

Jan. 9, 1968

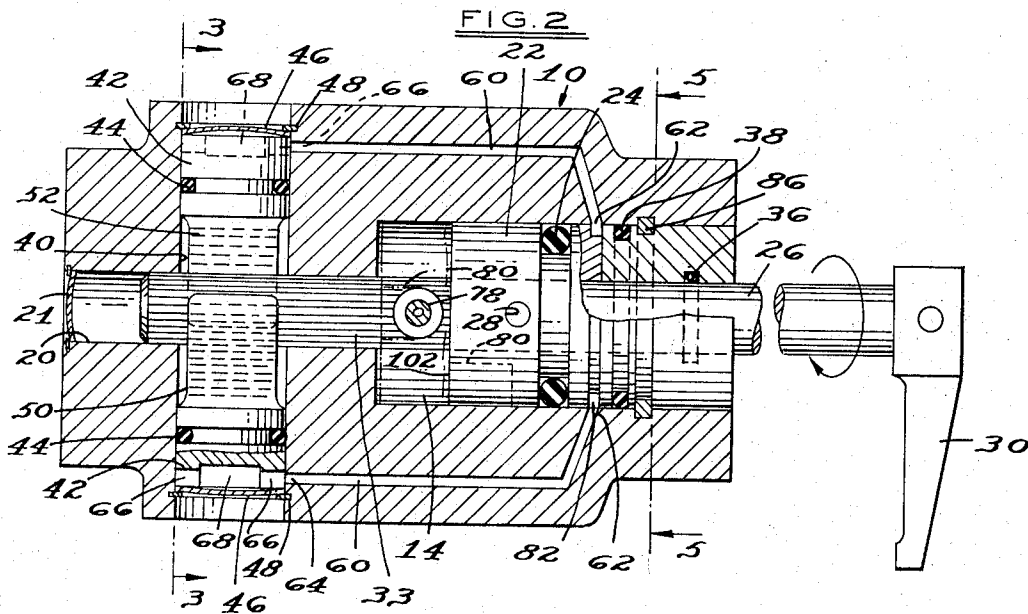
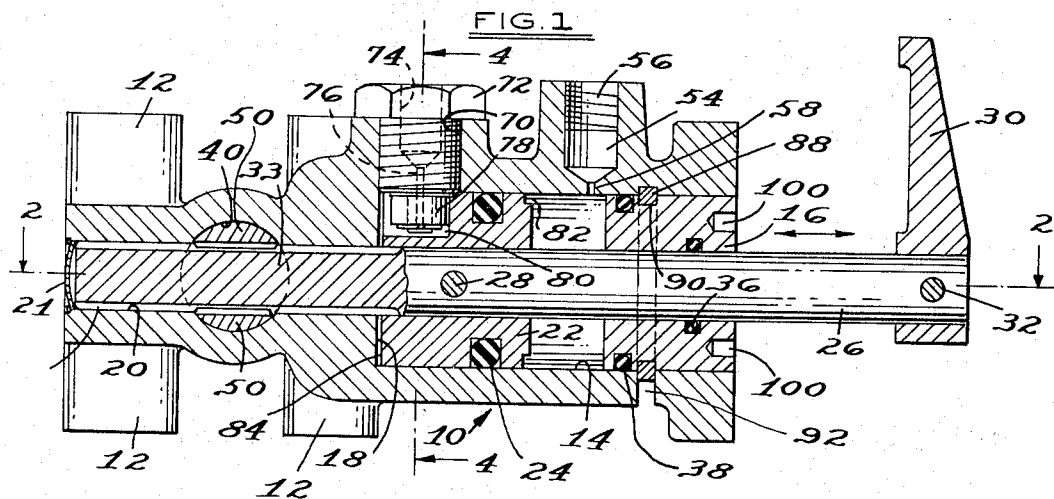
P. C. KOHLITZ

3,362,301

FLUID ACTUATED CLAMP

Filed April 20, 1966

2 Sheets-Sheet 1



INVENTOR

PAUL C. KOHLITZ

BY

Barnes, Kisselle, Leisch & Choate

ATTORNEYS

Jan. 9, 1968

P. C. KOHLITZ

3,362,301

FLUID ACTUATED CLAMP

Filed April 20, 1966

2 Sheets-Sheet 2

FIG. 3

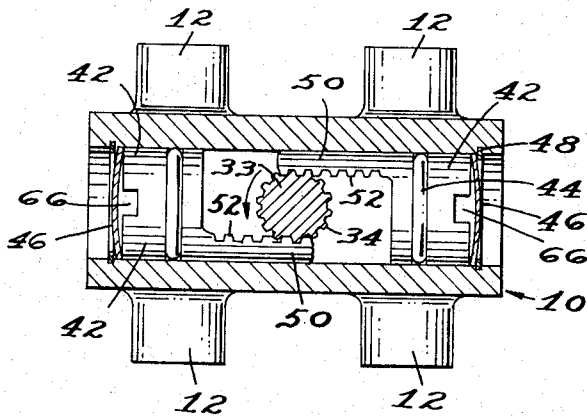


FIG. 5

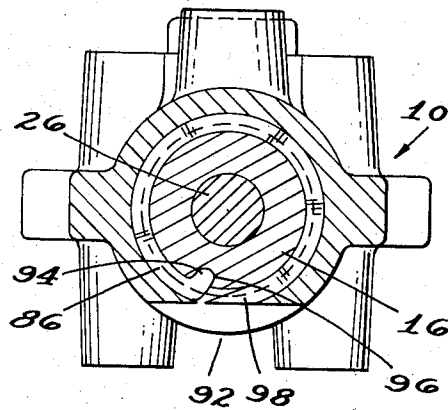
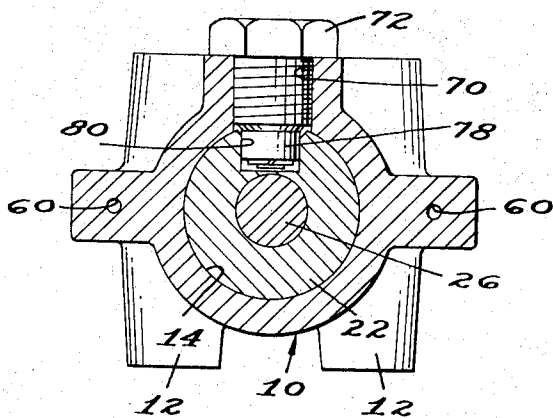


FIG. 4



INVENTOR

PAUL C. KOHLITZ

BY

Barney Kisselle, Raich & Choute

ATTORNEYS

1

3,362,301

FLUID ACTUATED CLAMP

Paul C. Kohlitz, 5791 Beaconsfield Ave.,
Detroit, Mich. 48234

Filed Apr. 20, 1966, Ser. No. 543,886

10 Claims. (Cl. 92—2)

2

This invention relates to a fluid actuated clamp and, more specifically, to a clamp of the type adapted for fixedly clamping a workpiece on a fixture such as when a machining or similar operation is being performed on the workpiece.

Fluid operated clamps of the type described frequently consist of a piston-cylinder arrangement wherein the axially shiftable clamp is connected to the piston and is caused to rotate through a predetermined angle while it is being shifted axially between clamped and released positions. The clamp is usually rotated through approximately 90° to enable the workpiece to clear the clamp when removed from the fixture.

One of the problems associated with such fluid actuated clamps relates to the excessively long stroke required to rotate the clamp and to shift it axially between the clamped and released positions. It is not uncommon in such arrangements to employ a spiral cam arrangement for rotating the clamp and shifting it axially in response to reciprocation of the piston in the cylinder.

It is an object of this invention to provide a fluid actuated clamp of the type described wherein the stroke required to rotate the clamp and to shift it axially is reduced to a minimum.

More specifically, it is an object of the present invention to provide a clamp of the type described which employs a main piston for shifting the clamp axially and a pair of auxiliary pistons connected to the main piston and adapted to rotate the main piston for rotating the clamp.

Other objects and features of the present invention will become apparent from the following description and drawings, in which:

FIGURE 1 is a sectional view through the fluid actuated clamp of the present invention showing the clamp in the clamped position.

FIGURE 2 is a sectional view along the line 2—2 in FIG. 1 and showing the clamp in the released position.

FIGURE 3 is a cross sectional view taken along the line 3—3 in FIG. 2.

FIGURE 4 is a sectional view taken along the line 4—4 in FIG. 1.

FIG. 5 is a sectional view taken along the line 5—5 in FIG. 2.

Referring to the drawings, the clamp of the present invention includes a housing 10 which is preferably formed as a casting having a plurality of lugs 12 thereon adapted for mounting the housing on a support. A cylinder 14 is formed within housing 10 having one end thereof extending to the end of the housing and closed by an end cap 16. The other end of cylinder 14 is defined by an end wall 18. An axial bore 20 extends from the other end of housing 10 and into cylinder 14 at the center of end wall 18. The outer end of bore 20 is closed by a plug 21. A piston 22 is slidably arranged within cylinder 14 and is sealed therein by an O-ring 24. A piston rod 26 is connected to piston 22 as by a pin 28. Rod 26 extends axially through end cap 16 and has a clamp arm 30 secured to the outer end thereof as by a pin 32. Rod 26 extends through piston and its inner end 33 is splined as at 34. Splined portion 34 extends axially through bore 20 and has a close sliding fit therein. The sliding connection between end cap 16 and rod 26 is sealed by an O-ring 36; and the peripheral connection between end cap 16 and cylinder 14 is sealed by an O-ring 38.

A second cylinder bore 40 is formed in housing 10. Cylinder 40 extends transversely of cylinder 14 and is intersected by bore 20. Within cylinder 40 there is arranged a pair of opposed auxiliary pistons 42. Each piston 42 is sealed within cylinder 40 by an O-ring 44 and each end of cylinder 40 is closed by a plug 46 which is retained in place by a snap ring 48.

Referring now to FIG. 3, each piston 42 is fashioned with an axial extension 50 at one side thereof; the extensions 50 being formed with gear rack portions 52 engaging diametrically opposite sides of the splined portion 34 of the inner end portion 33 of rod 26. With this arrangement it will be observed that when pistons 42 are displaced towards each other, rod 26 is rotated in a counterclockwise direction as viewed in FIG. 3, and when pistons 42 are displaced axially away from one another, rod 26 is rotated in a clockwise direction.

Housing 10 is provided with a first port 54 which is threaded as at 56 to receive an inlet fitting. Port 54 connects with cylinder 14 through a restricted orifice 58. Housing 10 is fashioned with a pair of passageways 60 which at one end communicate with cylinder 14 through diametrically opposite ports 62 which are axially aligned with orifice 58 and displaced 90° therefrom. The other ends of passageways 60 communicate with the outer ends of cylinder 40 as at 64 and register with diametral slots 66 at the outer ends of pistons 42. The outer end of each piston 42 is fashioned with a central recess 68 with which the slots 66 communicate. Housing 10 is formed with a second port 70 which is closed by a threaded plug 72. Plug 72 is fashioned with a threaded socket 74 at its outer end for connecting with a fluid fitting. Plug 72 is centrally apertured as at 76 so that socket 74 communicates with cylinder 14 adjacent the end wall 18 thereof. On the inner end of plug 72 there is journaled a roller 78. Piston 22 is fashioned with a groove 80 at the end thereof facing end wall 18 with which roller 78 is adapted to register and engage. Groove 80 is shown in broken lines in FIG. 2. The axial extent of groove 80 is not substantially greater than the diameter of roller 78.

As is clearly shown in FIGS. 1 and 2, piston 22 is formed with an annular shoulder 82 at one end thereof which registers with orifice 58 and ports 62 when the piston is in abutting relation with end cap 16. When piston 22 is displaced axially toward end wall 18, roller 78 engages the inner end of groove 80 so that there is a slight clearance space 84 between the end of piston 22 and end wall 18 (FIG. 1). Thus, with the piston in the position illustrated in FIG. 1, if fluid under pressure is directed through plug 72, this fluid is permitted to flow through the groove 80, clearance space 84 and through the splines 34 of the end portion 33 of rod 26 into the portion of cylinder 40 between the two opposed auxiliary pistons 42.

End cap 16 is retained in fixed position within the open end of cylinder 14 by a bendable metal ring 86 which is adapted to seat in registering circumferential grooves 88 and 90 in housing 10 and end cap 16, respectively. As is illustrated in FIG. 5, housing 10 is slotted as at 92 to expose a circumferential portion of groove 88. Ring 86 is provided with a radial inwardly extending lug 94 at one end thereof adapted to be engaged in a socket 96 in end cap 16. The other end of the ring 86 is tapered as at 98. With this arrangement it will be noted that ring 86 can be threaded into and out of engagement with the registering grooves 88, 90 by hooking lug 94 in socket 96 and rotating end cap 16. For this purpose end cap 16 is fashioned with a pair of diametrically opposite sockets 100 in the exposed face thereof for engagement with a spanner wrench. To remove ring 86 it is only necessary to engage a prying tool under the tapered end 92

3

of the ring and rotate end cap 16 in a clockwise direction, as viewed in FIG. 5, to thereby feed ring 86 out of the slotted portion 92.

In operation a source of fluid under pressure is connected with sockets 74 and 56. The pressure fluid may be compressed air; and the admission of fluid to sockets 74 and 56 may be controlled by any suitable means, such as a solenoid valve, manual valve, etc. With the parts in the positions illustrated in FIG. 1, it may be assumed that the clamping arm 30 is engaging a flange or other portion of a workpiece and holding the workpiece in clamped position on a fixture. If it is desired to release the workpiece, it is necessary to shift rod 26 to the right, as viewed in FIG. 1, and rotate clamping arm 30 90° to the position shown in FIG. 2. To accomplish this, air under pressure is admitted through socket 74 to passageway 76. As previously explained, the air admitted through passageway 76 communicates with portion of cylinder 40 between the inner ends of auxiliary pistons 42.

With the clamp in the engaged position the two auxiliary pistons 42 are in their inwardly retracted position. However, pressure fluid is incapable of displacing pistons 42 outwardly away from one another because piston 22 is locked against rotation by the interengagement of roller 78 with groove 80. Thus, the pressure fluid acts against the end face 102 of piston 22 and displaces the piston axially to the right as viewed in FIGS. 1 and 2. When piston 22 is displaced from the position shown in FIG. 1 to the position shown in FIG. 2, clamping arm 30 has been released from clamping engagement with the workpiece and the end face 102 of piston 22 has cleared roller 78. At this time piston 22 is not locked against rotation and thus the pressure fluid acting against the inner ends of auxiliary pistons 42 displaces the latter pistons outwardly away from each other. As pistons 42 are shifted axially away from one another, the interengagement of the rack portions 50 with the spline portion 34 of rod 26 causes the rod and clamp arm 30 to rotate as indicated in FIG. 2. In the arrangement illustrated the rack and gear arrangement produces rotation of clamping arm 30 through about 90°. In this position of clamping arm 30 it has cleared the workpiece to permit ready removal of the workpiece from the fixture.

When the clamp is in the released position shown in FIG. 2 and it is desired to clamp a workpiece to a work supporting fixture, after the workpiece is properly located on the fixture, fluid under pressure is directed through port 56. The pressure fluid exerts pressure against the shoulder 82 of piston 22 and by reason of passageways 60 also exerts pressure against the outer ends of auxiliary pistons 42. As soon as piston 22 shifts axially to the left slightly its end face 102 is engaged by roller 78 to arrest its axial displacement. However, piston 22 is at this time free to rotate and the pressure fluid acting against the outer ends of pistons 42 displaces these pistons inwardly toward each other and rotates piston 22. When groove 80 on piston 22 shifts circumferentially to a position in alignment with roller 78 the pressure fluid acting against the opposite end face of piston 22 displaces piston 22 to the left to the position shown in FIG. 1. Clamping arm 30 will thus have been rotated 90° and shifted axially with piston rod 26 to a position clamping the workpieces on the fixture.

In addition to the advantage of requiring only a short stroke to release the clamping arm and rotate it, the present clamp structure has several other important features. For example, with the arrangement described herein the clamping arm can be rotated and shifted axially with relatively low fluid pressure. This enables the present clamp structure to be used in clamping arrangements for the application of very heavy clamping pressure and also in connection with relatively delicate workpieces where a very light clamping pressure is desired.

Another important feature of the present invention resides in the arrangement whereby the direction of rota-

4

tion of the clamping arm can be reversed by simply rotating the rack pistons 42 180° in cylinder 40. Such repositioning of rack pistons 42 would cause the splined portion 34 of rod 26 to rotate in a direction opposite to that illustrated when the two rack pistons are shifted axially toward each other.

It will also be observed that in the arrangement illustrated the splined portion 34 of rod 26 serves several desirable purposes. It provides a driving connection between the rack pistons and the main piston 22; it provides a fluid passageway from the main cylinder bore 14 to the auxiliary cylinder bore 40 and also provides axial support for piston 22 so that in effect the main piston is axially supported at both its opposite ends.

I claim:

1. A fluid actuated clamp comprising means forming a first cylinder, a piston movable axially in said cylinder, a piston rod connected to the piston, a clamp member operatively associated with the piston rod, locking means on the cylinder and piston adapted, when in circumferential registration, to interengage when the piston is displaced to one end of the cylinder for preventing rotation of the piston and the clamp member, said piston being displaceable toward the other end of the cylinder to release said locking means and thereby permit rotation of the piston and the clamp member, means forming a second cylinder, a second piston movable axially in the second cylinder, means operatively interconnecting said first and second pistons for causing rotation of the first piston and clamp in response to axial displacement of the second piston in its cylinder and means for conducting pressure fluid to one side of both pistons and then to the opposite side of each piston, whereby when the first piston and cylinder are interengaged by said locking means and pressure fluid is directed to said one side of each piston, the pressure fluid first displaces the first piston axially to disengage said locking means and the second piston is then actuated by said pressure fluid to rotate the clamp member and when the locking means are disengaged and the pressure fluid is directed to the other end of each piston, the second piston is axially displaced to rotate the first piston and clamp member to a position where the locking means register and then the first piston is axially displaced to engage said locking means.

2. A fluid actuated clamp as called for in claim 1 wherein the two cylinders have their axes disposed transversely of one another.

3. A fluid actuated clamp as called for in claim 1 wherein said means interconnecting the two pistons includes interengaged gear and gear rack portions.

4. A fluid actuated clamp as called for in claim 3 wherein said gear rack portion is operatively associated with the second piston and wherein the gear portion is operatively associated with the first piston; the axes of the two pistons being transversely related and the gear and gear rack portion being adapted to accommodate axial movement of the first piston transversely of the gear rack portion associated with the second piston.

5. A fluid actuated clamp as called for in claim 1 wherein said locking means comprises a roller journaled in said first cylinder on a generally radially extending axis and an axially extending slot in the first piston in which said roller is adapted to engage, said slot extending to one end of said first piston and said end of said first piston lying in a plane generally perpendicular to the axis of the first cylinder and adapted to be engaged by said roller when said roller and slot are out of registration.

6. A fluid actuated clamp comprising means forming a first cylinder, a piston movable axially in said cylinder, a piston rod connected to the piston, a clamp member operatively associated with the piston rod, locking means on the cylinder and piston adapted, when in circumferential registration, to interengage when the piston is displaced to one end of the cylinder for preventing rotation

5

of the piston and the clamp member, said piston being displaceable toward the other end of the cylinder to release said locking means and thereby permit rotation of the piston and the clamp member, said piston having a gear portion connected thereto, means forming a second cylinder, a second piston movable axially in the second cylinder having a gear rack portion operatively connected with the gear portion of the first piston to rotate the first piston and clamp member in response to axial displacement of the second piston in its cylinder and means for conducting pressure fluid to one side of both pistons and then to the opposite side of each piston whereby when the first piston and cylinder are interengaged by said locking means and pressure fluid is directed to said one side of each piston, the pressure fluid first displaces the first piston and clamp member axially to disengage said locking means and the second piston is then actuated by said pressure fluid to rotate the clamp member and when the locking means are disengaged and the pressure fluid is directed to the other end of each piston, the second piston is axially displaced to rotate the first piston and clamp member to a position where the locking means register and then the first piston is axially displaced to engage said locking means.

7. A fluid actuated clamp as called for in claim 6 wherein said locking means comprises a radial projection

6

of the first cylinder and an axially extending slot on the first piston in which said projection is adapted to engage.

8. A clamp as called for in claim 6 wherein said second piston and second cylinder extend axially in a direction transversely of the axis of the first cylinder.

9. A clamp as called for in claim 6 including a third piston in said second cylinder axially opposed to said second piston and also having a gear rack portion engaging the gear portion of the first piston.

10. A fluid actuated clamp as called for in claim 9 wherein said gear portion comprises an axially splined cylindrical member projecting axially from the first piston, said rack portions engaging diametrically opposite portions of said spline portion.

References Cited

UNITED STATES PATENTS

280,668	7/1883	Rawlins	92—2
1,023,518	4/1912	Hansen	173—108 X
1,384,661	7/1921	Guiley	92—136 X
2,346,820	4/1944	Casler et al.	92—2 X
2,957,361	10/1960	Herbenar	92—136 X
3,030,935	4/1962	Hanes	92—2

25 MARTIN P. SCHWADRON, *Primary Examiner.*

I. C. COHEN, *Assistant Examiner.*