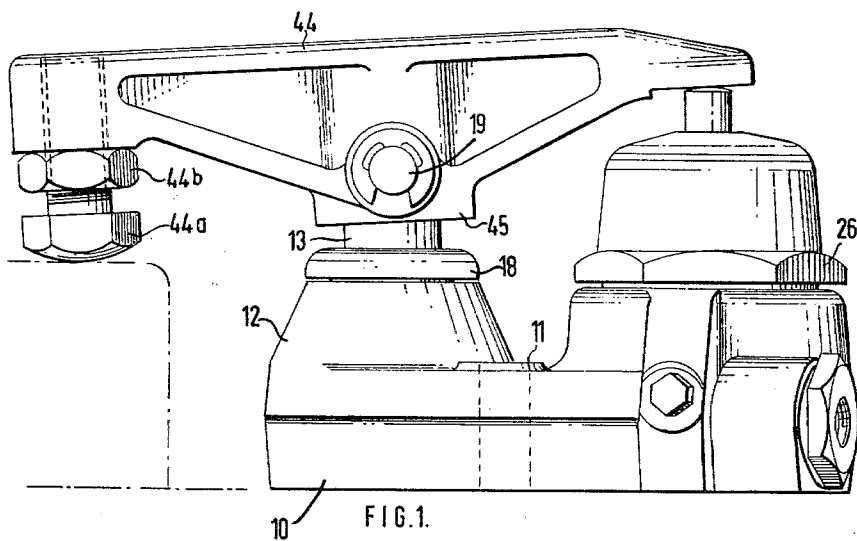
D. G. NORTHERN ET AL

3,173,673

POWERED WORK-CLAMPING DEVICE (TILT AND SWING)

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3 Sheets-Sheet 1



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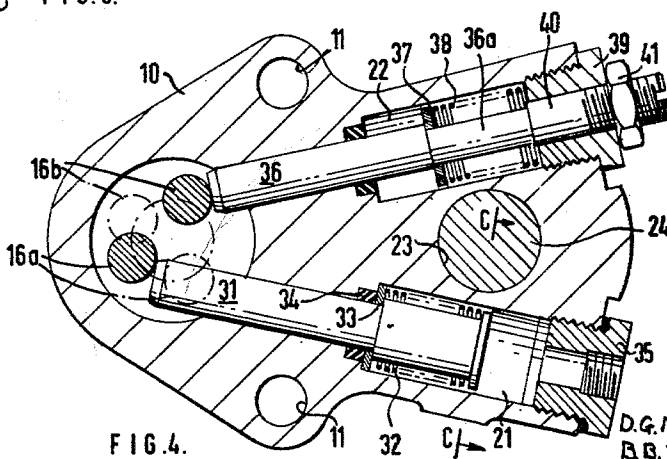
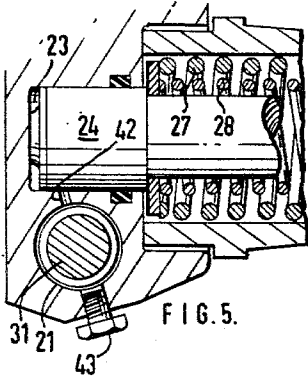
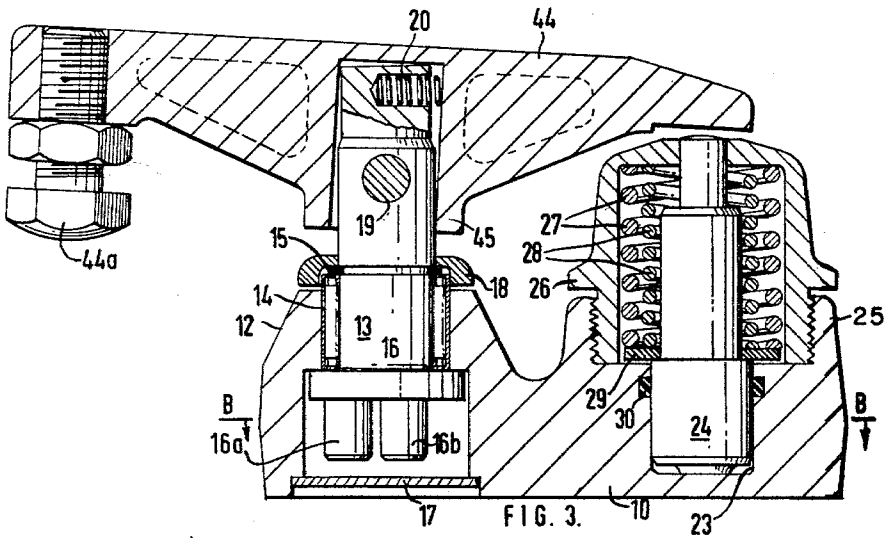
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POWERED WORK-CLAMPING DEVICE (TILT AND SWING)

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3 Sheets-Sheet 2



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POWERED WORK-CLAMPING DEVICE (TILT AND SWING)

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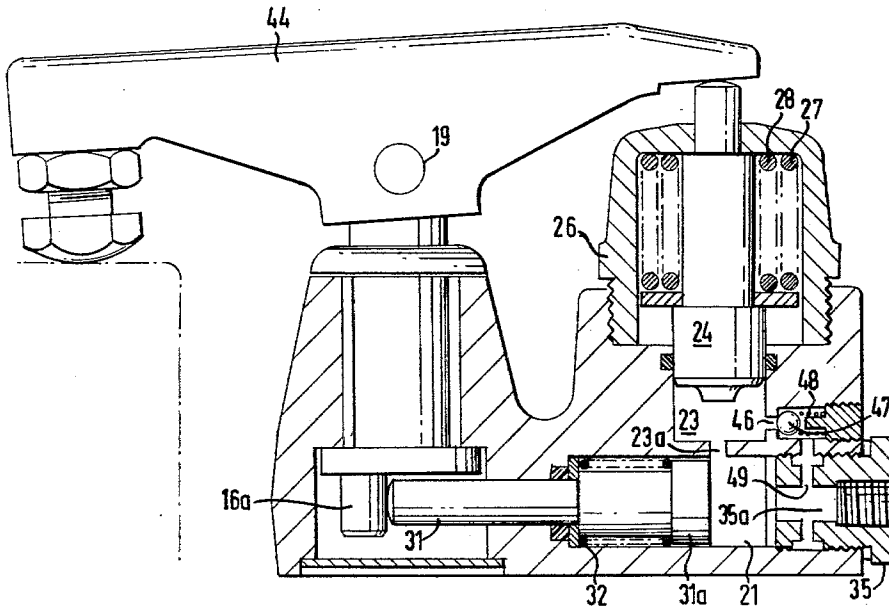


FIG. 6.

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3,173,673
POWERED WORK-CLAMPING DEVICE
(TILT AND SWING)

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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 jib whilst some mechanical operation, such as milling, drilling or grinding, is effected.

Hydraulically or pneumatically powered work-clamping devices are known consisting of a pivoted lever, one end of which is adapted to engage the work while a powered ram is operably connected to the lever to pivot the lever and advance or withdraw the said end relative to the work. In such devices the pivotal movement of the lever has to be such as to permit quick, easy and direct insertion and withdrawal of the work pieces, an operation which is generally manually effected, and this usually entails a pivotal movement of such lever through a substantial angle and initial movement of the clamping end relatively into the direct access zone through which the workpiece must be inserted and withdrawn and thereby the time factor for closing and opening of the clamps is increased and/or the accessibility for insertion and withdrawal of the workpiece is restricted.

The object of the present invention is an improved work-clamping device providing a minimum of movement, quick actuation and more freedom for insertion and withdrawal of the workpiece than heretofore known.

According to the invention a powered work-clamping device comprising a pivoted lever and power means for actuating the same is characterised by rotatable mounting means for the lever providing swinging work-clearing movement, in addition to the pivotal, work-clamping and releasing movement thereof and further power means connected to the lever and operably coupled to the first power means for sequential operation of the lever movements for swinging into position before pivotal closing, and preferably also for pivotal opening before swinging out.

In the accompanying drawings:

FIG. 1 is a side elevation of one example of a hydraulically powered work-clamping device made in accordance with the present invention.

FIG. 2 is a plan of the device shown in FIG. 1.

FIG. 3 is a sectional elevation on line A—A of FIG. 2.

FIG. 4 is a sectional plan on line B—B of FIG. 3.

FIG. 5 is a fragmentary sectional elevation on line C—C of FIGS. 2 and 4.

FIG. 6 is a part sectional elevation of an alternative construction.

As shown in FIGS. 1 to 5 of the drawings, the device comprises a base 10 having a pair of lugs 11 for mounting bolts (not shown) by which the base may be secured to the table of a machine, such as a milling machine. At one end of the base is a boss 12 in which is rotatably mounted a pillar 13 by means of needle rollers 14 (FIG. 3). The pillar 13 is adapted to be inserted from the underside of the base and the rollers are axially located thereon by means of a spring clip 15. At the lower end of the pillar is a head 16 carrying a pair of depending studs 16a and 16b the purpose of which is described later. A closure plate 17 is provided fitting into a rebate on the underside of the boss and secured in any

suitable way (not shown). The upper end of the pillar projects beyond the base and carries a cover 18 for protecting the bearing. In the said upper end is a transverse hole for a pivot pin 19 and at right angles thereto and near the upper end of the pillar is a transverse socket for a coil spring 20. At the other end of the base, as can be seen particularly in FIG. 4, are a pair of horizontal sockets 21, 22 inclined to each other and symmetrically of a centre line of the base. On such centre line is a vertical socket 23 (FIG. 6) forming the cylinder for a hydraulic ram plunger 24. On top of the base around the plunger is a boss 25 recessed and threaded to receive a cover 26 forming an abutment for and housing a pair of springs 27, 28. The ram is formed with a shoulder against which is located a washer 29 forming the lower abutment for the springs. The upper end of the ram is of reduced diameter and passes through the cover 26, the upper end being normally flush with the top of the cover. A packing gland 30 for the ram head is located in a suitable annular groove formed in the upper end of cylinder 23.

Within the socket 21 is a hydraulic ram plunger 31, the head of which carries a return spring 32 which serves to hold a collar 33 against a shoulder in the socket and to retain a packing ring 34. The outer end of the socket is screw threaded to receive a nipple 35 for connecting a hydraulic pipe line (not shown) to the socket. In the other socket 22 is located a spring return plunger 36, the outer end 36a of which is reduced in diameter to locate a spring-abutment washer 37 for a spring 38, the other end of which abuts against a screwed collar 39 located in the outer end of the socket. The collar 39 has a screwed axial hole in which is located a stop stud 40 carrying a locking nut 41. The inner ends of the ram 31 and plunger 36 engage the side peripheries of the studs 16a and 16b previously described.

As shown in FIG. 5, the cylinder 21 is hydraulically connected to the cylinder 23 by a cross passage the inner end 42 of which is of restricted size and the outer end of which is closed by a plug 43.

Pivotaly mounted on the upper end of the pillar 13 by means of the pivot pin 19 is the clamping lever 44 which has a central boss 45 with a clearance hole allowing a limited angle of tilt for the lever on the pillar under the action of the spring 20 which determines its normal position of rest. The rear end of the lever is adapted to overlie the upper end of the ram 24 whilst the forward end of the lever carries a screwed work-anvil 44a which has a locking nut 44b to enable it to be adjusted to the workpiece. The springs 27, 28 are collectively substantially stronger than the springs 32, 38 aforesaid for the reason described later.

In operation, the lever normally assumes the position shown in chain lines in FIG. 2 and with the lever tilted to the inclination shown in FIG. 3. To actuate the device, hydraulic pressure is admitted, under control of a valve not shown, to the cylinder 21 causing the ram plunger 31 to move to the left of FIG. 4, thereby pushing against the stud 16a and rotating the pillar 13 to move the lever into the operative position as shown in full line in FIG. 2. Such movement is made against little resistance and therefore hydraulic pressure, which has free access through the passage 42 to the cylinder 23, is kept down to a value below that required to overcome the combined resistance of the two springs 27, 28 whilst being sufficient to overcome the combined resistance of the springs 32 and 38. As soon as the outer end of the plunger 36 engages the adjustable stop 40, swinging movement of the lever arm is checked and hydraulic pressure then builds up to raise the ram 24 against the rear end of the lever and thereby force the anvil 44a into clamping engagement with the work-piece. Similarly, to remove the workpiece,

release of the hydraulic pressure allows the springs 27, 28 to rock the lever clear of the workpiece whilst maintaining a hydraulic pressure within the device in excess of that required to overcome the springs 32, 38 so that the lever still remains overhanging the work until it reaches the intermediate position shown in FIG. 3 with the lower end of the ram 24 engaging the inner end of the cylinder. Thereupon the springs 27, 28 cease to have any action on the hydraulic pressure which can then fall until the springs 32, 38 can withdraw and advance their respective ram and plunger, so that the plunger 36 engaging the stud 16b rotates the pillar 13 to swing the lever to the disengaged or rest position shown in chain line in FIG. 2. The strengths of the springs 27, 28 relative to the springs 32, 38 as above described determines the aforesaid sequence of movements.

As shown in FIG. 6, instead of relying wholly upon the differential strengths of the springs 27 and 28 relative to the springs 32 and 38 for the required sequential action of the swinging and pivotal movements, the swinging ram 31 is formed with a piston head 31a to act as a piston-valve relative to a port 23a leading to the cylinder 23 for the clamping ram 24. A pressure release passage 46 is provided in the body 10 leading from the cylinder 23 and controlled by a non-return valve ball 47 and spring 48. A further passage 49 leads into the socket 21 to holes 35a in the nipple 35.

In operation, the piston valve 31a closes the passage when no fluid pressure is provided at the nipple 35, and the springs 27, 28 are able to lower the clamping ram 24 by opening the ball valve 47 and expelling the fluid in the cylinder 23 to the fluid inlet side of the device at the nipple 35. When fluid pressure is supplied via the nipple 35, the ball valve 47 and piston valve 31a together prevent fluid pressure from reaching the ram cylinder 23 until the piston 31a has moved to uncover the port 23a. The ram 31 has then substantially completed the swinging of the lever into its operative position before movement of the ram 24 is initiated.

We claim:

1. A powered work-clamping device comprising, a rotatively mounted pillar, a clamping lever pivoted on said pillar, said lever being provided with a work-engaging element at one end, a hydraulically-operated piston for engaging the opposite end of the lever to thereby bring the work-engaging element into work-clamping position, spring means for biasing the piston to its retracted position, and means for swinging the pillar around its longitudinal axis to bring it to either clamping or non-clamping position, said means including off-set pins on the lower end of the pillar and plunger means operative against the pins to rotatively move the pillar.

2. A powered work-clamping device comprising, a pivoted lever having a work-clamping element at one end, a rotatable pillar for the lever, said pillar being rotatable to swing the lever to bring its work-clamping element either over or to one side of an object to be clamped,

power means for bodily swinging the lever to bring it either above or to one side of clamping position, means to tilt said lever in a manner to elevate or lower it, and means for operably connecting the means for tilting the lever with the power means for swinging it for sequential operation whereby the lever is bodily swung into an operative position over the object to be clamped before it is pivoted to clamp the object, and is pivoted to raise the clamping element before it is swung clear of the clamped object.

3. A powered work-clamping device according to claim 2, wherein the means for operably connecting together the power means for swinging the lever with the power means for tilting it, consists of a common source of hydraulic power, and spring return means for the lever-swinging means and for the lever-tilting means, said spring return means for tilting the lever to return tilting motion being stronger than the spring-return means for the lever-swinging motion.

4. A powered work-clamping device comprising, a base member, a vertical pillar rotatively mounted thereon, a clamping lever pivotally mounted in the upper end of the pillar, said lever having a work-clamping element at one end, a hydraulic piston located under the opposite end of the lever and hydraulically raised to tilt the lever to work-clamping position, spring return means for lowering the piston, the pillar being provided on its lower end with a plurality of eccentrically-positioned pins, and pistons operative at an angle to the pillar to engage against the pins and swing the pillar around a vertical axis and thereby position the clamping lever either above or to one side of the work to be clamped.

5. A powered work-clamping device comprising, a pivoted lever and power means for rotating the same and for tilting it, means at one end of the lever for clamping an object when said end of the lever is disposed over the object and is in a lowered position, said power means including a common source of hydraulic power and spring return means, and valve means movable with the swinging movement of the lever to prevent access of the hydraulic fluid to that portion of the power means which tilts the lever except when the lever is positioned above the object to be clamped.

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