

Dec. 27, 1949

C. B. VICKERS
VISE OR CLAMP SEQUENTIALLY ACTUATED
BY SCREW AND HYDRAULIC RAM

2,492,338

Filed June 5, 1946

3 Sheets-Sheet 1

Fig. 1.

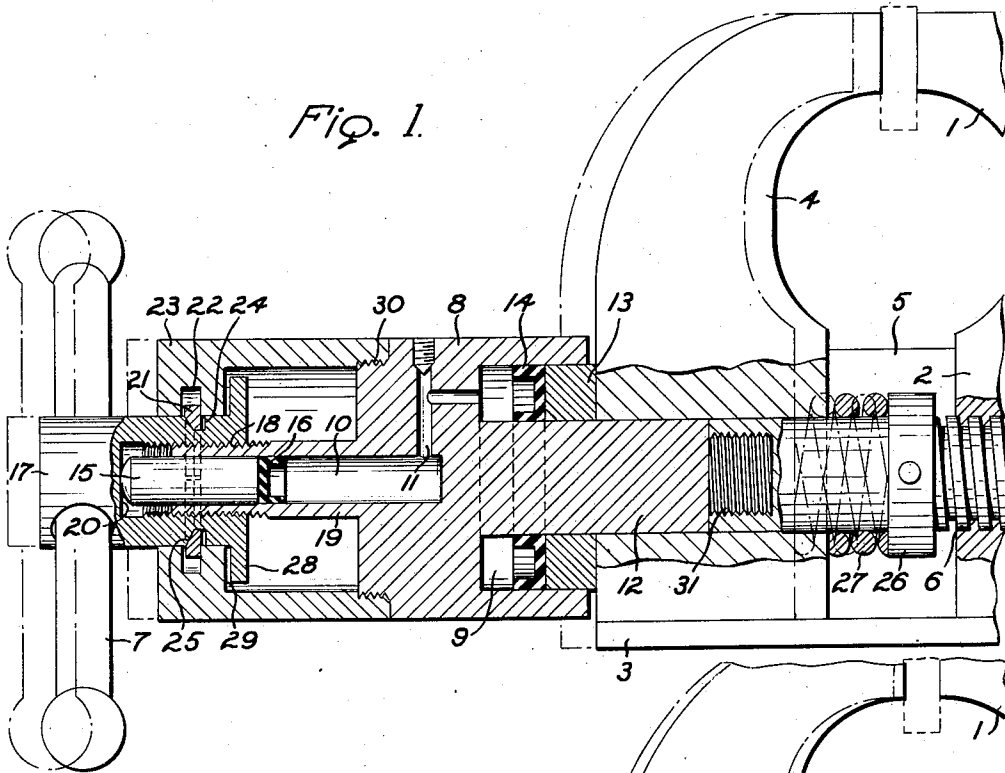
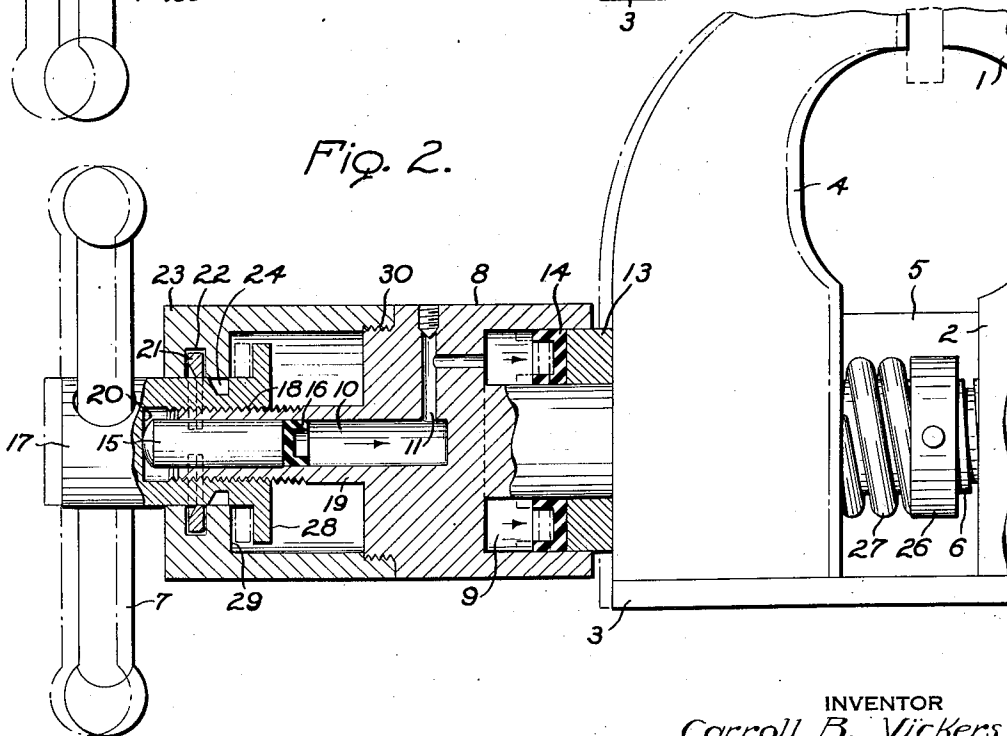


Fig. 2.



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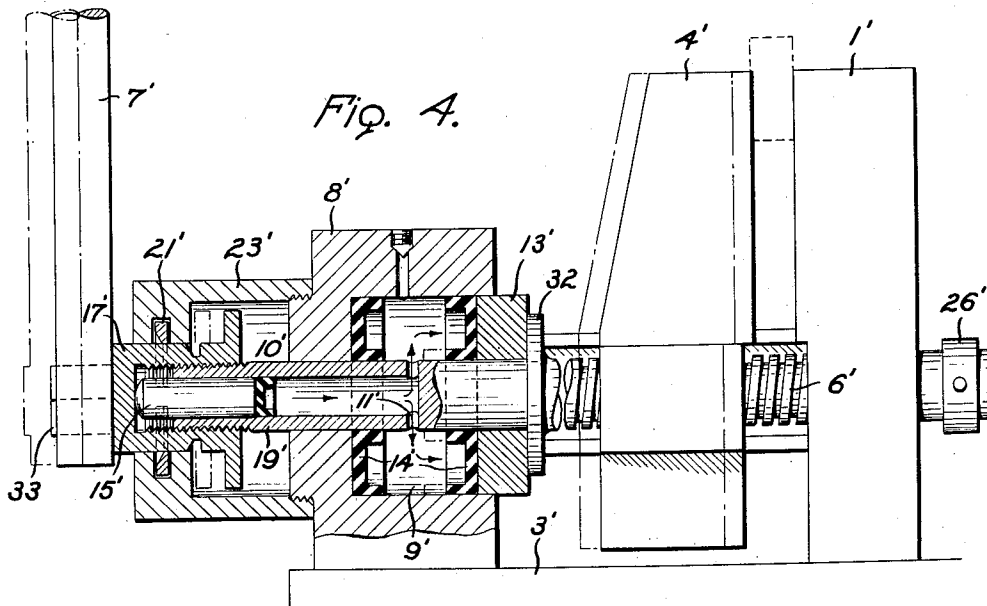
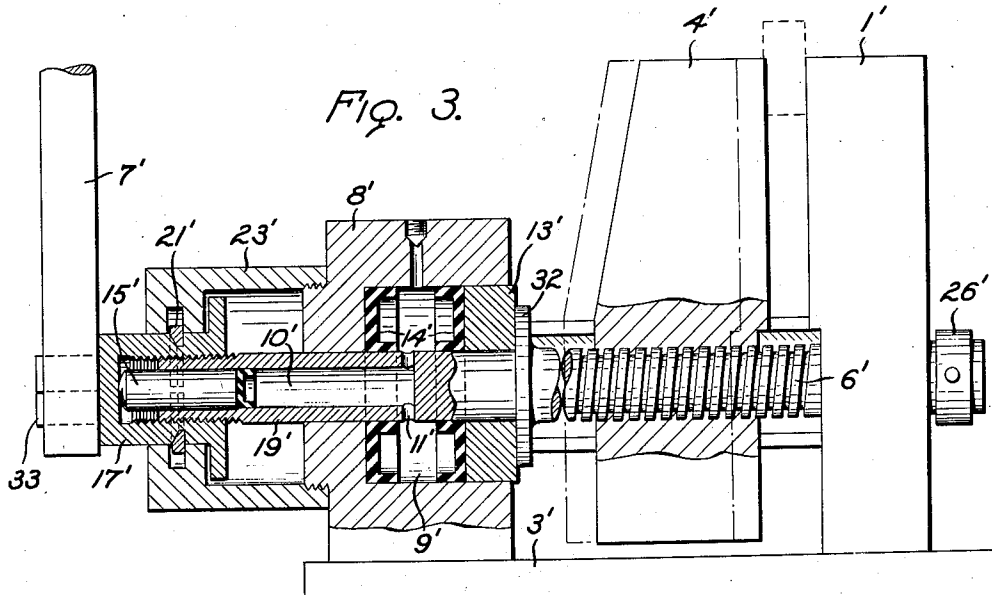
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3 Sheets-Sheet 3

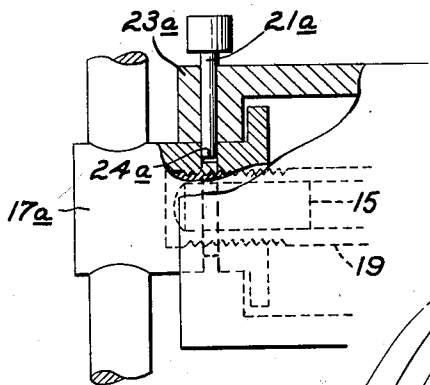


Fig. 5.

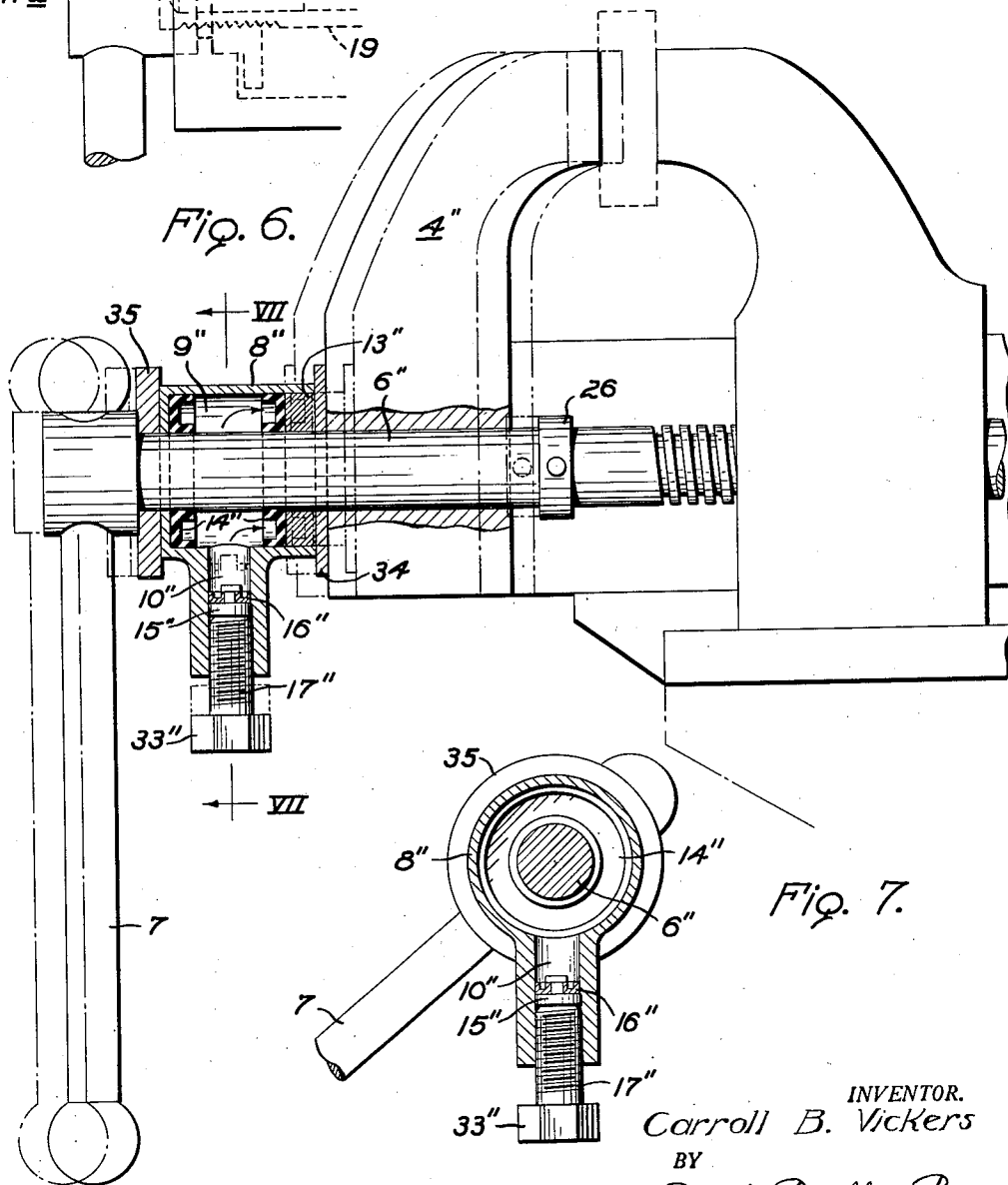


Fig. 7.

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VISE OR CLAMP SEQUENTIALLY ACTUATED
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12 Claims. (Cl. 81—17.2)

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This invention relates to a clamp or vise and particularly to the type employed in machine shops, the same utilizing a screw shaft for bringing the relatively movable jaws of the vise into clamping embrace with the workpiece. Sometimes difficulty is experienced in firmly gripping the workpiece so as to hold the same against slipping when being worked.

The object of the present invention is to provide a bench or workshop vise which will have an accelerated initial setting of the jaws followed by a relatively firmer clamping upon the workpiece but with less manual effort.

The invention further has for its aim to provide a vise or clamp having a quick acting preliminary adjustment with a relatively slower adjustment of greater mechanical advantage being automatically brought into play to produce a gripping pressure substantially greater than that afforded by the preliminary adjustment.

Further, the invention has for its object to provide a vise or clamp in which the usual screw thread adjustment of the movable jaw is automatically supplemented by a hydraulic or fluid adjustment so as to provide a grip of extreme force upon the workpiece.

The foregoing and other objects will manifest themselves as the description progresses, reference being had to the accompanying drawings, wherein:

Fig. 1 is a fragmentary view with parts in section, depicting the improved clamp or vise in its mechanically adjusted position;

Fig. 2 is a similar view illustrating the vise in its fluid clamped position;

Figs. 3 and 4 are respectively similar views showing the present invention embodied in a shaper and milling machine vise;

Fig. 5 is a fragmentary view showing a still further embodiment of the present inventive thought;

Fig. 6 is a view similar to Fig. 1 of a further modification; and

Fig. 7 is a transverse sectional view about on line 7—7 of Fig. 6.

Referring more particularly to the drawing, the numeral 1 designates the fixed jaw of a bench vise having a body 2 and a base 3. The movable jaw 4 of the vise has the usual bar support 5 sliding through the body, while the screw shaft 6 has threaded engagement in the body so that manipulation of the handle 7 will advance the movable jaw 4 toward and from the fixed jaw in the usual manner.

According to the present invention, means hav-

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ing a greater mechanical advantage are provided to supplement the screw imposed gripping force with one of greater intensity. According to the embodiment illustrated in Fig. 1, this is accomplished automatically by interposing a hydraulic unit between the handle 7 and the screw 6, such unit being responsive to a predetermined screw imposed force incidental to the preliminary setting of the movable jaw. The hydraulic unit comprises a body 8 having a work chamber 9 and a power chamber 10 intercommunicating through passage 11. The chamber 9 is formed about an extension 12 of the screw shaft and slidably receives a ring-like piston 13 packed by a ring shaped channeled packing 14 of rubber or the like. A plunger 15 is slidable in the power chamber 10 and is fluid sealed by a cupped packing member 16 of rubber or like material. The plunger 15 projects from the chamber 10 axially of the screw shaft and is designed to be acted upon by a cap nut-like member 17 in which the handle 7 is arranged. The cap nut 17 has threaded engagement, as indicated at 18, with cylindrical extension 19 in which the power chamber 10 is formed so that when the cap nut is turned relative to the body 8 it will advance thereon and slide the plunger 15 inwardly to exert pressure on a body of liquid confined between the plunger 15 and the piston 13. This will serve to project the ring-like piston outwardly from its chamber 9 so as to slide the movable jaw 4 with the force transmitted by the confined body of liquid, and since the cross sectional area of the plunger 15 is relatively smaller than that of the piston 13, such transmitted force will be augmented accordingly to cause the movable jaw 4 to grip the workpiece under an exceedingly great clamping pressure.

While the movable jaw will be urged hydraulically under this extreme force, the movement of the jaw will be relatively small and, therefore, such hydraulic action will not be called upon until the mechanical action of the screw 6 has taken up all slack by placing the movable jaw against the workpiece under a predetermined resistance. To this end the cap nut 17 is compelled to rotate with the body 8 and the screw 6 as a unit until such predetermined and abnormal resistance is encountered, and this is accomplished herein by locking the nut and screw together, as by providing a split spring ring 21 within a groove 22 in a surrounding part 23 of the body 8. The split ring 21 is designed to normally contract itself within an opposing groove 24 formed on the periphery of the cap nut 17, with the outer

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margin of the ring extending into the groove 22 to resist advancing movement of the nut and thereby produce a binding action in the threaded engagement 18. This binding or jamming action will, therefore, cause the parts 6, 8 and 17 to rotate as a unit for initially bringing the movable jaw 4 against the workpiece, as shown in full lines in Fig. 1, the broken lines therein representing the starting position of such screw unit.

Upon the continued turning of the screw unit 6, 8, 17, the abnormal resistance offered by the workpiece to further movement of the movable jaw will cause the cap nut to wedge or expand the lock ring 21 outwardly from the groove 24 and thereby release the cap nut for advancing along its threaded engagement 18 on the extension 19, as shown in Fig. 2 wherein the broken lines will indicate somewhat exaggerated the hydraulic movement imparted to the movable body. The lock is therefore released in response to a predetermined torque in the shaft or reacting thrust thereon as imposed by the movable jaw. The release of the cap nut may be facilitated by providing a bevel 25 between the outer face of the ring and the contacting side face of the groove 24. The advancing movement of the cap nut will be independent of and relative to the screw shaft 6 and the body 8, which two latter parts will remain stationary. Such advancing movement of the cap nut will force the plunger 15 into the chamber 10 and express the liquid through the communicating passage 11 into the work chamber 9 for projecting the piston 13 to place the final squeeze on the movable jaw into firmer embrace with the workpiece.

When it is desired to unclamp the workpiece, the cap nut will be rotated in the reverse direction by itself until its groove 24 again registers with the split locking ring 21 whereupon the latter will re-enter the relatively shallow groove 24 to interlock the cap nut and the body 8 against relative axial movement. This initial movement of the cap nut will release the hydraulic pressure on the movable jaw until the cap nut and body are again interlocked by the ring 21 whereupon the threaded engagement 18 between the cap nut and the chambered extension 19 will jam to bind the cap nut to the body 8 for rotating as a unit with the screw shaft 6 for mechanically camming or retracting the movable jaw from the workpiece at a relatively faster movement. During this retractive movement of the screw unit, the collar 26 which is fixed on the screw shaft 6, will cushion itself against the movable jaw through the medium of an interposed coil spring 27, such spring serving normally to hold the movable jaw against the piston 13 and indirectly urge the plunger 15 against the inner bottom wall 29 of the cap nut 17. In order to insure the mechanical retraction of the movable jaw, the cap nut 17 is provided with the peripheral flange 28 within the hollow body part 23 for engaging the wall 29 thereof. This will frustrate any tendency of the lock ring 21 to spring out from the groove 24 after the clamping jaw has been hydraulically released.

A vise constructed in accordance with the embodiment of Figs. 1 and 2 just described will mechanically effect a preliminary gripping of the workpiece to be followed by a much firmer gripping through the mechanical advantage gained by the use of the hydraulic unit. The change-over is effected automatically as the operator continues to turn the handle 7. Likewise the vise is automatic in its retractive movement. The construction is simple in design and effective in use.

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The hollow nut receiving part 23 of the body may be detachably threaded onto the main body portion, as indicated at 30, to facilitate assembly of the cap nut. Likewise, the shaft extension 12 may be detachably connected to the main shaft 6 by the screw threads 31.

The hydraulic feature may be incorporated in other types of vises, such as the vise of the shaper and milling machine shown in Figs. 3 and 4 wherein the movable jaw 4' has threaded engagement with the screw shaft 6' while the latter has journal sliding support in the fixed jaw 1', a collar 26' serving to prevent axial displacement of the shaft from the jaw 1'. While a spring may be interposed between the two jaws to function in the same manner as the spring 27, the same has been omitted from the illustration in these two figures. The ring-like piston 13' bears against a shoulder 32 on the shaft instead of bearing directly against the movable jaw since the latter is being advanced by the camming action of the threads on the screw shaft. The power chamber 10' communicates through ports 11' with the work chamber 9' between a pair of opposed packings 14' of annular channeled design. In lieu of the usual cross handle, the cap nut 17' is provided with a square or non-circular shank 33 for receiving a removable tool or socket wrench 7'.

The operation of this shaper and milling machine vise is similar to that previously set forth, the lock ring 21 serving to secure the cap nut to the chambered extension 19'. The extension is herein formed unitary with the screw shaft but independently of the body 8', the screw unit 6', 19' having journal support in the body 8' which latter in turn is fixed to the base 3'. Consequently the hollowed body part 23' is likewise fixed at all times while the cap nut has journaled support therein. As the cap nut is turned by the tool 7', when in the position shown in Fig. 3, it will rotate with the chambered extension and the screw shaft as a unit to bring the movable jaw 4' mechanically against the workpiece. Upon initially encountering abnormal resistance to the advancing jaw, the lock ring will then release the cap nut to turn upon and relative to the chambered extension for pushing the plunger 15' into the chamber 10' whereupon the fluid will be forced out through the ports 11' to project the piston 13' and, through the shoulder 32, advance the screw shaft together with the jaw 4' as a unit. A reverse turning of the cap nut 17' will initially release the hydraulic pressure and thereafter mechanically retract the movable jaw.

In both forms of the invention already described the cap nut is normally locked against advancing on the chambered extension 19 or 19' but automatically unlocked for such advancing movement when the predetermined mechanically transmitted or shaft imposed clamping force has been reached. Upon such unlocking the screw is arrested and the supplementing hydraulic pressure is applied to the movable jaw or holding member for more firmly securing the workpiece. This hydraulic adjustment is permitted by reason of a limited play or lost motion in the connection between either the movable jaw and the screw shaft, as in Figs. 1 and 2, or the screw shaft and the fixed jaw, as in Figs. 3 and 4.

In the modification of Fig. 5 the lock is manually actuated. This lock may be of simple form and is herein depicted as comprising a pin 21a which is slidable in an opening in the hollow body extension 23a for being projected into a peripheral groove 24a in the cap nut 17a. After the

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screw unit has preliminarily placed the movable jaw against the workpiece, the lock pin may be retracted to free the cap nut for advancing along the chambered extension 19 to depress the power plunger 15 and hydraulically applying the final clamping pressure.

If desired, the hydraulic pressure may be applied by means other than the vise handle, as shown in Figs. 6 and 7, wherein the hydraulic unit 8'' is interposed on the usual screw shaft 6'' between the movable jaw 4'' and the thrust collar 35 adjacent the handle 7. The hydraulic unit has a work chamber 9'' slidably receiving the annular work piston 13''. The annular channeled packings 14'' seal the chamber against leakage, and opening between these packing rings is the power chamber 10'' in which the plunger 15'' operates radially of the screw shaft, the latter being of proper length to receive the hydraulic unit thereon. The plunger is sealed by the packing ring 16'' and is actuated by a backing screw 17''. By applying a tool to the head 33'' the plunger will be moved inwardly to hydraulically project the work piston 13'' for securing the final clamping pressure after the movable jaw has been initially placed against the workpiece through the manipulation of the handle 7. If desired, a pressure distributing plate or collar 34 may be interposed between the piston 13'' and the movable jaw, a spring similar to the spring 27 being interposed between the movable jaw and the shaft collar 26 if desired.

In all forms of the invention it will be observed that the vise is preliminarily set by turning the screw shaft to advance the movable jaw thereon, and thereafter the hydraulic pressure is applied to firmly secure the workpiece in the vise with little manual effort. The clamp or vise is simple in construction and unitary in design. The hydraulic unit, combined with the mechanical movement, is applicable to other uses where it is desired to exert an extreme or heavy pressure upon an object beyond that which might be manually accomplished through a purely mechanical movement. For example, in letter presses the hydraulic unit could be readily installed. In fact, any pressure exerting device could utilize a mechanical movement for initially applying a preliminary holding pressure on the movable jaw and then supplement such holding pressure by the hydraulic unit as taught herein.

The foregoing description has been given in detail for clearness of understanding and without thought of limitation since the inventive principles involved are capable of assuming other physical embodiments without departing from the scope of the appended claims.

What is claimed is:

1. A pressure exerting device comprising a movable holding member, a screw shaft having a lost motion connection with said holding member for advancing the same to a preliminary work holding position, a hydraulic unit having a piston backing the holding member and operable to place an urge upon the latter to supplement the holding forces applied by said screw shaft, means releasably connected to the shaft for turning the same to so preliminarily set the holding member, normally inoperative means operable by said turning means for applying hydraulic pressure to the piston, and means responsive to a predetermined force applied to the holding member by said screw shaft for disrupting the operative relationship between said turning means and said screw shaft and establishing operative relation-

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ship between said turning means and said normally inoperative means for securing such supplementing hydraulic pressure.

2. A clamp of the character described, comprising cooperating jaws one being movable toward the other, a screw shaft connecting the two jaws together for limited lost motion and operating to advance and retract said movable jaw toward and from the companion jaw, means independent of the screw shaft for turning the latter to secure a preliminary setting of the movable jaw against an interposed workpiece, means releasably coupling the turning means to the screw shaft for so turning it and responsive to a predetermined clamping force applied by said screw shaft to said movable jaw for releasing said turning means to move independently of the shaft, and means operable by said turning means during such independent movement for supplementing the screw imposed pressure upon the jaw to the extent of the lost motion.

3. A clamp of the character described, comprising cooperating jaws one being movable toward the other, a screw shaft connecting the two jaws together for limited lost motion and operating to advance and retract said movable jaw toward and from the companion jaw, means independent of the screw shaft for turning the latter to secure a preliminary setting of the movable jaw against an interposed workpiece, a hydraulic unit interposed between said turning means and the movable jaw and having a chamber with a piston therein, said unit operable to move said movable jaw with respect to the companion jaw by reason of such lost motion, and means releasably connecting the turning means to the screw shaft for turning as a unit, said releasable means responding to a predetermined clamping force imposed on the movable jaw by the turning movement of the screw shaft to release the turning means for independent movement, said turning means coacting with the hydraulic unit during such independent movement for so moving the movable jaw thereby.

4. A clamp of the character described, comprising cooperating jaws one being movable toward the other, a screw shaft connecting the two jaws together for limited lost motion and operating to advance and retract said movable jaw toward and from the companion jaw, means detachably connected to the screw shaft for turning the same to secure a preliminary setting of the movable jaw against an interposed workpiece, a hydraulic unit interposed between said turning means and the movable jaw and having an annular chamber extending about the screw shaft with a ring-like piston in the chamber operable to exert clamping force upon the movable jaw to move the latter relative to the companion jaw by reason of such lost motion, and means operable by and upon detachment of the turning means from the shaft to exert pressure on a body of liquid confined in said chamber for so actuating the ring-like piston.

5. A clamp of the character described, comprising cooperating jaws one being movable toward the other, a screw shaft connecting the two jaws together for limited play and operating to advance and retract said movable jaw toward and from the companion jaw, means for turning the screw shaft to secure a preliminary setting of the movable jaw against an interposed workpiece, a hydraulic unit having an annular chamber with a ring-like piston therein extending about the screw shaft and operable to exert

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clamping force upon the movable jaw to move the latter relative to the companion jaw by reason of such play, said screw shaft having an axial extension formed with a chamber in communication with the first chamber, a plunger arranged in the extension chamber and operable to subject the confined body of liquid to a piston actuating pressure, said turning means having threaded engagement on the extension and operable thereby to depress the plunger for so actuating the piston, and means normally holding said turning means against plunger advancing movement on the extension but operable to release said turning means for such plunger advancing movement.

6. A clamp of the character described, comprising cooperating jaws one being movable toward the other, a screw shaft connecting the two jaws together for limited play and operating to advance and retract said movable jaw toward and from the companion jaw, means for turning the screw shaft to secure a preliminary setting of the movable jaw against an interposed work-piece, a hydraulic unit interposed between said turning means and the movable jaw and having an annular chamber extending about the screw shaft with a ring-like piston in the chamber operable to exert clamping force upon the movable jaw to move the latter relative to the companion jaw by reason of such play, said screw shaft having an axial extension formed with a chamber in communication with the first chamber, a plunger arranged in the extension chamber and operable to subject the confined body of liquid to a piston actuating pressure, said turning means having threaded engagement on the extension and operable thereby to depress the plunger for so actuating the piston, and means responsive to a predetermined screw imposed force and normally holding said turning means against plunger advancing movement on the extension but operable in response to such predetermined shaft imposed force to release said turning means for such plunger advancing movement.

7. A vise comprising a fixed jaw, a movable jaw, a screw shaft operatively connecting the two jaws and having a limited lost motion connection with one jaw, an annular chamber about the shaft, a ring-like piston encircling the shaft and arranged within the chamber for exerting a clamping pressure upon the movable jaw, said shaft having an axially extending chamber communicating with the first chamber, a plunger in said axially extending chamber cooperating with the piston to confine an interposed body of liquid therebetween, a cap nut threaded on the shaft over the outer end of the plunger, and means locking the cap nut to the shaft for turning therewith as a unit and releasable to permit the cap nut to advance along the shaft to depress the plunger.

8. A vise comprising a fixed jaw, a movable jaw, a screw shaft operatively connecting the two jaws and having a limited lost motion connection with one jaw, an annular chamber about the shaft, a ring-like piston encircling the shaft and arranged within the chamber for exerting a clamping pressure upon the movable jaw, said shaft having an axially extending chamber communicating with the first chamber, a plunger in said axially extending chamber cooperating with the piston to confine an interposed body of liquid therebetween, a cap nut threaded on the shaft over the outer end of the plunger, means locking the cap nut to the shaft for turning therewith

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as a unit and releasable to permit the cap nut to advance along the shaft to depress the plunger, and spring means acting to urge the movable jaw against the ring piston whereby to project the plunger against the cap nut.

9. A vise comprising a fixed jaw, a movable jaw, a screw shaft operatively connecting the two jaws and having a limited lost motion connection with one jaw, an annular chamber about the shaft, a ring-like piston encircling the shaft and arranged within the chamber for exerting a clamping pressure upon the movable jaw, said shaft having an axially extending chamber communicating with the first chamber, a plunger in said axially extending chamber cooperating with the piston to confine an interposed body of liquid therebetween, a cap nut threaded on the shaft over the outer end of the plunger, and a lock normally securing the cap nut to the shaft for turning as a unit and releasable upon abnormal resistance to the shaft imparted movement of the movable jaw for releasing the cap nut whereby the continued turning of the latter will advance the cap nut along the shaft to depress the plunger and exert a clamping force upon the movable jaw supplemental to that imposed by the screw shaft.

10. A vise comprising a fixed jaw, a movable jaw, a screw shaft operatively connecting the two jaws and having a limited lost motion connection with one jaw, an annular chamber about the shaft, a ring-like piston encircling the shaft and arranged within the chamber for exerting a clamping pressure upon the movable jaw, said shaft having an axially extending chamber communicating with the first chamber, a plunger in said axially extending chamber cooperating with the piston to confine an interposed body of liquid therebetween, a cap nut threaded on the shaft over the outer end of the plunger, and a lock normally securing the cap nut to the shaft for turning as a unit and releasable upon abnormal resistance to the shaft imparted movement of the movable jaw for releasing the cap nut whereby the continued turning of the latter will advance the cap nut along the shaft to depress the plunger and exert a clamping force upon the movable jaw supplemental to that imposed by the screw shaft, said lock comprising a split ring normally contracted into a peripheral groove on the cap nut, with the outer margin of the locking ring engaging in a groove formed in the surrounding part of the shaft whereby to cause a binding in the threaded engagement of the cap nut with the shaft to so lock the cap nut and shaft into a turnable unit, said locking ring being expandable out into the groove of the shaft to release the cap nut for advancing along the shaft by reason of its threaded engagement therewith.

11. A vise comprising a fixed jaw, a movable jaw, a screw operatively connecting the two jaws with limited play therebetween, means for turning the screw to impose a clamping pressure upon the movable jaw, normally inoperative hydraulic means having greater mechanical advantage for imposing a higher clamping pressure upon the movable jaw by reason of the play connection, and pressure responsive means operable in the presence of a predetermined screw imposed force for rendering said screw turning means inoperative with respect to the screw and concurrently for connecting said screw turning means to said hydraulic means for actuating the latter.

12. A vise or like device comprising a fixed jaw, a movable jaw, a screw operatively connecting the

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two jaws with limited play therebetween, means detachably connected to the screw for turning the same to impose a predetermined clamping pressure upon the movable jaw, normally inoperative hydraulic means operable to impose a greater clamping pressure upon the movable jaw by reason of the limited play connection, and pressure responsive means operable in the presence of the predetermined screw imposed pressure for disconnecting the turning means from the screw and operatively connecting said screw turning means to the hydraulic means for actuating the latter.

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