Oct. 24, 1967 W. SMIERCIAK 3,348,836

CLAMPING MEANS HAVING HYDRAULIC POWER ASSISTING DEVICES

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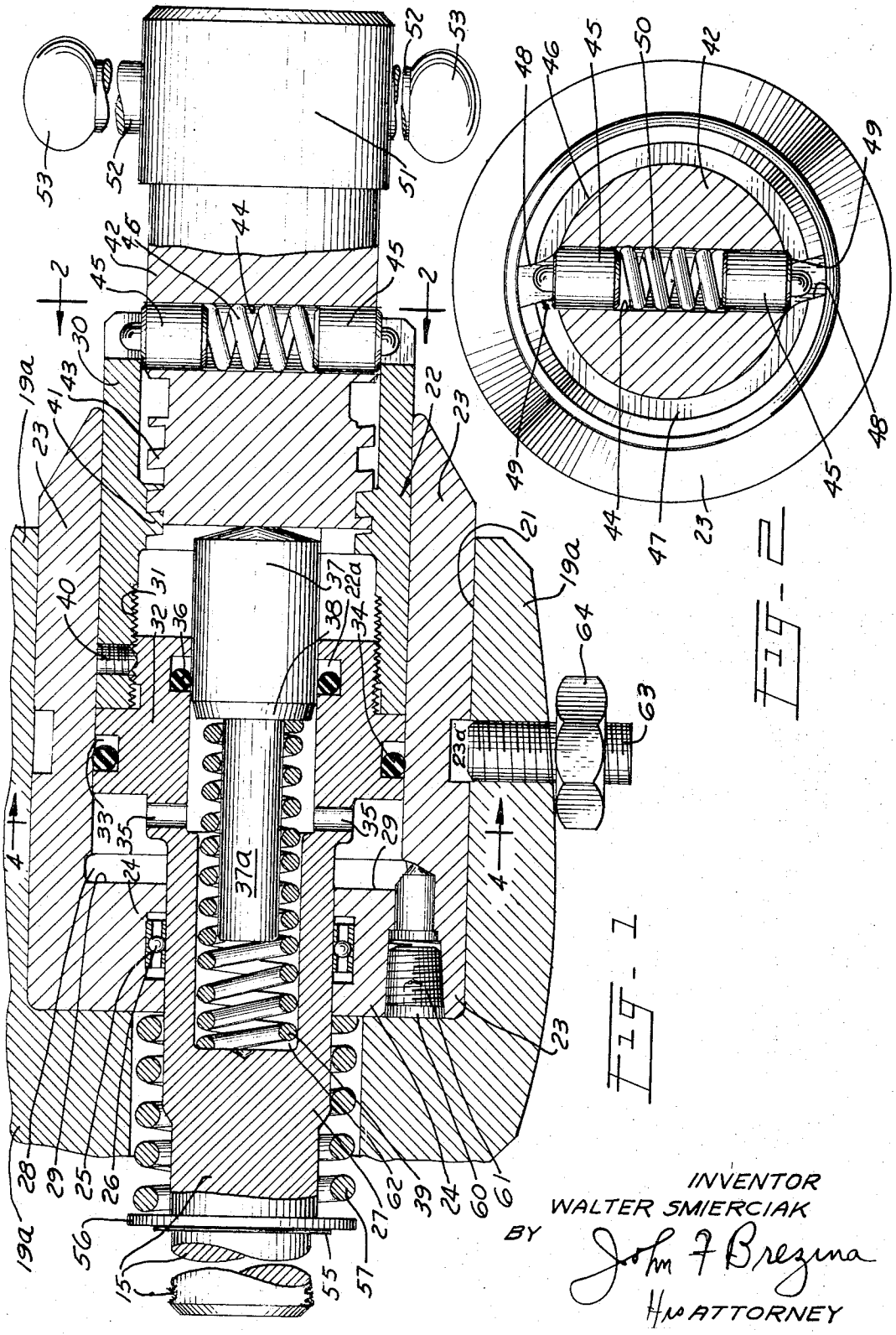

FIG. 1

FIG. 2

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Fig. 3

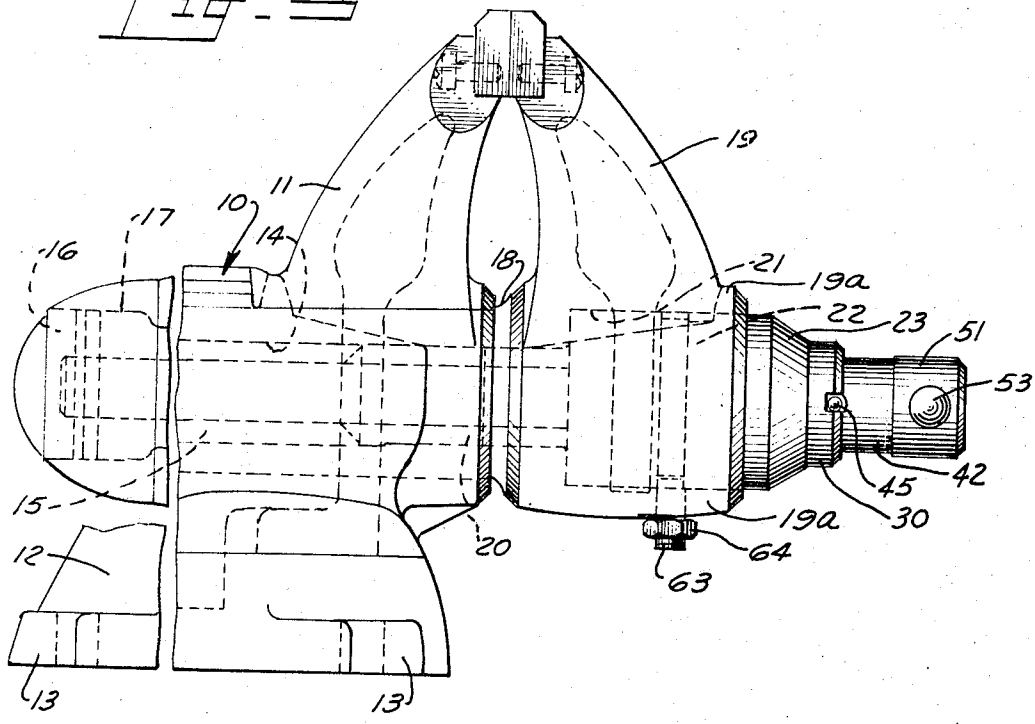
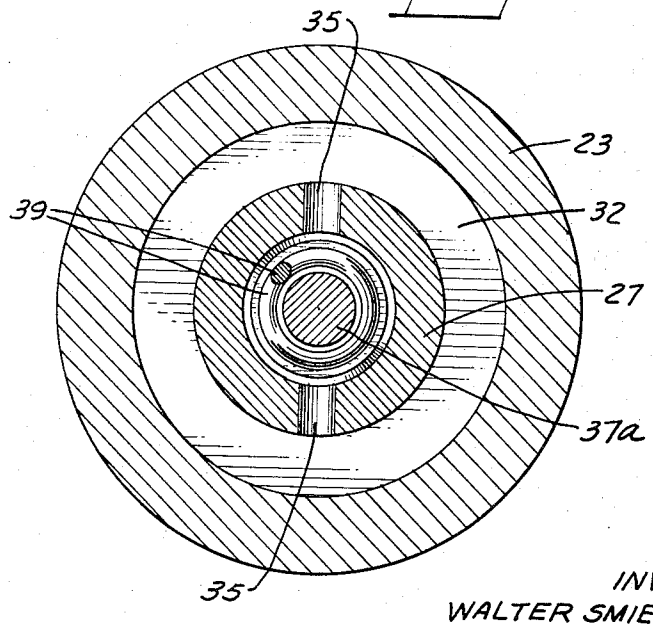


Fig. 4



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CLAMPING MEANS HAVING HYDRAULIC POWER ASSISTING DEVICES

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9 Claims. (Cl. 269—25)

This invention is directed to vises and clamping devices in general which have novel means for boosting and for transmitting with increased force manual power applied to the spindles or screws thereof to move and hold a movable jaw or clamping member against various objects and work pieces, and which greatly reduces the amount of manual force which has to be applied to the spindles or screws of such devices in order to clamp and hold objects with greatly increased force and pressure.

It is known that in the use of vises and clamps of relatively larger sizes which are used for industrial, manufacturing and other heavy duty work, it is necessary to apply a substantially great amount of manual work and pressure to tighten the screws and spindles sufficiently to securely hold various work objects, and this necessitates a substantial amount of manual effort and time. Also in many instances of gripping and holding larger objects and pieces, the degree and extent of screw-actuated clamping and vise action is not sufficient to firmly grip and hold the objects and work pieces to maintain the same in desired grip position during the performance of various work steps. This problem exists because the average workman will normally apply only a given amount of pressure to handles and pins of vises to tighten the screws and jaws thereof, which often is insufficient to meet the existing requirements.

It is an important object of my invention to provide vises and clamping devices which include a movably mounted jaw cooperating with a stationary jaw and with novel mechanism and hydraulic means whereby manual rotation of a shaft and handle will selectively press a piston to press a hydraulic liquid to transmit the applied pressure with greatly increased force to a movable slidable thrust member which is mounted to press a movable jaw toward and into work engaging positions.

Other and further objects of my invention are to provide vises and clamping devices having the features recited in the preceding paragraph and in which the manually applied pressure will be hydraulically transmitted and increased to press against a movable element of substantially increased size, which has means for moving a slidable element or housing against a movable jaw or a clamping element, and which has spring means for retracting said housing or element to initial positions and which has a ratchet mechanism mounted between a manually rotatable shaft or driver and an inner sleeve or cylindrical housing.

A further object of my invention is the provision of a novel means and mechanism for hydraulically transmitting and multiplying the movement of manually applied rotation of a shaft or screw through a piston and through a hydraulic medium to a slidably mounted member or housing, which latter is in turn adapted to effect a working movement of a jaw or clamping unit for clamping, or for holding objects or to perform other work steps.

On the drawings:

FIG. 1 is a cross sectional view on a longitudinal vertical plane of my novel clamping device or vise, and illustrating most of the interior portions thereof and having certain parts broken away. FIG. 2 is a cross sectional view taken on a vertical plane taken on line 2—2 of FIG. 1. FIG. 3 is a side elevational view of a vise with a substantial portion of the body thereof broken away and showing only the tail section and showing the exterior view thereof.

FIG. 4 is a cross sectional view taken on line 4—4 of FIG. 2.

As shown in FIG. 3, reference numeral **10** illustrates a portion of the elongated passaged body which carries an upwardly extending stationary jaw **11** which may be formed integrally therewith. Numeral **12** designates generally a typical base having apertured ears **13**, one of said ears being illustrated, said ears providing means for bolting the vise and base to a suitable support, such as a work bench.

The body portion **10** has a longitudinal passage **14** therethrough, through which a portion of the spindle or screw **15** extends. The screw **15** extends through the rear portion of the body **10** and into and through a passage in a metal end cap or tail cap **17** which is recessed, as indicated. A nut **16** is threaded on the rear threaded end of the spindle **15** and is mounted in the recessed end cap **17**.

Slidably mounted within the enlarged passage **20** of the body **10** is the elongated metal sleeve or shank portion **18** with which the movable jaw **19** is preferably formed integrally. The middle portion of the housing **23** has an enlarged annular retainer groove **23***a* therein, which is clearly shown in FIG. 1. Said groove **23***a* receives the end portion of the screw **63** to prevent a sliding movement of the portion of the vise having a movable jaw.

Referring to FIG. 1, numeral **23** designates an elongated substantially cylindrical metal housing or casing which has inwardly extending integral flange **24** which defines a round passage therein. The metal flange **24** has an annular groove or recess **25** therein in which is mounted a suitable annular hydraulic seal **26**. Said flange **24** is mounted for slidable engagement on the enlarged annular intermediate portion **27** of the piston **32**, said enlarged intermediate portion **27** being formed integral with piston or cylindrical member **32**, as illustrated in FIG. 1. An elongated passage or chamber **62** is formed in said piston, as illustrated. The integral flange **24** of the end portion of said housing **23** has an enlarged inner annular face **29** normally in a vertical plane and surrounding the enlarged portion **27** of the screw and partially defining enlarged chamber **28**.

Within the chamber of said cylindrical housing **23** is slidably mounted an elongated longitudinally passaged slidable cylindrical member which may be composed of either one part or of two connected parts. Said member is preferably of two preformed parts to provide for necessary machining operations. In my preferred form, said slidable member includes a separate cylindrical metal sleeve **30** which is suitably connected at one end thereof by threading engagement of threads **31** with one end portion of a metal passaged cylinder or piston **32** which has an annular groove **33** formed therein in which a suitable O or sealing ring **34** is mounted. Said cylinder or piston **32** has formed in its end portion a plurality of outwardly extending ports **35**, as indicated in FIG. 1, through which

a hydraulic fluid is selectively forced, as hereinafter described.

Said cylinder or piston **32** also has an inwardly opening annular recess or groove **22***a* therein, in which is suitably mounted a sealing O ring **36** which forms a seal with the enlarged slidable portion of a metal cylindrical probe or plunger **37**. Probe or plunger **37** is of cylindrical form and has an elongated reduced integral central portion **37***a* thereon, as indicated in FIG. 1. An expandable metal spring **39** is mounted in the enlarged recess of the enlarged neck portion **27** and about said reduced end **37***a* of said plunger **37**, as shown. A set screw **40** is threadingly secured in a threaded passage of the sleeve **30** to lock the latter in secured position connected to the cylinder **32**. **38** is a beveled edge of plunger **37**.

Formed on the inner portion of the metal sleeve **30** are a plurality of right hand relatively thick screw threads **41**, as illustrated. Numeral **42** designates a metal stub shaft or driver which is rotatably mounted and which has on its inner portion right hand screw threads **43** which enter and engage with the threads **41** of sleeve **30**. The inner end of the driver **42** normally engages, when actuated, and pushes the end portion of plunger or probe **37**, as shown.

The intermediate portion of the shaft or driver **42** has formed therein a diametrically extending passage **44**, as shown in FIGS. 1 and 2, and in said passage are slidably mounted two metal plugs or pawls **45** with a metal expansion spring **50** mounted therebetween to normally press said plugs **45** outwardly. Each of said plugs **45** have an externally projecting rounded stud thereon which engages a ratchet mechanism as hereinafter described.

The outer end portion of the cylindrical member or sleeve **30** has a pair of preferably integral arcuate beveled flanges **46** and **47** formed thereon which are on opposite sides of the passage in the outer end portion of the sleeve **30**, as indicated in FIG. 2. One end portion of each of said flanges have bevelled portions **48**, as shown in FIG. 2 which, when the driver is rotated in clockwise direction, will be engaged by the projected studs of the plugs **45** as the plugs or pawls **45** first engage the beveled shoulders **48**, the said pawls **45** will press the beveled shoulders to transmit rotation to the sleeve **31**, and such rotation will continue until the work piece is clamped between the jaws. When the work piece produces a predetermined resistance of the rounded ends of the pawls **45** will slide inward over said beveled faces to thereby retract said pawls against the action of the spring **50**. Thereupon, the continued forward manual rotation of the driver **42** will cause its inner threads **43** to thread into threads **41** of the sleeve to advance the driver **42** and its thread-bearing portion, during which time the ends of the pawls will slide within the inner face of the sleeve **30**. During such advance of the driver, the plunger **37** is moved inward as described. The opposite ends of each of said arcuate flanges **46** and **47** have their end faces formed with relatively sharp angles or corners **49**, as shown in FIG. 2, so that when said driver **42** is manually rotated in counter-clockwise direction (see FIG. 2) the studs of plugs **45** will first rotate within the sleeve **30** until said pawls have reached the slots adjacent shoulder **49** whereupon said pawls will be moved outward by said spring **50** to original position. When the driver is rotated in counter clockwise retracting direction, the pawls **45** will engage the angular shoulders **49** to transmit such reverse rotation to the sleeve **30** and to the elongated cylindrical member of which it is a part and to said screw and to said casing.

The stub shaft or driver **42** has a diametrically passaged head **51**, in the passage of which is suitably mounted a slidable handle or pin **52**, the opposite ends of said pin **52** preferably having enlarged heads **52** formed thereon, as illustrated in FIG. 1.

Referring to the left hand portion of FIG. 1, the screw or spindle **15** has a diametric passage therein in which is

mounted a metal pin **55** and a metal retainer ring or collar **56**.

A metal expansion spring **57** is mounted about the portion **27** prior to the mounting and securance of collar **56** and pin **55**. One end of said spring bears against the end face of the flange **24** of the housing **23** to normally push said housing **23** so as to maintain the hydraulic fluid under some pressure to prevent formation of air pockets therein and to prevent any undesirable movement of cylinder **32** and sleeve **30**.

The end portion of the housing **23** has a passage **60** formed therein extending from its end face to connect with the interior chamber within said housing. A suitable plug **61** is removably and threadingly mounted in said passage, said passage providing a means for introducing a hydraulic liquid into the chamber within said housing **23** and into the chamber surrounding the reduced portion **37***a* of the probe or plunger **37**, such liquid entering the said chamber through the ports **35**.

As illustrated in FIG. 3, the lower portion of the hub **19***a* of the movable jaw **19** has a threaded passage formed therein. A metal set screw **63** is threaded in said passage and a lock nut **64** is threaded on the outer part of said nipple as illustrated to secure said nipple in permanent position. Said screw **63** provides a convenient means of connecting the housing **23** to cylindrical and recessed hub portion **19***a* of the movable jaw **19**, so that during retraction and rotative movement both said jaw **19** and said thrust casing will be moved together longitudinally. It is to be understood that thrust housing **23** can rotate as described as the end of screw **63** permits rotation of the casing even though said screw constantly engages said groove **22***a*.

Upon clockwise rotation of the driver **42**, due to the engagement of threads **43** and threads **41**, said driver is moved inward to cause its inner end to push plunger or probe **37** inward against the hydraulic fluid. This inward movement forces portions of the hydraulic fluid, which has been put into the chamber **62** and into chamber **28** to be forced through radially extending ports **35** into chamber **28** to press against the enlarged face **29**, whose area is much larger than the inner area of the plunger **37**. Thereby the force applied against the larger face **29** is multiplied and greater than the force against the inner face of plunger **37** in proportion to the ratio of area **29** is to the area of the pressing face of plunger **37**.

Such increased force presses housing **23** inward along with the movable jaw, and against work pieces and simultaneously compresses spring **39**. During the period of such increased pressure against the movable jaw, the clamped work piece will be clamped and held with greatly increased pressure over that which could be attained by use of a threaded screw. The forward area of plunger **37** which contacts the hydraulic liquid has a specific area, and the inner face **29** of casing **23** is of an area much greater than the area of said plunger. Accordingly, the increased pressure exerted on face **29** is increased or multiplied in a ratio proportionate to the greater area of the face **29** which is pushed by the liquid. For example, where the area of the plunger is 2 square inches and the area of face **29** is 4 square inches, the pressure exerted on the movable jaw is doubled. Where the ratio of face **29** is 4 to 1, the pressure attained against the clamped work is approximately 6,000 lbs., or 3,000 p.s.i.

As the driver **42** comes to a dead stop, due to the contact of the inner end of the driver with the inner end face (at the right of FIG. 1) of cylinder **32**, the pressure of 3,000 lbs. p.s.i. is attained on the work piece.

When the reduced end **37***a* of plunger or piston **37** strikes the end of the recess or passage **62** and when the end face of the driver **42** contacts the inner face of piston **32**, the forced movement of hydraulic fluid ceases and any continued manual rotation of the driver will cause the screw **15** to be rotated, to cause said screw (due to its threading engagement with an internally threaded anchor-

ing sleeve or member within the vise body) to push the movable jaw into work-gripping and holding position. Such continued manually actuated movement of the driver to rotate the screw **15** will not normally occur unless the hydraulic fluid is exhausted.

When work pieces in locked position are to be released from a vise or clamp, a user will rotate the driver **42** counter-clockwise to retract it, until the inwardly depressed plugs or pawls **45** reach the positions of the slots between the ends of the flanges **46** and **47**, whereupon said plugs or pawls are pushed outward by spring **50** so that the studs on pawls or plugs **45** will engage the shoulders **49** of flanges **46** and **47**. Upon such engagement the said reverse rotative manual movement will rotate casing **23** and spindle or screw **15** and sleeve **30** in counter-clockwise direction to rotate the screw **15** to retract the driver **42** to original position. At this point the threads **43** have been backed up to original position.

My novel vises and clamping means having power assisting means and devices described which have the respective cooperating structural parts, provide novel constructions and provide novel means for not only transmitting, but also increasing the manually applied power to press movable jaws and clamping units into tight engagement with various work pieces. The advantages attained thereby not only substantially reduce the manual work necessary, but also result in the work pieces and articles being subjected to greatly increased gripping and holding action.

While the foregoing specification sets forth the invention in specific terms, it is to be understood that numerous changes in the shape, size and materials may be resorted to without departing from the spirit and scope of the invention as claimed hereinafter, and it is contemplated that various changes may be made in the embodiment of the invention herein specifically described without departing from or sacrificing any of the advantages of the invention or any features thereof, and nothing herein shall be construed as limitations upon the invention, its concept or structural embodiment as to the whole or any part thereof except as defined in the appended claims.

I claim:

1. In combination with a manually operable clamping device having a body and a movable jaw and a rotatably mounted spindle;

means for increasing the transmitted pressure to a movable jaw comprising an inner cylindrical passaged thrust casing;

an inner cylindrical piston slidably mounted within said thrust casing and having ports therein;

an inner sleeve on said piston;

a plunger slidably mounted in said inner piston;

means for introducing hydraulic liquid in said cylindrical casing and between it and a portion of said plunger;

spring means for retracting said plunger to starting position;

a driving member threadingly and rotatably mounted in said inner sleeve;

and a handle on the outer portion of said driving member;

the manual rotation of said driving member beyond a pre-determined pressure point being adapted to press said plunger inwardly to press hydraulic fluid into an enlarged chamber within said casing to thereby substantially increase the pressure against an enlarged inner face of said thrust casing, said thrust casing being adapted to press said movable jaw of said clamping device to closing position;

and a spring mounted about an outer portion of said spindle and adapted to maintain under pressure the hydraulic fluid between said piston and the inner face of said casing.

2. A device as recited in claim **1**, and having a retractable and spring pressed means between said driving member and said cylindrical sleeve adapted to transmit rotative movement to said cylindrical sleeve to said piston and screw and to thereby permit retraction of said piston and said screw.

3. A device as recited in claim **1**, wherein said spindle has a longitudinal recess opening on its end portion and in which said spring means is mounted;

and having sealing rings mounted between said inner piston and said thrust housing and between said plunger and said piston.

4. In a vise,

a body having a stationary jaw, a recessed mobile jaw and a spindle connected to said movable jaw;

a slidable movable thrust casing extending into the recess of said movable jaw;

a cylindrical piston member slidably mounted in said thrust casing and having a sleeve thereon, said piston member having a fluid chamber;

a plunger movable in said cyindrical piston member;

said thrust member having an inner pressure face of greater area than said plunger;

said cylindrical piston member having passages therein and a chamber for hydraulic fluid;

a driver rotatably and threadingly mounted in said sleeve portion of said cylindrical piston member;

spring pressed pawls mounted on said driver adapted to releasably connect said driver and said sleeve;

the inward movement of said driver being adapted to move said spindle forwardly and to move said plunger inwardly to transmit increased power through a hydraulic liquid to said thrust casing to thereby move said movable jaw with application of less manual force to said driver;

a spring for returning said plunger to retracted position;

and a second spring mounted on said spindle and normally pressing against a portion of said thrust casing to maintain the hydraulic in said fluid chamber under pressure.

5. A device as recited in claim **4** and having external threads on said driving member and cooperating inner threads on said inner cylinder whereby rotation in one direction of said driving member will push said plunger inwardly.

6. In a vise,

a body having a stationary jaw, a movable jaw and a spindle connecting said jaw;

a movable thrust casing;

an inner sleeve slidable in said thrust member;

a rotatable driver threadingly mounted in said sleeve;

a cylindrical member slidably mounted in said thrust casing;

a piston movable in said cylindrical member;

said thrust casing having an inner pressure face of greater area than said piston;

said cylindrical member having passages therein and a chamber for hydraulic fluid;

the inward movement of said driver being adapted to move said piston inwardly to transmit increased power through a hydraulic liquid to said thrust member to thereby move said movable jaw with application of less force to said driver;

a spring for returning said piston to retracted position;

and a second spring adjacent said thrust casing for pressing said thrust casing against said hydraulic fluid.

7. A vise as recited in claim **6** and having a releasable mechanism having spring pressed pawls between said driver and said sleeve whereby clockwise rotation of said driver will move said piston inwardly to cause fluid actuated forward movement of said thrust casing and counter-clockwise rotation will retract said driver to permit said first mentioned spring to retract said piston and permit said thrust casing member to retracted position.

8. A vise as recited in claim 7 and wherein said driver has threads on its inner portion and said sleeve has cooperating inner threads whereby rotation in one direction of said driver will push said piston inwardly to transmit increased power to move said thrust member.

9. A device substantially as recited in claim 4, and having threads on a portion of said driver and cooperating threads on a portion of said sleeve whereby rotation of said driver will move the said spindle longitudinally; and releasably spring pressed means between said driver and said sleeve adapted to retract to inoperative position when said spindle and movable jaw have been advanced forwardly to impinging engagement of a work piece.

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RICHARD H. EANES, JR., *Primary Examiner.*