United States Patent [19]

Sendoykas et al.

[11] **3,724,836**

[45] **Apr. 3, 1973**

[54] POWER OPERATED SWING CLAMP

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[22] Filed: **July 12, 1971**

[21] Appl. No.: **161,474**

[52] **U.S. Cl.**.....**269/32**, 269/94

[51] **Int. Cl.**.....**B23q 3/08**, B25b 5/06

[58] **Field of Search**.....269/24, 27, 31, 32, 35, 92, 269/94, 135, 139

[56] **References Cited**

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Primary Examiner—Robert C. Riordon
Assistant Examiner—Neil Abrams
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[57] **ABSTRACT**

A power operated swing clamp for clamping a work piece to a bed plate having a cam and bell crank mechanism for rotating the clamping arm into and out of operable clamping position. The cam is connected to the piston of the clamping cylinder thereby eliminating the need for separate power means to rotate the clamping arm into position prior to clamping actuation. The bell crank includes lost motion spring means to prevent damage to the clamp in the event that the clamping arm strikes an object in its path of swing toward operable clamping position.

11 Claims, 14 Drawing Figures

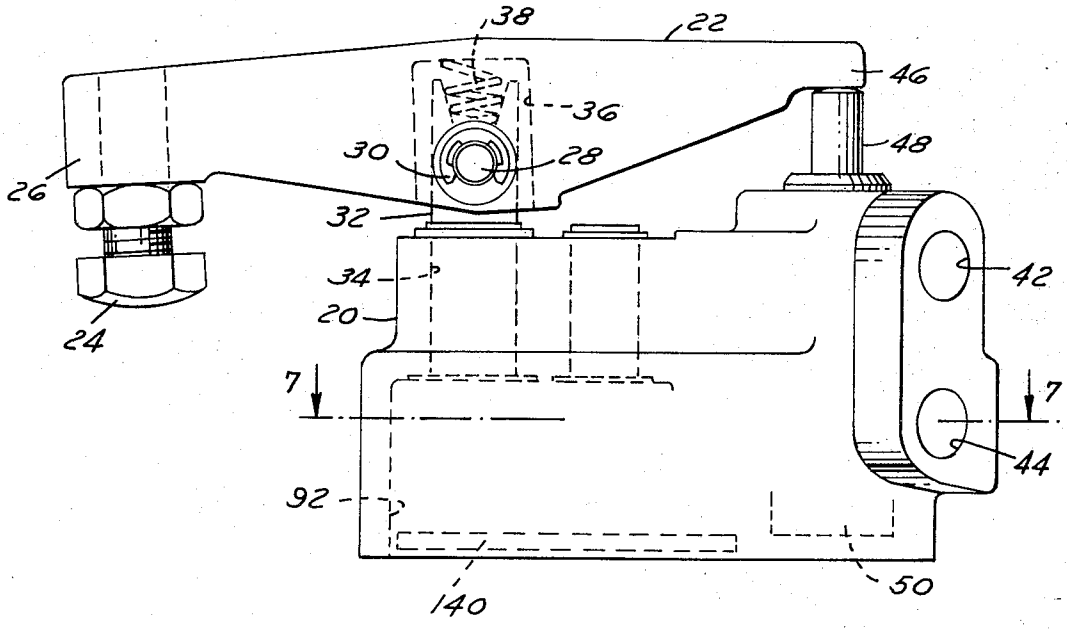


FIG. 1

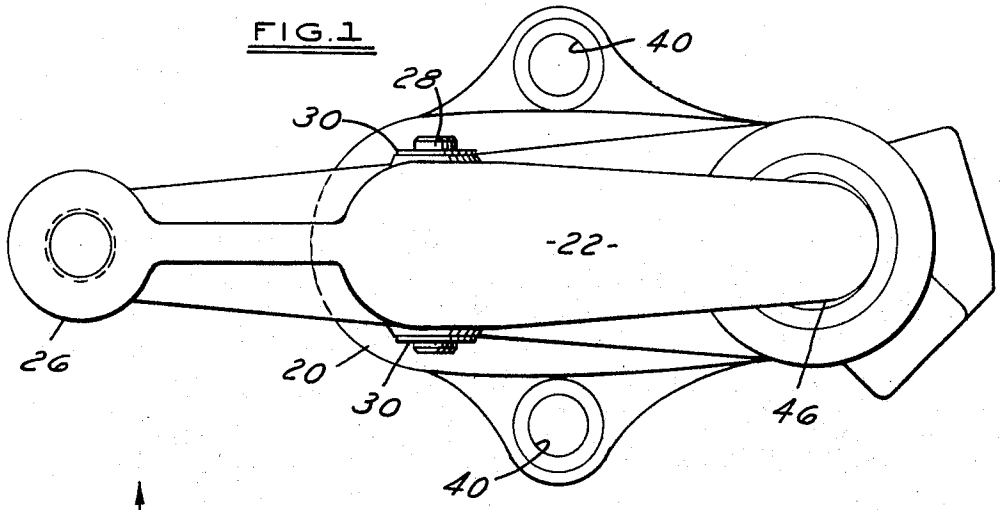


FIG. 7

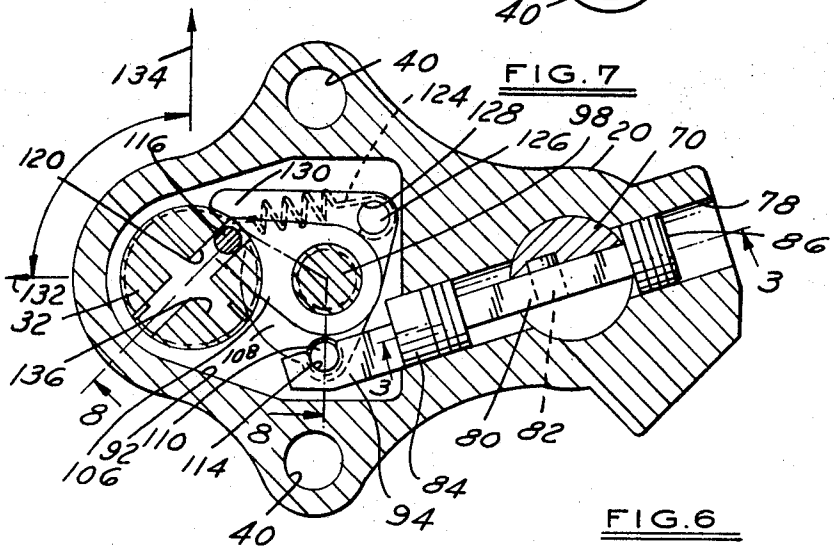


FIG. 5

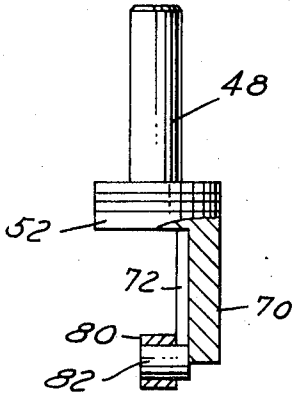
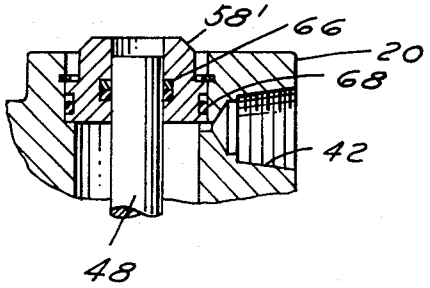


FIG. 6



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FIG. 2

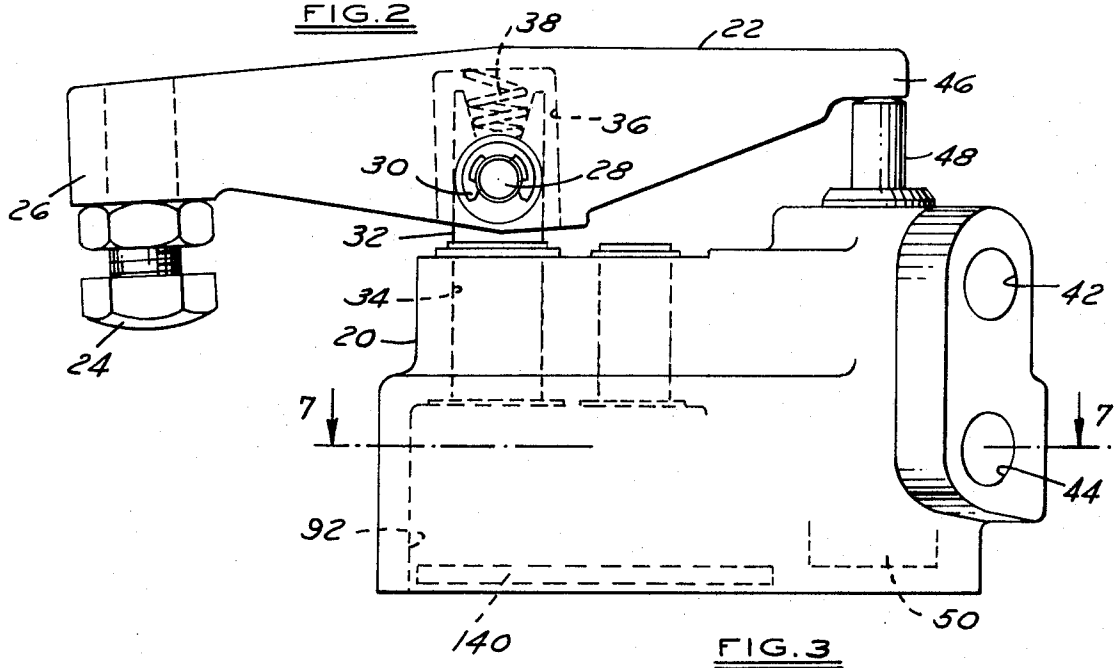


FIG. 3

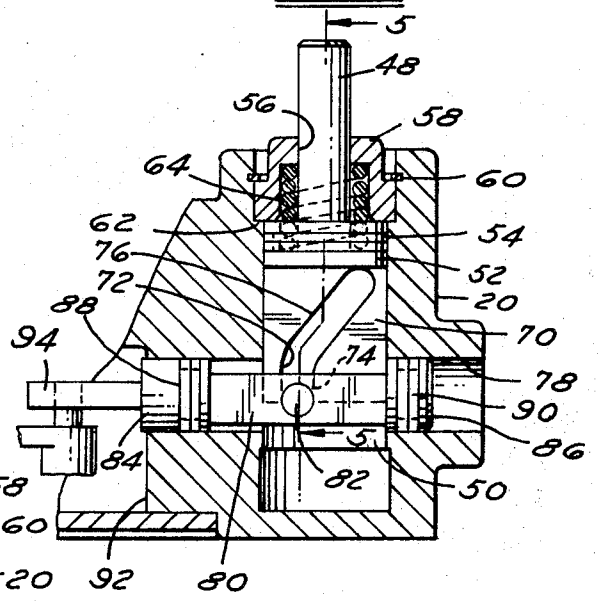
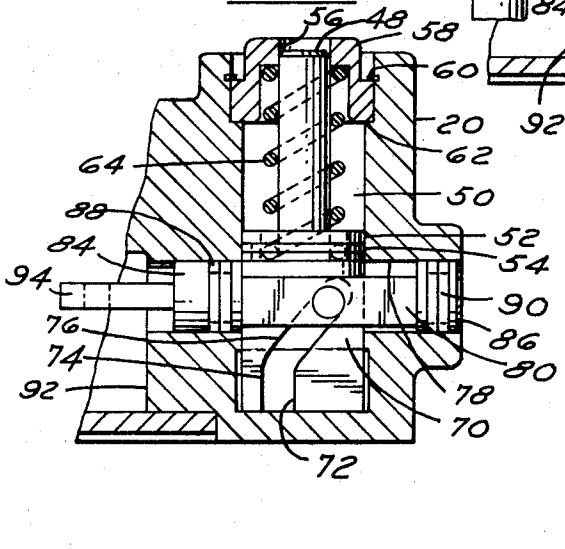


FIG. 4



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FIG. 8

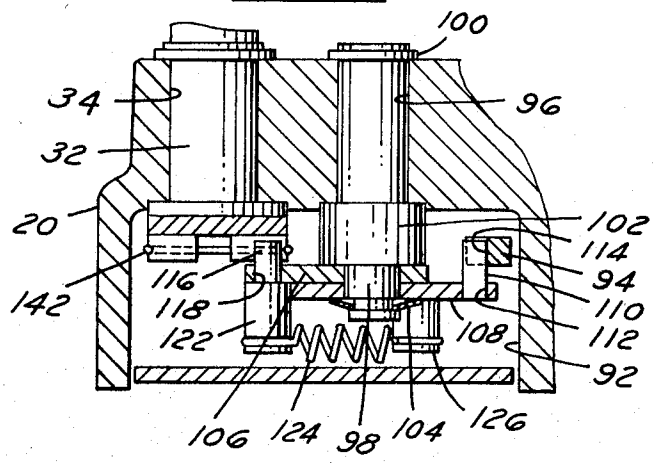


FIG. 9

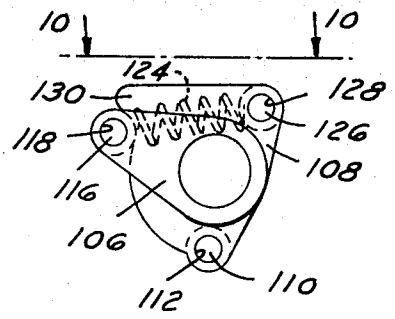


FIG. 11

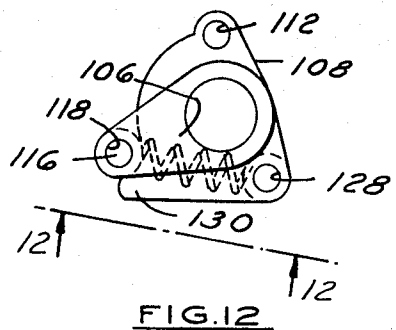


FIG. 12

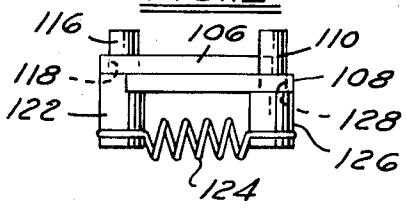
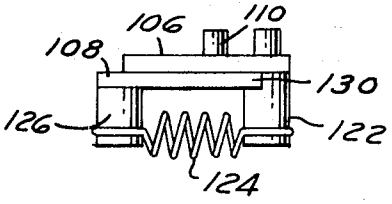


FIG. 10



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FIG. 14

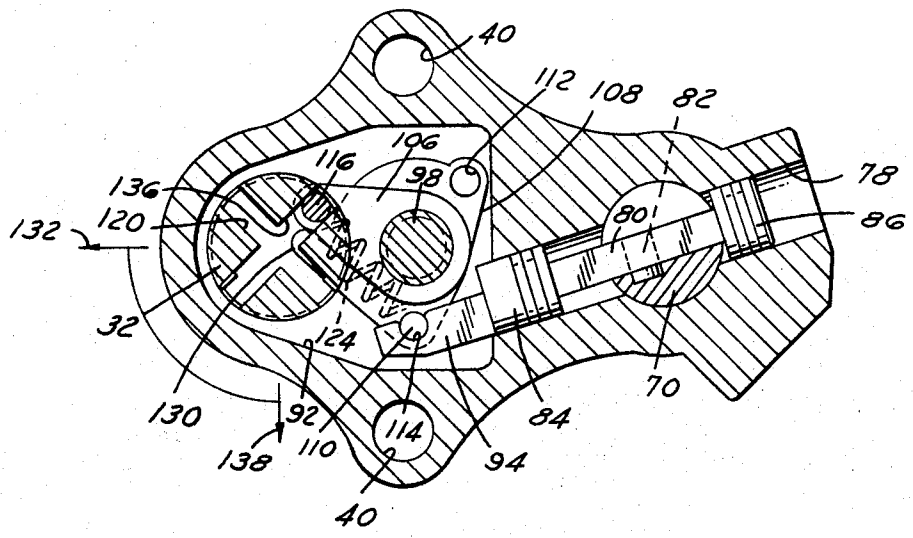
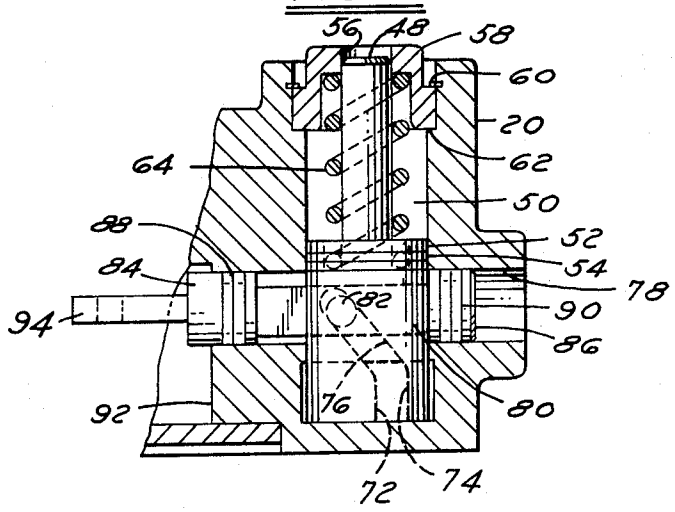


FIG. 13



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POWER OPERATED SWING CLAMP

BACKGROUND OF THE INVENTION

The field of the invention relates to power operated clamping devices which are fastened to the bed plate or work table of a machine and are used to securely clamp a work piece to a bed plate or work table. Such clamps are usually either retractable or swingable to move the clamping arm completely out of the way of the work piece so that it may be lifted from the bed plate without interference. Most swing clamps operate by rotating the clamping arm 90° from a left hand or right hand position into position over the work piece before the clamping arm is pivoted slightly to clamp the work piece down.

Prior swing clamps have generally used separate power operated means to swing the clamping arm into and out of position prior to the pivoted clamping motion in a direction perpendicular to the plane of swing. Since the motion of the swinging arm must be coordinated with the final clamping motion, usually a fluid circuit having valves sequentially operative is utilized to coordinate the swinging movement and the clamping movement.

SUMMARY OF THE INVENTION

The present invention is an improved swing clamp having a mechanical linkage to rotate the clamping arm, which includes a cam connected directly to the piston of the single power cylinder which also provides the final clamping movement of the clamping arm. The cam engages a follower which in turn actuates a bell crank including a spring loaded lost motion mechanism to prevent damage to the clamp in the event that the swinging arm strikes an object mid path in its swing toward operable clamping position. The bell crank mechanism engages a slot in the shaft on which the clamping arm is supported. To provide greater versatility the shaft is provided with a cross slot and the bell crank can follower are designed to allow the reversal in the assembly thereof to provide either a left hand or a right hand swing for the clamping arm. The single fluid powered cylinder of the clamp may be single or double acting and requires no valving or complicated hydraulic circuitry within the clamp body.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top elevation of the clamp in clamping position;

FIG. 2 is a side elevation of the clamp in clamping position;

FIG. 3 is a partial section through the fluid cylinder with the clamp actuated;

FIG. 4 is a partial section through the fluid cylinder with the clamp retracted;

FIG. 5 is a partial section of the piston cam and follower taken along the line 5—5 of FIG. 3;

FIG. 6 is a partial section of the upper end of the fluid cylinder for an alternative double acting fluid cylinder;

FIG. 7 is a cross section of the clamp taken along the line 7—7 of FIG. 2 as assembled for a right hand swing;

FIG. 8 is a partial section taken along the line 8—8 of FIG. 7;

FIG. 9 is a top view of the bell crank assembled for a right hand swing;

FIG. 10 is a side view of the bell crank in FIG. 9 taken from the direction 10—10;

FIG. 11 is a top view of the bell crank assembled for left hand swing;

FIG. 12 is a side view of the bell crank in FIG. 11 taken from the direction 12—12;

FIG. 13 is a partial section of the fluid cylinder showing the piston in retracted position with the clamp assembled for left hand swing; and,

FIG. 14 is a cross section of the clamp taken along the line 7—7 of FIG. 2 as assembled for a left hand swing.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIGS. 1 and 2, the swing clamp includes a body or base 20 and clamping arm 22, provided with a work engaging fitting 24 at the work engaging end 26. The clamping arm 22 pivots about a pin 28 with clip ring fasteners 30 on either side of the clamping arm. A vertical shaft 32 extends from a hole 34 in the base 20 upwardly into a cavity 36 in the clamping arm. The center portion of the pin 28 is located in a hole in the shaft 32. A balancing spring 38 engages the end of the shaft 32 and the cavity 36 in the clamping arm to urge the clamping arm into unclamped position. The base 20 of the clamp includes holes 40 for bolting the clamp to a bed plate and ports 42 and 44 for the supply of pneumatic or hydraulic fluid. In the case of a single acting fluid cylinder, only port 44 is used and port 42 remains sealed. The actuating end 46 of the clamping arm is shown engaged with the piston rod 48 of the fluid powered cylinder 50 inside the base 20. As shown in FIG. 2 the clamping arm 22 is in clamped position with the piston rod 48 tightly engaging the actuating end 46. When the clamp is released the piston rod 48 will be pulled downward away from the actuating end 46 and the balancing spring 38 will cause the clamping arm 22 to pivot about the pin 28 and release the work piece.

Shown in FIGS. 3, 4 and 5 are the fluid cylinder and piston assembly. The piston rod 48 is connected to the piston 52 which includes sealing rings 54. The piston rod 48 passes through a hole 56 in the guide block 58. The guide block 58 in turn is held in place by a clip ring 60 and shoulder 62 in the base 20. For the single acting fluid cylinder shown a return spring 64 extends between the piston 52 and the inside of the guide block 58. In FIG. 6 the upper portion of the fluid cylinder 50 for the alternative double acting cylinder is shown. A modified guide block 58' includes a piston rod seal 66 and guide block seal 68 necessary to prevent leakage of high pressure fluid entering through the port 42. Returning to FIGS. 3 and 4, below the piston 52 extends a cam support 70. The cam comprises a cam slot 72 having a portion 74 parallel to the axis of the piston and piston rod and a portion 76 oblique to the axis of the piston and piston rod 48.

Intersecting the fluid cylinder 50 is a bore 78 containing the cam follower mount 80. The follower mount supports the cam follower 82 which comprises a pin press fit into the mount 80 and extending into the cam slot 72 as best shown in FIG. 5. The follower mount 80 includes two guides 84 and 86 in the bore 78 on either side of the fluid cylinder 50. The guides 84 and 86 include sealing rings 88 and 90. The bore 78 extends into a cavity 92 in the base 20 of the clamp. The follower mount 80 includes an extension 94 into the cavity 92.

In FIGS. 7 and 8, the shaft 32 extends through the bore hole 34 into the cavity 92. In a second vertical bore hole 96 the bell crank pivot shaft 98 is suspended from a clip ring 100. The pivot shaft 98 includes a shoulder portion 102 and locking ring 104 to retain the crank arm 106 and pivot plate 108 of the bell crank. A stud 110 is brazed into a hole 112 in the pivot plate 108 and extends upwardly into a slot 114 for engagement with the follower mount extension 94. A second stud 116 is brazed into a hole 118 in the crank arm and extends upwardly into a slot 120 across the lower end of the shaft 32. The stud 116 includes a lower portion 122 which extends below the pivot plate 108 and has one end of a spring 124 thereattached. The other end of the spring 124 is attached to a third stud 126 brazed into a second hole 128 in the pivot plate 108. The spring 124 thereby urges the stud 116 lower portion 122 against an extending tongue 130 of the pivot plate 108. Thus, the crank arm 106 and pivot plate 108 are constrained to move in unison under normal operating conditions.

The operation of the mechanism is as follows: As shown in FIGS. 3 and 7, the clamp is in extended clamping position with the clamp arm in the direction given by the arrow 132. Upon retraction and lowering of the piston 52 the clamp arm will be first released as the parallel portion 74 of the cam slot 72 passes by the follower pin 82. When the follower pin 82 engages the oblique portion 76 the follower mount 80 will be forced to the right in FIG. 7. The shaft 32 will rotate clockwise and the clamping arm will rotate to the right to the position given by the arrow 134. Subsequent actuation of the clamp will drive the follower mount 80 to the left and the shaft 32 and clamping arm 22 will be rotated counter clockwise into the position 132. The piston rod 48 engages the actuating end 46 of the clamping arm after the follower pin 82 engages the elbow portion between the oblique portion 76 and parallel portion 74 of the cam slot 72. Thus, the pivoting of the clamping arm 22 about the pin 28 does not occur unless the clamping arm is in the position given by the arrow 132. In the event that the clamping arm moving from the position 134 counterclockwise upon actuation meets an obstruction, the shaft 32 and crank arm 106 will cease rotation; however, the pivot plate 108 is free to continue rotating clockwise as the follower mount 80 moves to the left. The spring 124 will merely extend as the tongue 130 disengages from the lower portion 122 of the stud 116. The clamp is therefore protected against damage by an obstruction when the clamp arm is swung toward operable clamping position.

FIGS. 9 and 10 show top and side views of the bell crank mechanism assembled for a right hand swing as disclosed above with reference to FIGS. 7 and 8. An important benefit of the present invention as shown in the preferred embodiment is use of substantially the same parts in a slightly altered assembled condition to provide a clamp with a left hand swing. FIGS. 11 and 12 show the top and side view of the bell crank mechanism assembled for left hand swing. The same crank arm 106, stud 116 and stud extension 122 as well as spring 124 are used, with the stud 116 brazed into the hole 118 in the crank arm 106. The pivot plate 108 which may be cut and drilled from flat stock is merely turned upsidedown. The hole 112 is no longer utilized and the hole 128 has the stud 110 and stud 126 brazed directly above and below. As an alternative, a separate part comprising the stud 110 and spring holder 126 might be inserted in hole 128 in the same manner as the stud 116 and extension 122.

FIGS. 13 and 14 correspond to FIGS. 4 and 7 with the bell crank and other moving parts assembled for left hand swing. The piston 52 is rotated 180° for a left hand swing assembly and as shown in FIG. 14 the cam support 70 is on the opposite side. The follower 82 has been press fit to extend from the opposite side of the follower mount 80. Alternatively, the follower mount may be merely rotated 180° since the guides 84 and 86 are cylindrical in the bore 78. The slot 114 in the extension 94 has sufficient clearance for either position of the follower mount 80 since this clearance is required to allow freedom for the stud 110 to move along a circular arc while the slot 114 and extension 94 are moving along a straight path. As shown in FIG. 13 the follower mount 80 is in its furthest position to the left which in the case of the left hand swing is the retracted position as is also clear from the position of the cam slot 72. Lastly, in assembling the clamp the shaft 32 must be rotated 90° to position the other slot 136 shown in FIG. 14 in engagement with the stud 116. When the clamp is actuated from its retracted position shown in FIGS. 13 and 14, the piston 52 will move upwardly causing the follower 82 and follower mount 80 to move to the right and consequently causing the bell crank pivot plate 108 and crank arm 106 to rotate counter clockwise and the shaft 32 in turn to rotate clockwise. The clamping arm 22 which in retracted position extends in the direction 138 will thereby swing into the position given by the direction 132.

Generally, upon ordering a camp the customer will specify right hand or left hand configuration and the manufacturer will assemble the bell crank with brazed parts described above and assemble the complete clamp as ordered. Optionally, however, the holes 112, 118 and 128 may be threaded and the studs 116 and 110 as well as the spring mount 126 provided with a threaded portion so that the clamp may be disassembled and reassembled for either swing. Other means such as clip rings might also be used on the studs to retain them in the holes of the bell crank. A closure plate 140 may be pivoted to seal the mechanism inside the cavity 92. A resilient wire ring 142 fitting into a groove around the periphery of the shaft 32 and intersecting the slot 136 and 120 may be provided to prevent the stud 116 from slipping outside of the slots in the event the clamping arm is inadvertently pushed beyond its normal operating path by some outside force.

We claim:

1. A power operated swing clamp comprising a mounting base, a rotatable shaft mounted in said base and extending therefrom, a pivot on said shaft having the pivot axis angularly disposed relative to the shaft axis, a clamping arm mounted on said pivot having a work piece engaging end, a fluid powered cylinder in said base, said cylinder including a piston, actuating engaging means between said piston and said clamping arm to clamp a work piece thereby, and actuating connection means between said piston and said shaft whereby fluid actuation of said piston will cause rotation of said shaft and said clamping arm into operative position prior to actuation of said clamping arm.

2. A power operated swing clamp as set forth in claim 1 wherein said additional connection means includes interengaging cam and follower means between said piston and said shaft.

3. A power operated swing clamp comprising a mounting base, a rotatable shaft mounted in said base and extending therefrom, a pivot on said shaft having the pivot axis angularly disposed relative to the shaft axis, a clamping arm mounted on said pivot and having a work piece engaging end and an actuating end, a fluid powered cylinder in said base, said cylinder including a piston, and piston rod, said piston rod engageable with said clamping arm actuating end to clamp a work piece thereby, cam means attached to said piston, follower means moveably mounted in said base and engaging said cam, drive means operatively connecting said follower means with said shaft whereby fluid actuation of said piston will cause rotation of said shaft and said clamping arm into operative position prior to engagement of said piston rod with said clamping arm actuating end.

4. The clamp according to claim 3 wherein said drive means include bell crank means pivotaly mounted in said base, a slot in said shaft perpendicular to the axis thereof and a stud mounted on said bell crank means and engaging said slot.

5. The clamp of claim 4 wherein said bell crank means includes a crank arm and pivot plate both rotatable about the same pivotal mounting, mutually engageable complementary stop means on said crank arm and pivot plate and spring means connecting said crank arm to said pivot plate, said spring means normally urging said complementary stop means into engagement.

6. The clamp of claim 3 wherein said follower means is constrained to move transversely to said piston within said fluid cylinder and includes an extension to operatively connect with said drive means outside of said fluid cylinder.

7. The clamp of claim 6 wherein said drive means includes bell crank means pivotally mounted in said base, a slot in said shaft perpendicular to the axis thereof and a stud mounted on said bell crank means and engaging said slot.

8. The clamp of claim 7 wherein said bell crank means includes a crank arm and pivot plate both rotatable about the same pivotal mounting, mutually engageable complementary stop means on said crank arm and pivot plate and spring means connecting said crank arm to said pivot plate, said spring means normally urging said complementary stop means into engagement.

9. The clamp of claim 8 wherein said clamp may be assembled for a right hand or left hand swing by including a cross slot in said shaft, and in the assembly of said clamp rotating said piston 180°, said follower means 180° and reversing said pivot plate top for bottom prior to the attachment of said stud in the assembly thereof.

10. A power operated swing clamp comprising a mounting base, a rotatable shaft mounted in said base and extending therefrom, a pivot on said shaft extension having the pivot axis substantially perpendicular to the shaft axis, a clamping arm mounted on said pivot and having a work piece engaging end and an actuating end, a fluid powered cylinder in said base, said cylinder including a piston and piston rod, said piston rod engageable with said clamping arm actuating end to clamp a work piece thereby, a cam attached to said piston comprising a slot having a portion parallel to the piston rod axis and a portion oblique thereto, a guide passage in said base intersecting said cylinder, a follower mount including sealed guides in said passage on either side of said cylinder, a follower on said follower mount engaging said cam slot, a pivot plate and crank arm coaxially rotatably mounted in said base, said pivot plate operatively engaged by said follower mount, said crank arm operatively engaging said shaft, mutually engageable complementary stop means on said pivot plate and crank arm and spring means connecting said pivot plate and crank arm whereby said spring means normally urges said complementary stop means into engagement and the movement of said follower in the oblique portion of said cam slot causes rotation of said shaft.

11. A power operated work holding device comprising a mounting base, work clamping means mounted on said base, mounting means accommodating prepositioning movement of said clamping means, distinct mounting means accommodating final work clamping movement of said clamping means, a fluid powered cylinder mounted on said base including a piston, actuating connecting means between said piston and said clamping means providing said prepositioning movement during initial travel of said piston, and actuating engaging means between said piston and said clamping means providing said final work clamping movement during final travel of said piston.

* * * * *