Dec. 9, 1969 J. J. SENDOYKAS 3,482,830

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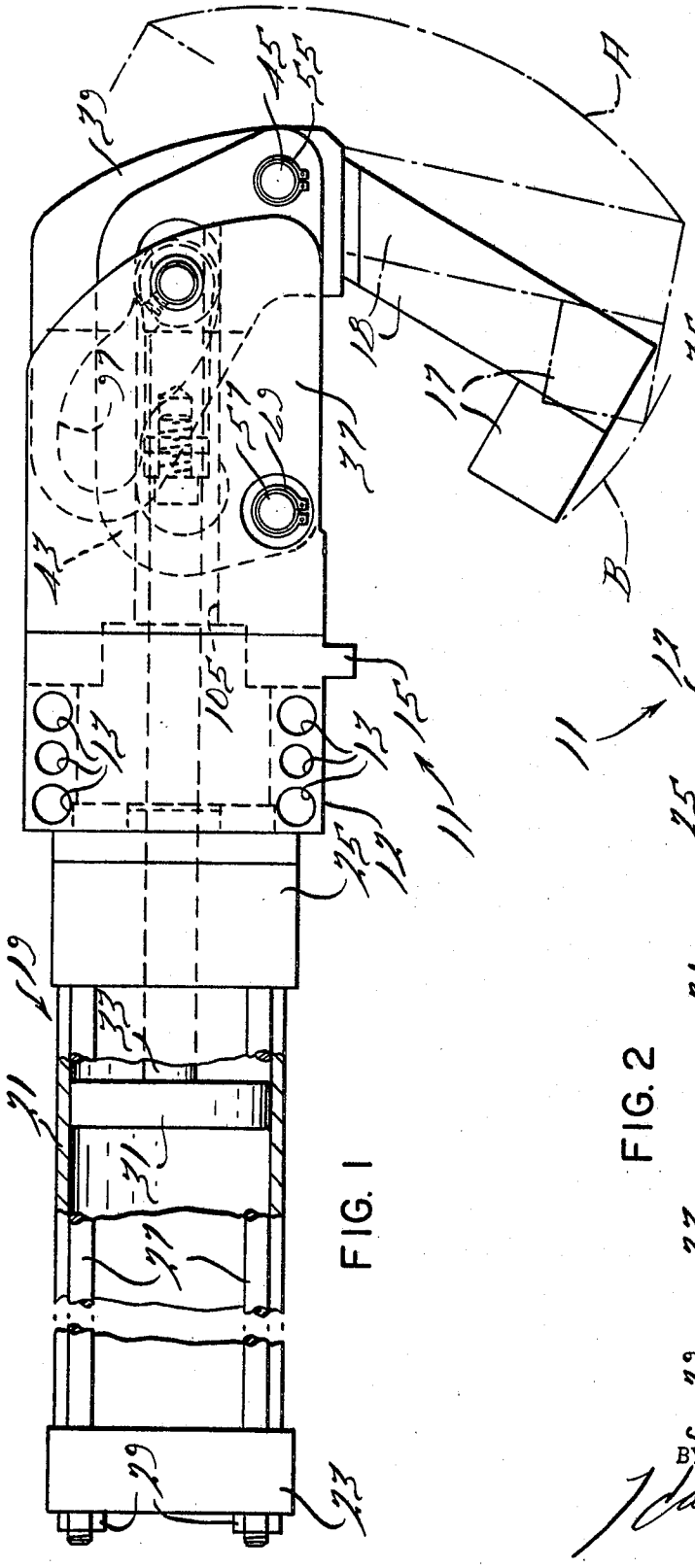


FIG. 1

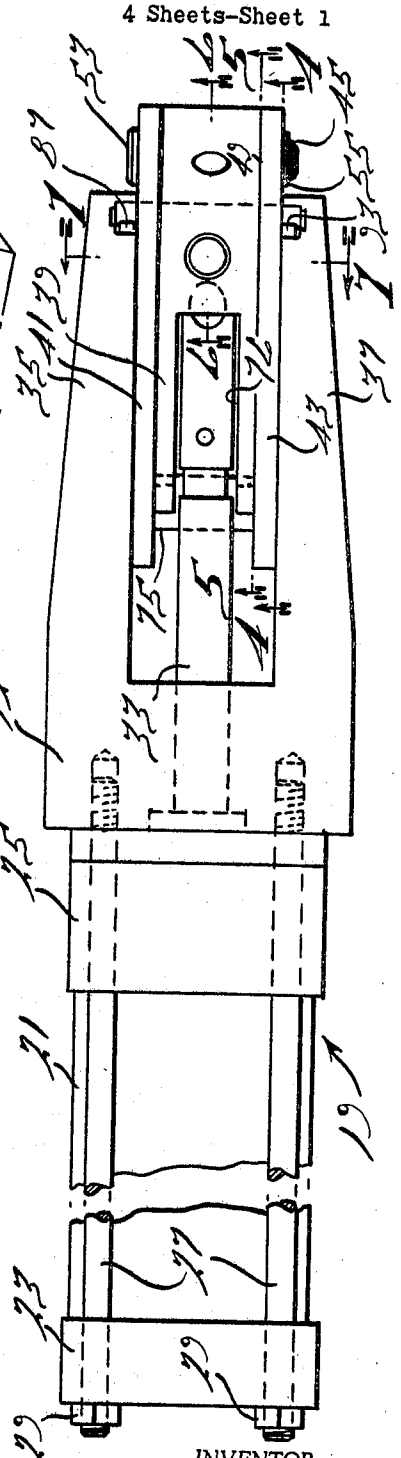


FIG. 2

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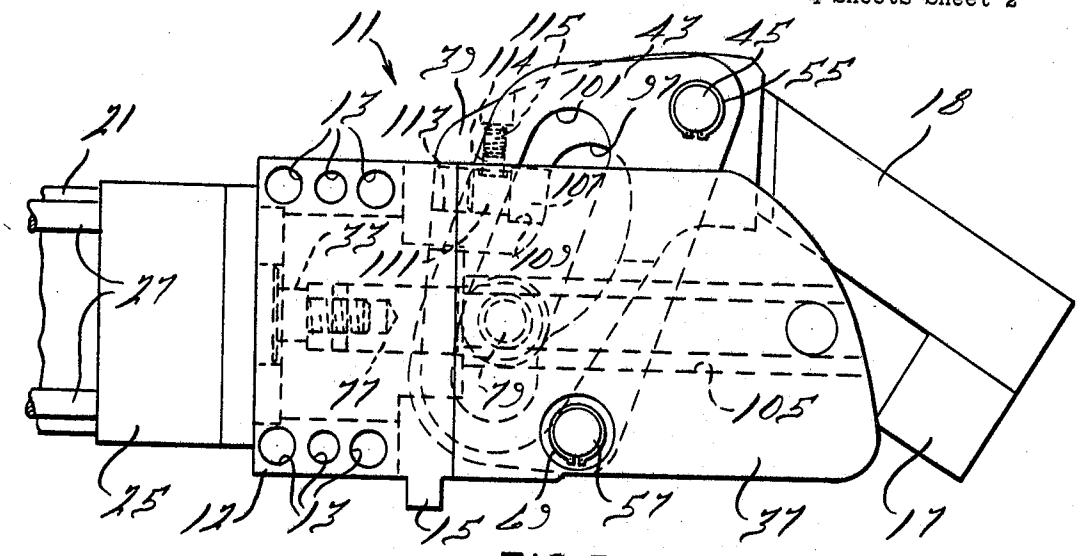


FIG. 3

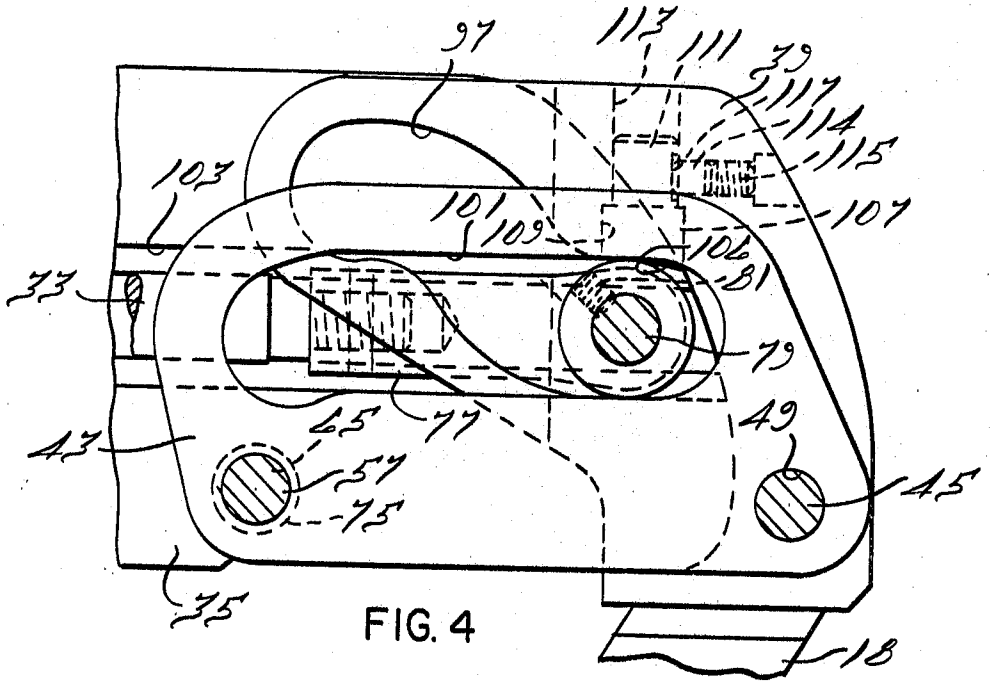


FIG. 4

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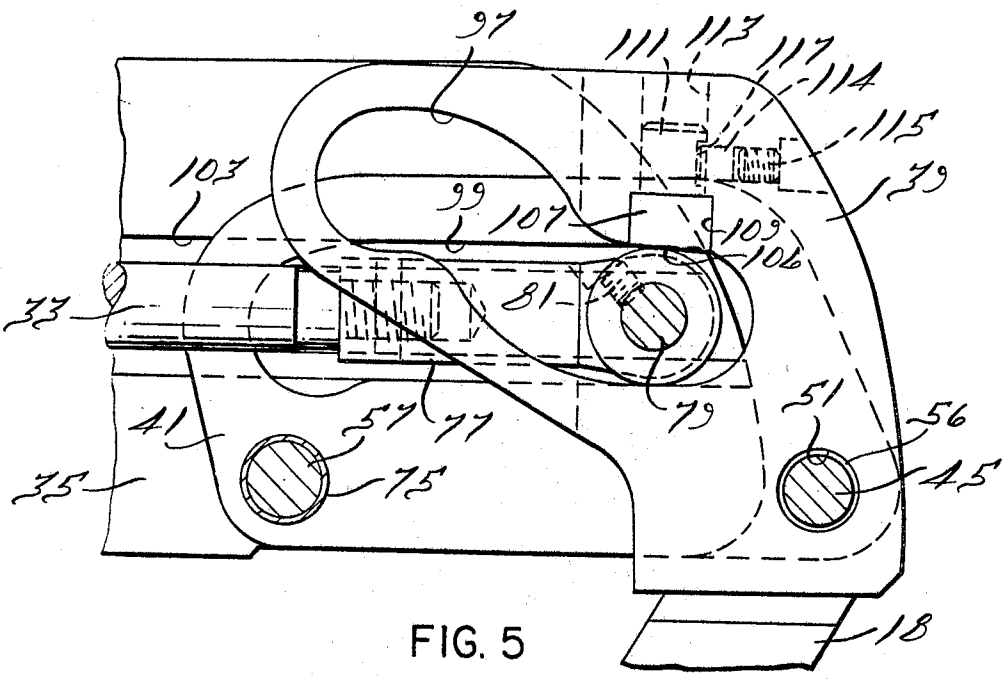


FIG. 5

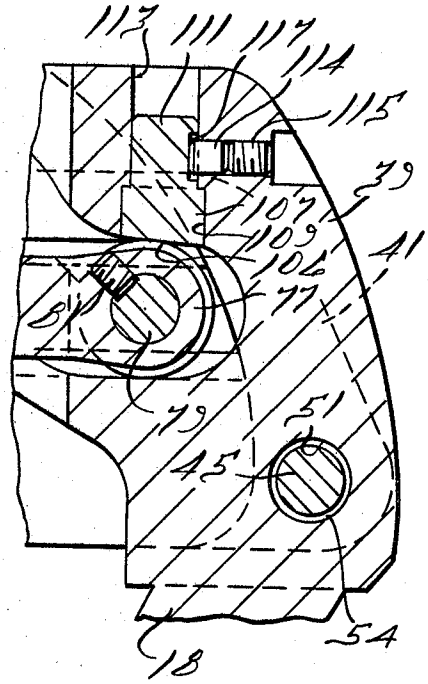


FIG. 6

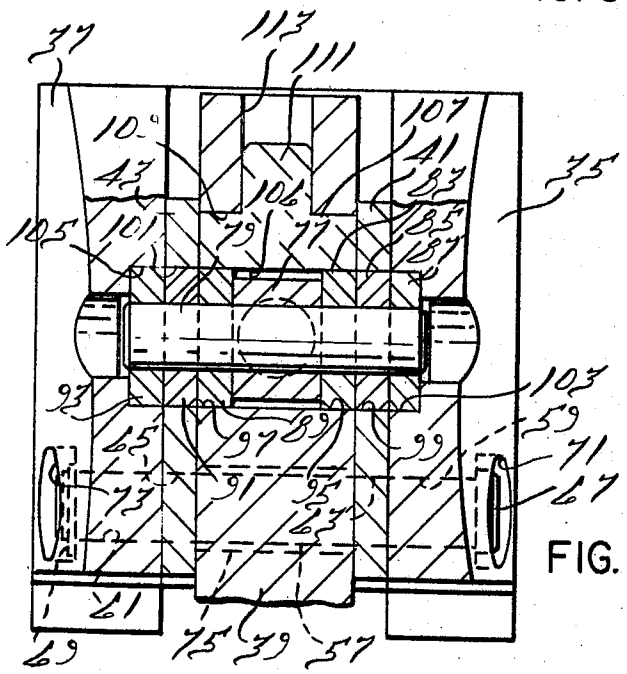


FIG. 7

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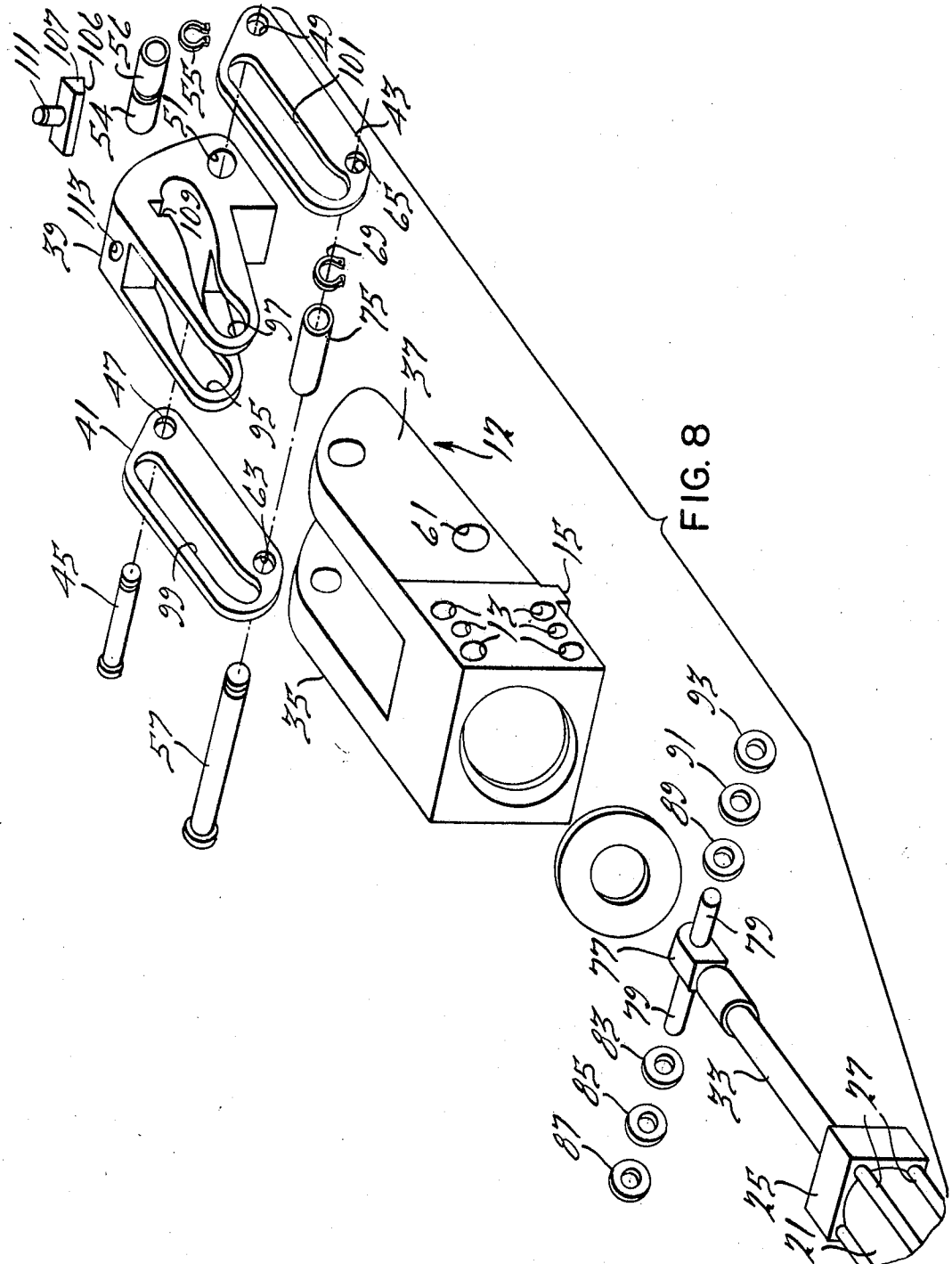


FIG. 8

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U.S. Cl. 269—32 17 Claims

ABSTRACT OF THE DISCLOSURE

The device herein disclosed is a work clamp having a base, support means in the form of side plates pivotally mounted on the base for movement about a fixed axis, a work clamping jaw pivoted on the swinging end of the support means for rocking movement about an axis parallel to the fixed axis, and drive means for pivoting the support means and the jaw sequentially about their respective pivots.

This invention relates generally to work holders, and particularly to force and motion transmission mechanism for work clamps.

In order to function satisfactorily, a work clamp must be capable of withstanding the expected forces thereon and securely hold a workpiece in the installation in which it is to be used. In one popular version, a power operated pivotal jaw cooperates with a fixed base or jaw to releasably hold workpieces during handling thereof or performance of an operation thereon. It will be appreciated that in order to develop a sufficiently strong clamping force in this type of mechanism, it is desirable to employ a relatively long, jaw-carrying lever arm. This also is desirable for the reason that it facilitates complete and rapid withdrawal of the pivotal jaw for easy workpiece insertion and removal from the clamp.

Though this construction possesses the above advantages, it also has certain disadvantages. Particularly, a relatively long, jaw-carrying, pivotal lever arm requires considerable clearance beyond the end of the clamp structure to facilitate its movement. This, in turn, limits the number of such clamps that can be used in a given area and/or makes it difficult or impossible to employ this type of clamp with a work handling or operation performing device positioned close to the end of the clamp structure.

Pivotal jaw clamp constructions are desirable because their construction is relatively simple and inexpensive and yet are capable of developing high clamping forces. Thus, a clamp of this type capable of full jaw withdrawal and which requires a minimum of operational clearance for the movable jaw would be highly desirable.

An important object of the present invention is to provide an improved force and motion transmission mechanism for a pivotally operated clamp jaw wherein the jaw is fully withdrawable for easy workpiece insertion and removal but which requires a minimum of operational clearance.

Further objects of the present invention include the provision of a work clamp of the above character which is relatively inexpensive to manufacture, simple but rugged in construction and reliable and smooth in operation.

Other objects and advantages of the present invention will become more apparent from a consideration of the following detailed description taken in conjunction with the drawings in which:

FIGURE 1 is a side elevational view illustrating a work clamp embodying the present invention and shown with the movable jaw in the clamping position;

FIG. 2 is a top plan view of FIG. 1;

FIG. 3 is a fragmentary view, similar to FIG. 1, but showing the movable jaw in the released position;

FIG. 4 is an enlarged sectional view of FIG. 2 taken along the line 4—4 thereof;

FIG. 5 is an enlarged sectional view of FIG. 2 taken along the line 5—5 thereof;

FIG. 6 is an enlarged sectional view of FIG. 2 taken along the line 6—6 thereof;

FIG. 7 is an enlarged sectional view of FIG. 2 taken along the line 7—7 thereof; and

FIG. 8 is an exploded perspective view of the clamp.

Broadly described, the present invention includes a base, support means pivotally mounted on said base for movement about a first axis, jaw means pivoted on said support means about a second axis parallel to said first axis, drive means for pivoting said support means and said jaw means, said drive means and said support and jaw means having cooperating cam means whereby said drive means sequentially pivots said support means about said first axis and said jaw means about said second axis.

Referring now more specifically to the drawings, a clamp **11** constructed according to the present invention is shown as having a base **12** provided with mounting holes **13** adapted to receive suitable fastening screws (not shown) or other fastening means to secure the clamp **11** to a work handling or operation performing device (not shown) with which the clamp is to be used.

The base **12** is provided with a flange-like projection **15** integral therewith which together with the base **12** forms a workpiece stop or fixed jaw against which the workpiece (not shown) is to be clamped. A movable jaw **17** fixed to or integral with a lever arm **18** is supported for movement relative to the base **12** and is cooperable with the base **12** and projection **15** to clamp the workpiece (not shown) thereagainst.

The clamp jaw **17** is powered by a hydraulic motor **19** which includes a cylinder **21** having front and rear headers **23**, **25** and which is secured to the base **12** by a plurality of lag bolts **27** and nuts **29**. A piston **31** is slidably disposed within the cylinder **21** and has a piston rod **33** secured thereto for movement therewith. The piston rod **33** slidably extends through the front header **25** and an opening in the base **12** and is operatively connected with the clamp jaw **17** so that upon movement of the piston rod **33** in one longitudinal direction, the jaw **17** is moved toward the projection **15** to clamp a workpiece thereagainst. Conversely, when the piston rod **33** is moved in the reverse longitudinal direction, the jaw **17** swings away from the projection **15** and releases the workpiece.

As shown in FIG. 2, the base **12** has a pair of forwardly extending spaced arms **35**, **37** freely receiving a body **39** fixed to or integral with the jaw lever arm **18** therebetween. A pair of side plates **41**, **43** forming support means for the body **39** are positioned one between each side of the body and a respective one of the arms **35**, **37** and the side plates **41**, **43** and the body **39** are pivotally interconnected at their forward ends by a pivot pin **45** extending through openings **47**, **49**, **51** in the side plates **41**, **43** and the body **39**, respectively. The pin **45** has an enlarged head **53** at one end and receives a split retaining ring **55** at its other end to hold it in place. Bushings **54** and **56** shown in FIG. 8 are provided in the pivot opening **51**

of the body 39 to take wear which occurs when the body rocks on the pivot pin 45.

The rear ends of the inside plates 41, 43 are pivotally supported upon the arms 35, 37 by a pivot pin 57 which extends through aligned openings 59, 61 in the arms 35, 37 and openings 63, 65 in the side plates 41, 43, respectively. The pin 57, like the pin 45, has an enlarged head 67 at one end and receives a split retaining ring 69 at the other. If desired, the arms 35, 37 are countersunk at 71, 73 to receive the pivot pin head 67 and the ring 69, respectively. A sleeve 75 surrounds the pin 57 and abuts the side plates 41, 43 to prevent them from tilting relative to each other and binding on the pivot pin 57.

The outer end of the piston rod 33 extends into a slot 76 in the body 39 and is threaded into a block 77 provided with a cross pin 79 secured thereto by a set screw 81 and which extends laterally to either side of the piston rod 33. The cross pin 79 carries six rollers 83, 85, 87, 89, 91, 93, three on either side of the block 77, which rollers cooperate with the body 39, the side plates 41, 43 and the arms 35, 37 to effect desired movement of the jaw 17 toward and away from the projection 15.

The rollers 83, 89 are disposed in elongated, generally S-shaped cam slots 95, 97, respectively, formed in the body 39. Similarly, the rollers 85, 91 are disposed in elongated cam slots 99, 101, formed in the side plates 41, 43, respectively. A pair of longitudinal straight slots 103, 105 is formed in the arms 35, 37 and receives the rollers 87, 93, respectively. Thus, as the piston rod 33 is moved forwardly or toward the right as seen in FIGS. 1 and 2, the rollers 87, 93 riding in the slots 103, 105 guide the forward end of the piston rod and the block 77 so that it moves substantially in a straight line. The rollers 83, 89 and the rollers 85, 91 riding in the cam slots 95, 97 and 99, 101, respectively, cause the body 39 and the side plates 41, 43 to pivot about the pins 45, 57 in a manner to achieve the desired movement of the jaw 17.

Initially, the piston rod 33 is retracted and the jaw 17 is in a released position as illustrated in FIG. 3. As the piston rod 33 begins moving forwardly or toward the right, the rollers 87, 93 ride forwardly in the slots 103, 105. The rollers 83, 89 and 85, 91 bear on the bottom of the cam slots 95, 97 and 99, 101, respectively, and swing the body 39 and the side plates 41, 43 downwardly or in a clockwise direction about the pivot 57. During this initial stage of piston rod movement, the body 39 moves conjointly with the side plates 41, 43 and swings about the pivot 57 causing the lever arm 18 and jaw 17 to swing through the path A shown in FIG. 1.

When the side plates 41, 43 have pivoted to a position where the cam slots 99, 101 are substantially aligned with the slots 103, 105 in the body arms 35, 37, pivotal movement of the side plates 41, 43 stops. Continued forward movement of the piston rod 33 eventually brings the rollers 83, 89 to bear against the top of the cam slots 95, 97 and causes the body 39 to swing in a clockwise direction relative to the side plates 41, 43 about the pivot 45. Alignment between the slots 103, 105 and 99, 101 holds the side plates 41, 43 against movement relative to the base 12. During this movement of the body 39, the lever arm 18 and the jaw 17 swing through path B to the position shown by full lines in FIG. 1 to clamp a workpiece (not shown) against the base 12 and the projection 15.

It will be observed that the arcuate length of path B can be varied by varying the degree of curvature of the S-shaped cam slots 95, 97. Also, the positions of the pivots 45, 57 relative to each other and to the iam slots 95, 97, 99, 101 can be varied according to particular needs or desires.

As the piston rod 33 approaches its forwardmost position, the rollers 83, 89 engage a bottom surface 106 of of a wedge block 107 mounted in a cross slot 109 in the body 39. The wedge block 107 has a shank 111 extending upwardly in an opening 113 in the body 39 and a key 114 backed up by a set screw 115 extends slidably into a keyway 117 in the shank 111 to hold the wedge block 107 in position. Some vertical movement of the wedge block 107 is permitted since the keyway 117 is somewhat longer than the key 114 and the wedge block 107 normally hangs down into the cam slots 95, 97 to be engaged by the rollers 83, 89 as they approach the outer limit of their travel.

As the piston rod 33 moves forwardly, the rollers 83, 89 engage the wedge block bottom surface 106 and push the wedge block 107 upwardly until the key 114 seats against the bottom of the keyway 117. Thereafter, the rollers 83, 89 wedge between the wedge block bottom surface 106 and the lower surfaces of the cam slots 95, 97 so that forward movement of the piston rod 33 and pivotal movement of the jaw 17 about the pivot 45 ceases.

Ideally, forward piston rod movement should stop when the jaw 17 securely clamps the workpiece (not shown) against the base 12 and the projection 15. However, because of workpiece tolerances, this is not always true. The cooperation of the rollers 83, 89 with the wedge block 107 and the cam slots 95, 97, permit the jaw 17 to clamp the workpiece (not shown) tightly against the base 12 and the projection 15, allowing for slight tolerances in the workpiece, and yet provide a forward limit for piston rod travel. In practice, the wedge block surface 106 forms an angle of about 5° with a plane normal to the axis of the shank 111. Should it be desired to adjust the clamping position of the jaw 17, the wedge block 107 can be removed and replaced by another having the desired size and configuration.

As best seen in FIGS. 3–5, the clamping arm 18 traverses a relatively flat downward trajectory during the first portion of its movement toward clamping position as shown at A in FIG. 1 and then swings abruptly inwardly to the fully clamped position as shown at B. This motion of the clamping arm 18 is important because clamps of this type frequently are mounted in exceedingly cramped or confined quarters. The present arrangements permits the clamping arm 18 when unclamped to swing completely away from the work so as to clear the latter for easy insertion and removal and at the same time avoids interference between the arm and a fixture or machine parts frequently located close to the end of the clamp so as to be in the path of the latter if it merely swung in a true arc away from its clamped position.

When the piston rod 33 is fully advanced, the parts occupy the positions shown in FIGS. 1, 2 and 4–7 and the jaw 17 is set in the clamping position. As the piston rod 33 begins to retract to begin the releasing sequence, the rollers 87, 93 move straight back in the slots 103, 105 and the rollers 83, 89 initially are released from the surface 106, wedge block 107 and the lower surfaces of the cam slots 95, 97. Thereafter, the rollers 83, 89 bear downwardly on the body 39 at the cam slots 95, 97 and swing the body 39 in a counterclockwise direction about the pivot 45 as seen in FIG. 1 and cause the lever arm 18 and the jaw 17 to swing counterclockwise through path B. This continues until the body 39 has turned sufficiently to generally align the slots 95, 97 in the body 39 with the slots 99, 101 in the side plates 41, 43. At this point, the jaw 17 will be positioned substantially as shown by dot-dash lines in FIG. 1.

Continued retraction of the piston rod 33 brings no substantial movement of the body 39, the side plates 41, 43 or the jaw 17 until the rollers 85, 91 reach the rear end of the slots 99, 101. At this time, the side plates 41, 43 begin to swing upwardly or in counterclockwise direction about the pivot 57 as seen in FIG. 1. The configuration of the slots 95, 97 and 99, 101 being substantially the same at their rearward ends, the body 39 swings with the side plates 41, 43 so that the lever arm 18 and the jaw 17 now pivots about the pin 57 and the outer edge thereof swings through the arc A shown in FIG. 1.

From the foregoing, it will be apparent that the pivot

axis of the lever arm **18** and jaw **17** shifts during both the clamping and releasing sequences. Thus, during clamping, the jaw mounted lever arm **18** first swings about the pivot **57** through arm A and during the final stage of clamping swings about the pivot **45** through arc B. During releasing, the order is reversed and the jaw lever arm **18** first swings about pivot **45** through arc B and then about pivot **57** through arc A. It will be seen, therefore, that different predetermined patterns of movement are established whereby the support plates **41**, **43** and the clamping arm **18** rock about their respective pivot points **57** and **45** in operative response to a single movement of the piston **31** and the piston rod **33**. FIG. 1 illustrates the path of travel for the jaw **17** and it will be seen there that the arc A requires considerably less clearance beyond the end of the clamp base **12** than would arc B if it were extended and therefore makes the clamp **11** of the present invention useful even in comparatively close quarters. Furthermore, by swinging the jaw **17** about the pivot **45** to effect actual clamping, use is made of the jaw lever arm **18** and the jaw **17** clamps the workpiece (not shown) against the base **12** and projection **15** with a force equal to its maximum capability.

By the foregoing, there has been disclosed an improved clamp calculated to fulfill the inventive objects hereinabove set forth and while a preferred embodiment of the present invention has been illustrated and described in detail above, various additions, substitutions, modifications and omissions may be made thereto without departing from the spirit of the invention as encompassed by the appended claims.

What is claimed is:

1. A clamp comprising a base, support means pivotally mounted on said base for movement about a first axis, jaw means pivoted on said support means about a second axis parallel to said first axis, drive means for pivoting said support means and said jaw means, said drive means and said support and jaw means having cooperating cam means whereby said drive means sequentially pivots said support means about said first axis and said jaw means about said second axis.

2. A clamp as defined in claim **1** wherein said cam means is constructed for movement of said jaw means conjointly with said support means as the latter pivots about said first axis.

3. A clamp as defined in claim **1** wherein said cam means is constructed to hold said support means substantially stationary when said jaw means pivots about said second axis.

4. A clamp as defined in claim **1** wherein said support means includes plate means pivoted on said base, and said jaw means includes a body pivoted on said plate means.

5. A clamp as defined in claim **4** wherein said cam means includes cam slot means formed in said plate means and said body and cam roller means carried by said drive means movable relative to said base and positioned in said cam slot means.

6. A clamp as defined in claim **5** wherein said cam roller means is supported for generally straight line, reciprocating movement, said cam slot means in said plate means having a generally straight, major portion and said cam slot means in said body having a generally S-shaped configuration.

7. A clamp as defined in claim **5** wherein said drive means includes hydraulic motor means having a reciprocating piston rod means, said cam roller means carried by said piston rod means and guidably supported in essentially straight slot means in said base.

8. A clamp as defined in claim **4** wherein said base has a longitudinal slot therein, said plate means including a spaced pair of plates within said base slot, said body positioned between said plates.

9. A clamp as defined in claim **7** wherein said cam roller means includes a cross pin movable with said piston rod, a plurality of rollers disposed on said cross pin and each movably disposed in a respective one of said slot means.

10. A clamp as defined in claim **1** wherein said cam means includes a generally S-shaped cam slot in said jaw means, an elongated slot means in said support means and a cam roller means carried by said drive means and movable in said slot and slot means.

11. A clamp as defined in claim **6** including wedge means in said cam slot in said body and engageable with said cam roller means near one limit of its reciprocating movement.

12. A clamp as defined in claim **1** including means on said base forming a fixed jaw cooperable with said pivoted jaw to hold a workpiece.

13. A clamp having a fixed pivot and including support means mounted on and swingable about said fixed pivot, a clamping arm mounted on and swingable about a movable pivot carried by the swinging end of said support means, reciprocable actuator, and cam means driven by said actuator means and coacting with said support means and said clamping arm to swing said support means and said clamping arm about their respective pivots, whereby reciprocation of said actuator rocks said clamping arm on said movable pivot as it is swung bodily about said fixed pivot by said support means.

14. A clamp comprising reciprocably actuated cam follower means, a base having guides receiving said cam follower means and controlling its movement during reciprocation thereof, support means mounted on a fixed pivot carried by said base and having first cam means coactive with said cam follower means and actuated by the latter during reciprocation thereof to swing said support means about said pivot, and a clamping arm mounted on a movable pivot carried by the swinging end of said support means, said clamping arm having a body portion provided with second cam means coactive with said cam follower means and operable thereby during reciprocation thereof to rock said clamping arm on said movable pivot.

15. A clamp having a fixed pivot and including support means mounted on and swingable about said fixed pivot, a clamping arm mounted on and swingable about a movable pivot carried by the swinging end of said support means, a reciprocable actuator, and means carried by said actuator drivingly coacting with said support and with said clamping arm and operative to translate reciprocatory motion of said actuator in one direction into pivotal rocking movement of said support about said fixed pivot and also into pivotal rocking movement of said clamping arm about said movable pivot both in a direction to move said clamping arm into clamping position, said means being operative also to translate reciprocatory motion of said actuator in the opposite direction into reverse rocking movement of said support means and of said clamping arm about their respective pivots, whereby to move said jaw out of clamping position.

16. A clamp having a fixed pivot and including support means mounted on and swingable about said fixed pivot, a clamping arm mounted on and swingable about a movable pivot carried by the swinging end of said support means, a reciprocable actuator, cam means on said support means and said clamping arm, and cam follower means coactive with said cam means for translating reciprocatory motion of said actuator in one direction into pivotal rocking movement of said support means about said fixed pivot and of said clamping arm about movable pivot, said cam means and said cam follower means being operative by a first increment of reciprocatory motion of said actuator in one direction to rock said support means and to swing said clamping arm about said fixed pivot both in a direction to move said clamping arm toward clamping position, and operative by a second increment of reciprocatory motion of said actuator in said one direction to rock said clamping arm on said swinging pivot, whereby to move said jaw into final clamping position,

said cam means and said cam follower means being further operative by a first increment of reciprocatory motion of said actuator in a reverse direction to rock said clamping arm about said movable pivot in a direction to move said clamping arm out of clamping position and by a second increment of reciprocatory motion of said actuator in a reverse direction to rock said support and to swing said clamping arm about fixed pivot both in a direction to move said jaw to a fully open or unclamped position.

17. A clamp having a fixed pivot and including support means mounted on and swingable about said fixed pivot, a clamping arm mounted on and swingable about a movable pivot carried by the swinging end of said support means, actuator means coactive with said support means and said clamping arm operable by a first increment of movement to rock said support means about said fixed pivot so as to swing said clamping arm in a substantially flat trajectory toward a clamping position and by a second

increment of movement to rock said clamping arm about said movable pivot and to move said clamping arm to a final clamping position.

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U.S. Cl. X.R.

74—107; 269—233, 238