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Wermuth et al.

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[54] MECHANICAL CLAMPING DEVICE, IN PARTICULAR MACHINE VICE

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[58] **Field of Search** 269/221, 222, 223, 228, 246

[56] **References Cited**

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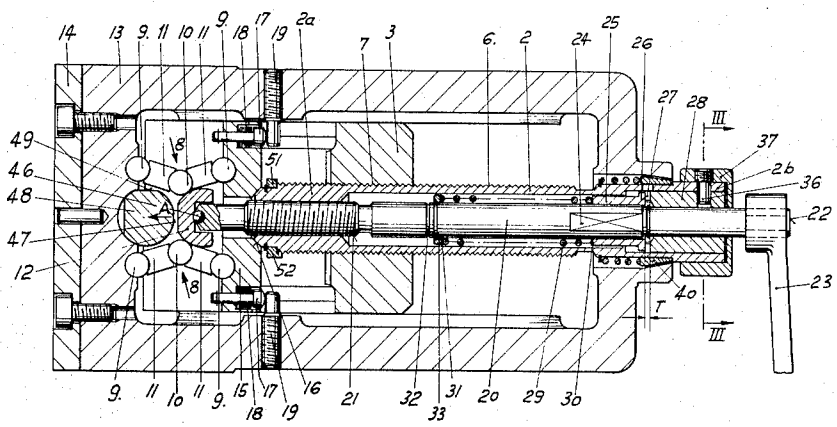
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[57] **ABSTRACT**

A clamp member for a vice or the like. A hollow spindle is threaded into a stationary block and carries a slide member thereon and a drive rod therein. A limited-torque clutch connects a drive rod to said hollow spindle and solid connecting means connects said manual drive means to said drive rod. Upon rotation of the handle, force is transmitted through the limited-torque clutch to rotate the hollow spindle with respect to the stationary block for advancement of same and simultaneous advancement of the slide until the work-engaging plate initially contacts the workpiece. Thereafter, the clutch slips and force is then applied through the drive rod to force multiplication means and applied to the work-engaging plate for imposing clamping force thereon. The drive rod is only torsionally stressed for most of its length and hence is not subjected to bending forces. It is compressively stressed only for a short distance at the end adjacent the force multiplication means and can at this point be readily and adequately guided.

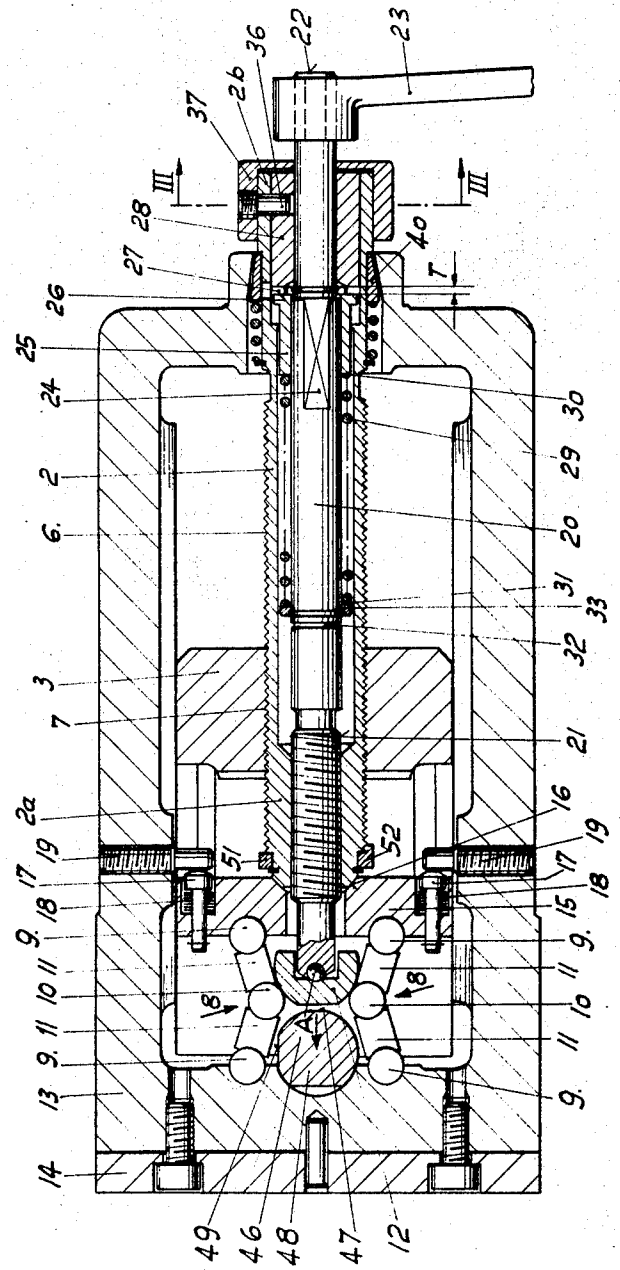
8 Claims, 3 Drawing Figures



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Fig. 1.



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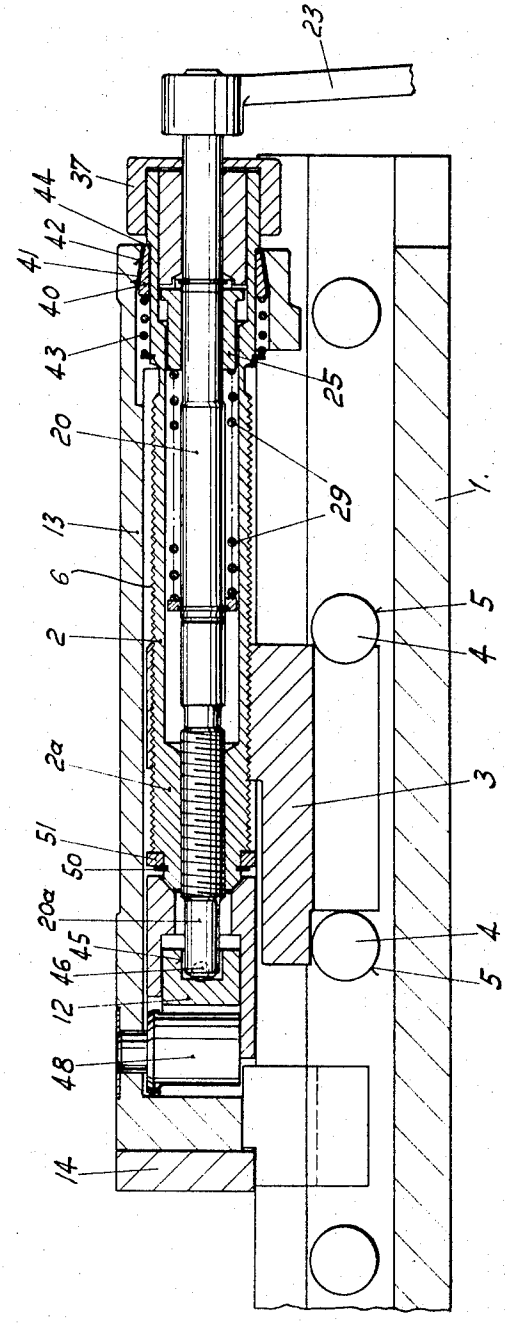
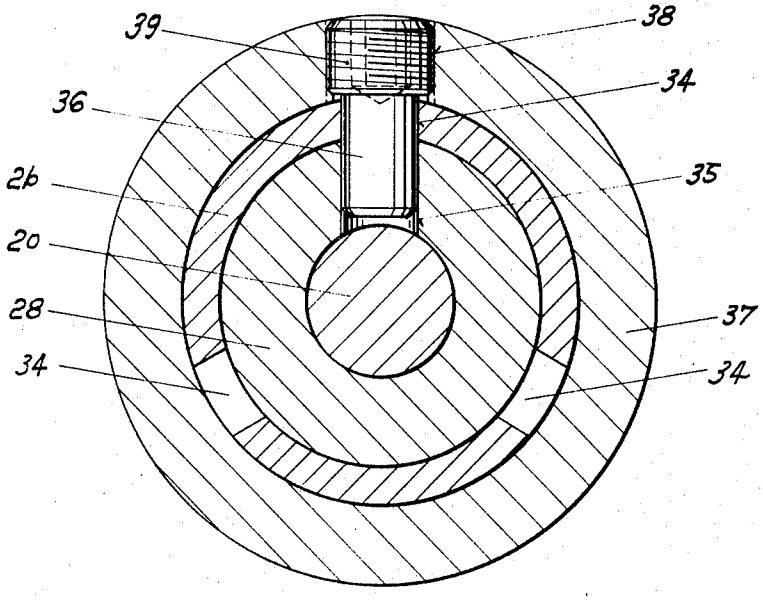


Fig. 2

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Fig. 3



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MECHANICAL CLAMPING DEVICE, IN PARTICULAR MACHINE VICE

The invention relates to a mechanical clamping device, in particular a machine vice, with a high-speed hollow spindle threadably engageable in a stationary bearing block, drivable by means of a hand crank through a drive shaft and a torque coupling and rotatably supported in the slide member, an abutment arranged in the slide member on which on one side is supported the front end of the hollow spindle and on the other side is supported the pair of toggle levers, and with a pressure rod arranged longitudinally movably in the hollow spindle acting through a pressure pad onto the pair of toggle levers, said pressure rod being moved in the hollow spindle after disengagement of the torque clutch upon further rotation of the hand crank to press apart the pair of toggle levers.

In one presently known vice of this construction, the drive shaft is constructed as a drive spindle supported on the pressure rod with a ball and ball bearing, which drive spindle is threadably engageable with a clutch sleeve fixedly connected to the end of the hollow spindle. A clutch disk is supported on this drive spindle, which clutch disk is axially movable, biased with cup springs and is in axial engagement with the clutch sleeve of the hollow spindle. This vice is relatively expensive to manufacture because of the many required drive parts and furthermore is susceptible to trouble. The path of force transmission is unfavorable since in the case of high-pressure clamping both the action and reaction forces are transmitted through a number of parts connected in series, which parts are thus all stressed by the high pressure. Since the diameter of the hollow spindle is limited, the highly stressed force transmitting parts arranged inside the spindle cannot always be constructed with adequate strength and hence there often exists a considerable danger of overloading or breakage. In order to avoid this, an additional safety clutch has to be connected into the drive.

In the case of high-pressure clamping (involving several tons clamping force) this high clamping force is transmitted as pressure force onto the entire length of the pressure rod, the drive spindle and a great length of the hollow spindle (here traction (pulling force)) to the stationary bearing block of the vice. Through this the pressure rod is not only stressed for bending and an undesirable bending is effected but this pressure rod, drive spindle and hollow spindle are compressed or extended by the high forces so that during high-pressure clamping a relatively soft impact occurs which is not clearly feelable for the operator rotating the hand crank. Since during operation of a vice the operator as a rule is used to a hard impact, very often in such prior devices by further rotating the drive crank, the drive is overloaded or damaged. Also in the known vice, it is possible that improper operations occur due to a premature disengagement of the torque clutch before the workpiece has been preclamped or, also by not engaging of said clutch during opening of the vice. These erroneous operations are, among other things, due to the fact that the cup springs, which are hard and act onto the clutch disk, effect a strong increase of the pressure force during disengagement of the clutch so that through this a strong friction force is applied to clutch parts after disengagement, which friction force upon release of the vice prevents the reengagement of the clutch.

The basic purpose of the present invention is to produce, by avoiding the above-mentioned disadvantages, a mechanical clamping device, in particular a vice, the drive of which is considerably simpler in construction, but more sturdy and safe in functioning and with which further a more favorable force course is achieved than with presently known devices.

To attain this purpose, a mechanical clamping device, in particular a vice of the type mentioned above, is provided in which according to the invention the pressure rod and the drive shaft consist of one single through pressure spindle which has threads only in a zone close to the pressure pad and is by this thread threadedly engageable in the front end of the hollow spindle. This new drive requires only relatively few parts which can be manufactured at a low cost. It also has a very advantageous path of force transmission since the pressure spindle acting as a pressure rod is no longer stressed for bending and in the new construction both the action and also the reaction force is transmitted over the quickest path from the front end of the pressure spindle to the front end of the hollow spindle and from same to the stationary bearing block of the vice. This new construction further makes possible a new advantageous construction of the torque clutch which assures a safe functioning of said torque clutch.

The invention will be described hereinafter in connection with one exemplary embodiment illustrated in the drawing, in which:

FIG. 1 is a horizontal cross-sectional view of the slide member of a machine vice;

FIG. 2 is a vertical cross-sectional view of said slide member;

FIG. 3 is a cross-sectional view along the line III—III of FIG. 1.

The frame of a machine vice is identified at **1** in the drawings. The vice has a stationary bearing block **3** for threadedly supporting a hollow spindle **2**. To change the clamping width, this bearing block can be arranged longitudinally movably in the frame **1**, for example, by means of pins **4** which are insertable in corresponding transverse bores **5** of the frame **1**. The hollow spindle has an external thread **6** and the bearing block a corresponding internal thread **7** for a threaded engagement therebetween.

A pair of toggle levers **8**, which can consist of rollers **9**, **10** and of levers **11** supported on said rollers, is provided in the slide member **13** which supports a clamping jaw **14**. A pressure pad **12** is mounted on said pair of toggle levers **8**, or on the center roller **10**, which pressure pad when moved in direction A, will press apart the pair of toggle levers and thus effect the high-pressure clamping. An abutment **15** is also provided in the slide member. The pair of toggle levers with the rollers **9** are mounted on one side of the abutment **15** and the front end **2A** of the hollow spindle **2** is mounted on the other side of the abutment **15** as at **16**. Suitable means are provided to press by spring force the pair of toggle levers inwardly during the release of the vice, namely the pulling back of the pressure pad **12**. Said means can consist of bolts **17** movable arranged in the abutment **15**, said bolts being loaded by springs **18** and supported on pins **19** arranged in the slide member.

As can be understood from the drawing, instead of the pressure rod and drive crank used up to now, there is here provided a single pressure spindle **20** which has a thread **21** occupying only a zone close to the pressure pad and can threadably engage with said thread the front hollow spindle end **2*a***. The rear end of sad pressure spindle **20** has a polygonal projection **22** which is used to receive a hand crank **23**. A cylindrical clutch sleeve **25** is arranged longitudinally movably and secured against rotation by means of a wedge **24** or the like on the pressure spindle. The clutch sleeve has a clutch flange **26** which at **27** axially engages a clutch sleeve **28** by means of suitable clutch teeth or recesses. The clutch sleeve **28** is connected to the rear end **2*b*** of the hollow spindle. The movable clutch sleeve **25** is advantageously of a length which is greater than the diameter of the sleeve which provides an effective guiding of said clutch sleeve on the pressure spindle **20** so that a canting of same is impossible and accordingly an exact shifting of the clutch is effected. This accurate functioning of the clutch is also assured by the arrangement of a relatively long coil spring **29** which is arranged on the pressure spindle **20** and is supported at one end on the movable sleeve **25** at **30** and at the other end on the pressure spindle at **31**. For this purpose a snap ring **33** can be provided in various annular grooves **32**. In this pressure spring **29**, which is considerably softer in comparison to cup springs, there occurs practically no increase of the pressure force during disengagement of the clutch sleeve **25**, **26** so that during disengagement of the clutch sleeve the friction force between the two clutch sleeves **25** and **28** is relatively low. This permits during the release of the vice, namely the turning back of the pressure spindle **20**, a safe reengage-

ment of the clutch so that inaccurate shiftings are avoided. Furthermore, a double thread **6**, **7** or **21** is provided advantageously for a threaded engagement of both the hollow spindle **2** into the bearing block **3** and also the pressure spindle **20** into the hollow spindle. The double thread **21** has the advantage that the depth of engagement T (and therewith the height of the clutch teeth or engaging depths) of the torque clutch **25**, **28** can be enlarged to twice the size in comparison to a single thread. This reduces the wear and a longer life is obtained. The double thread **6**, **7** is advantageous for the hollow spindle **2** in view of a thin wall thickness because this thread requires only a small thread depth.

For changing the rotary position of the clutch sleeve **28** opposite the hollow spindle **2**, **2***b*, several radial openings **34** are provided in said hollow spindle, one radial opening **35** and a releasable clutch pin **36** insertable in said openings are provided n the clutch sleeve **28**. This assures in a simple manner the maintaining of the angle slide path (approximately 135°) of the torque clutch during installation by choosing the suitable opening **34**. The illustrated advantageous embodiment provides a clutch or cap sleeve **37** which grips over the end **2***b* of the hollow spindle and has a radial opening **38** for receiving the head **39** of the clutch pin **36**. This sleeve **37** is milled at the periphery and can be used as a hand grip in place of the crank **23**.

A brake is provided in order to avoid an improper shifting (for example, in clamps with a loose vice head portion, workpieces with a strong burr, etc.). For this purpose, brake ring **40** with an outer cone **41** is provided axially movably on the rear end **2***b* of the hollow spindle. Said outer cone **41** cooperates with an inner cone **42** provided in the slide member. The brake ring **40** is biased by a coil spring **43** arranged on the spindle and said coil spring presses the brake ring toward the end of the spindle into the cone **41**. Furthermore, a collar **44** is arranged on the end of the hollow spindle. The collar **44** moves the brake ring **40** in direction A during forward screwing of the hollow spindle **2** and thus releases the brake. This brake is thus only effective during opening of the vice, however, is released by the collar **44** during closing of the vice so that therewith the entire coupling torque of the clutch **25**, **28** can be used for preclamping the workpiece.

A very effective diameter of the brake ring **40** is provided in the above-described brake so that a stronger effective brake moment is obtained. Since the brake cone **42** of the slide member is positioned at the end of same, the operation of this brake cone is thus also simplified.

In the illustrated advantageous embodiment, the front end **20***a* of the pressure spindle is received into an opening **45** of the pressure pad **12** and a steel ball **46** is supported in the spindle end with which steel ball the spindle end is supported on the pressure pad.

The above-described machine vice operates as follows:

During rotation of the pressure spindle **20** by means of the hand crank **23**, the hollow spindle **2** threadably engages the bearing block **3** through the engaged torque clutch **25**, **28** and the slide member is thus moved in direction A until the jaw **14** engages the workpiece. Since the slide member **13** and the hollow spindle **2** now stop, the torque clutch **25**, **28** disengages during further rotation of the pressure spindle **20**. The pressure spindle then threadably engages the thread **21** in the hollow spindle **2** so that the spindle is moved in direction A and the pressure pad **12** presses apart the pair of toggle levers **8**. The slide member is thus moved a small distance into direction A and the workpiece is clamped with a great force. It can be seen that in producing this high pressure upon rotating the pressure spindle **20** by the hand crank **23**, said pressure spindle is stressed for almost its entire length only for rotation, not however, for bending since the spindle is supported with the thread **21** at the front end **2***a* of the hollow spindle and accordingly the spindle is stressed for pressure only in the zone of the thread **21** and of the spindle end **20***a*. Since, on the other hand, the hollow spindle **2** with the thread **6**, **7** is supported on the stationary bearing block **3**, these clamping forces are thus transmitted through strong structural parts in the most direct manner possible whereby practically no compression or expansion of these structural parts can take place when finally upon further rotation of the pressure spindle **20** the pressure pad **12** abuts the stop face **47** whereby a second stop face **49** can also be adjusted by rotating the stop **48**. In view of the above-mentioned short force transmission through strong parts, an engagement which is clearly noticeable to the workman is obtained between the pressure pad **12** and the stop face **47** or **49**. The function of the above-described machine vice is furthermore made visible to the operator in that upon closing of the vice, namely biasing, the clutch sleeve **37** rotates with the pressure spindle **20**, however, stops during clamping of the workpiece with high pressure. The same process only in reversed order is also indicated optically to the operator during releasing of the vice.

A positive limitation of the backward movement of the hollow spindle **2** is provided also during the release of the vice. A stop ring **51** is arranged for this purpose on the front end **2***a* of the hollow spindle, said stop ring **51** being held by a snap ring **50** and projecting over the periphery of the hollow spindle. The stop ring **51** has an axially projecting nose **52** with a radial stop face which abuts a corresponding radial stop face of the bearing block **3**. Thus, without any danger of clamping, a strong easily releasable abutment is obtained.

Aside from the above-described simple, strong and operatively safe construction, the new clamping device also has the advantage of being compact in construction inasmuch as the length of the hollow spindle has been shortened due to the deletion of the safety clutch, but in spite of this, as can be seen in the drawings, a very great path for the slide member is obtained with said hollow spindle.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A mechanical clamping device having a hollow spindle rotatably supported in a slide member, said hollow spindle being threadably engageable in a stationary bearing block and drivable by means of a hand crank through a drive shaft and torque coupling, an abutment arranged in said slide member having the front end of said hollow spindle mounted on one side and a pair of toggle levers mounted on the other side, pressure rod means supported for longitudinal movement in said hollow spindle and acting onto said pair of toggle levers by means of a pressure pad, said pressure rod means being movable longitudinally of said hollow spindle only after a disengagement of said torque coupling upon further rotation of the hand crank to thereby press apart said pair of toggle levers, wherein the improvement comprises said pressure rod means and said drive shaft being made of one piece to define a pressure spindle extending lengthwise of said slide member, said pressure spindle having thread means adjacent said pressure pad, said thread means being threadably coupled to said hollow spindle adjacent the front end thereof.

2. Clamping device according to claim **1**, wherein said torque coupling comprises a first clutch sleeve, which is longitudinally movable on said pressure spindle and secured against a relative rotation, has a clutch flange thereon which is in axial engagement with a second clutch sleeve connected to the rear end of said hollow spindle, and a coil spring arranged on said pressure spindle, said coil spring being supported at one end on said first clutch sleeve and at the other end on said pressure spindle.

3. Clamping device according to claim **2**, wherein several radial openings are provided in said hollow spindle and one radial opening is provided in said second clutch sleeve, a releasable clutch pin insertable in a selected one of said openings in said hollow spindle and said opening in said second clutch sleeve for selecting the rotating position of said second clutch sleeve relative to said hollow spindle.

4. Clamping device according to claim **3**, including a cap sleeve mounted on one end of said hollow spindle, said cap sleeve having a radial opening therein for receiving the head of said clutch pin.

5. Clamping device according to claim 1, including a brake ring axially movably mounted on the rear end of said hollow spindle and having an outer cone surface thereon, a coil spring arranged on said hollow spindle and urging said brake ring toward the rear of said hollow spindle, an inner cone surface on said slide member cooperable with said outer cone surface of said brake ring, and means defining a collar on the rear end of said hollow spindle, said collar, upon a forward rotation of said hollow spindle, moving said brake ring and releasing same therewith.

6. Clamping device according to claim 1, including a stop ring on the front end of said hollow spindle, said stop ring being held by a snap ring and projecting radially outwardly beyond the periphery of said hollow spindle.

7. Clamping device according to claim 1, wherein the front end of said pressure spindle enters a recess in said pressure pad and wherein a steel ball is mounted in the front end of said hollow spindle, said steel ball engaging the bottom surface of said recess in said pressure pad.

8. Clamping device according to claim 1, wherein a double thread is provided for threadably coupling both the hollow spindle to the bearing block and also the pressure spindle to the hollow spindle.

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