June 25, 1963 H. W. M. FREUND 3,095,190

PNEUMATIC HYDRAULIC VISE

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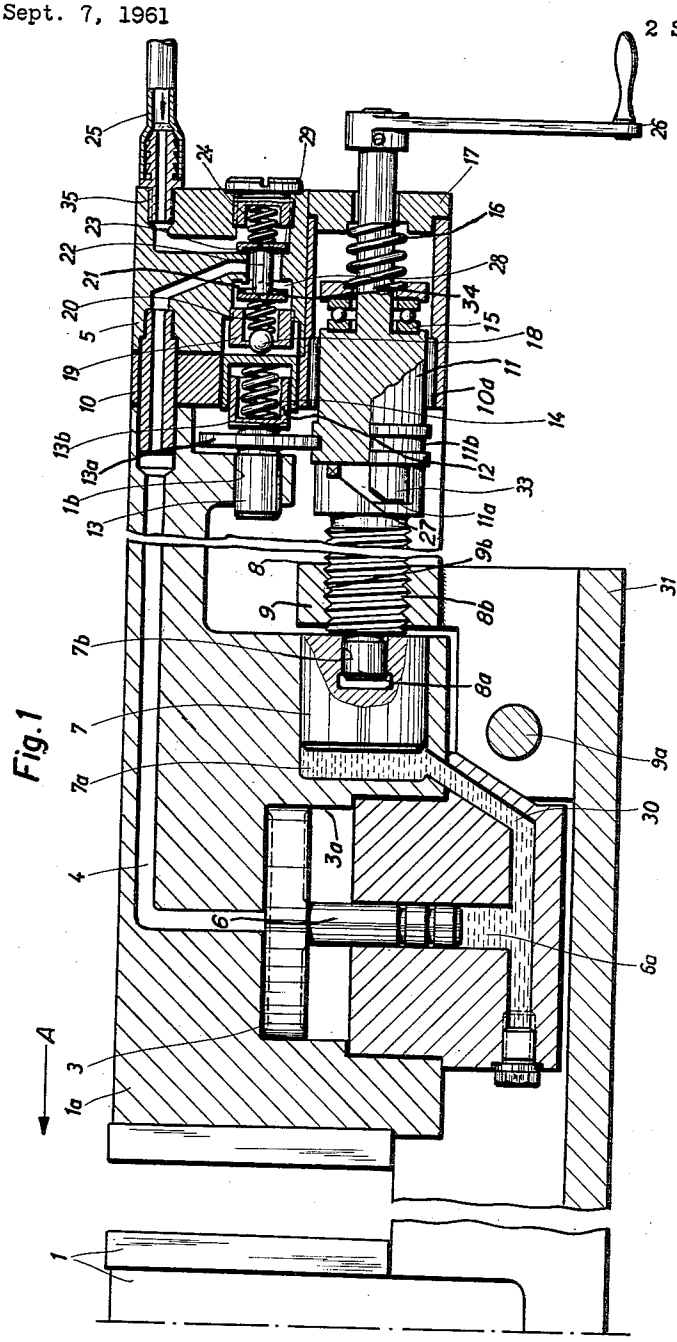


Fig. 1

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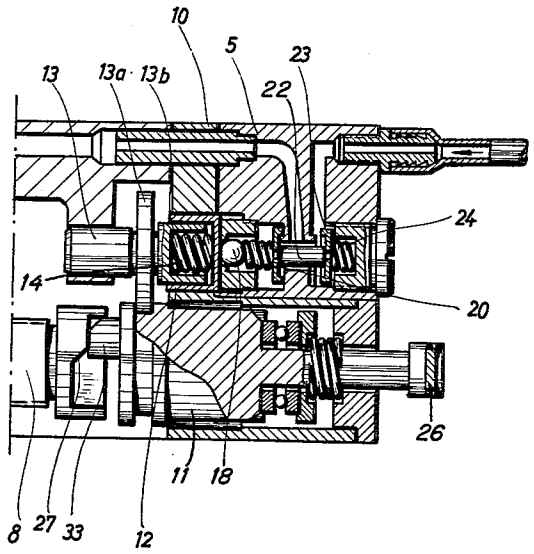
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Fig. 2



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PNEUMATIC HYDRAULIC VISE

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The present invention relates to a pneumatic hydraulic vise in which the compressed air acts through the intervention of a pressure transformer on a pressure fluid which in its turn adjusts the vise jaw.

Vises which are adjusted directly by compressed air are known in the art. The drawback of this heretofore known type of vise consists in that due to the relatively low pressure of the customary prevailing compressed air installation and due to the direct actuation of the air piston, relatively large cylinder dimensions and consequently relatively large dimensions for the vise or clamping apparatus are necessary. Vises operable by compressed air of the size of the customary mechanical vises have a low clamping power.

Compressed air actuated vises have become known heretofore in which the piston conveys its clamping force to the movable jaw through the intervention of a lever system. While with this type of vises higher clamping forces can be produced, these known clamping devices have the drawback of a very short stroke, inasmuch as the stroke of the movable jaw hardly exceeds a few millimeters. Also with this type of vise, the dimensions are prohibitive if customary clamping forces are to be produced.

Furthermore, pneumatic hydraulic vises have become known in which a small pressure transformer is installed in the lower portion of the vise. With these vises, the movable jaw is first advanced toward the work piece until it is spaced therefrom by a few millimeters, whereupon a pressure valve is opened which initiates the clamping operation and after a dead stroke exerts the desired clamping force. These clamping devices have the drawback that they consume the major portion of the pressure for overcoming the dead stroke.

Pneumatic hydraulic vises in which the pressure transformer is located outside the vise have additionally to establish the connection between pressure transformer and vise through the intervention of a high pressure hose. Such high pressure hoses are undesired and are very sensitive against bending stresses.

It is, therefore, an object of the present invention to provide a pneumatic hydraulic vise which will overcome the above mentioned drawbacks.

It is another object of this invention to provide a pneumatic hydraulic vise which will make it possible mechanically to feed the movable jaw to the work piece and then to initiate an automatic pneumatic hydraulic clamping action.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawing, in which FIG. 1 shows a pneumatic hydraulic vise according to the present invention. FIG. 2 shows the right-hand portion of FIG. 1 but with the respective elements occupying a position in which a work piece is in clamped-in position.

The pneumatic hydraulic vise according to the present invention is characterized primarily in that a manually operable feeding spindle is provided with a jaw clutch comprising a first jaw clutch element and a second jaw clutch element and also including an axially displaceable jaw shaft which latter is connected to a control shaft for an air controlling valve. By means of an arrangement

of this type it is possible mechanically to feed the movable jaw of the vise into engagement with the work piece and then at a small crank turning angle of approximately 15° through the intervention of a pressure transformer to clamp in the work piece at a very high clamping pressure.

According to a practical embodiment of the invention, the jaw shaft may be provided with a radial groove engaged by a collar, disc, or the like of the control shaft for the compressed air valve.

With a vise of this type, it is possible to arrange the pressure transformer, i.e. the air actuated piston, with the hydraulic piston in the movable jaw whereby a compact construction of the vise will be obtained. Advantageously, the pressure transformer may be arranged adjacent the clamping piston but it may also be arranged laterally of the spindle in the movable jaw.

Specifically referring to the drawing, the vise illustrated therein comprises a stationary jaw **1** and a movable jaw **1***a* provided with a larger cylinder bore **3***a* and a smaller cylinder bore **6***a*. Reciprocably mounted in the cylinder bore **3***a* is a compressed air operable piston **3** the upper side of which communicates through a passage **4** with a compressed air valve block **5**. The piston **3** has connected thereto a hydraulic plunger **6** reciprocably mounted in cylinder **6***a*. The hydraulic cylinder **6***a* is connected through a passage or oil chamber **30** with a cylinder **7***a* in which is reciprocably mounted the clamping piston **7**. The clamping piston **7** has a bore **7***b* in which is reciprocably mounted the front portion **8***a* of a spindle **8** the thread **8***b* of which engages a correspondingly threaded bore **9***b* of a member **9** which latter is anchored in the lower portion **31** of the vice by means of a bolt **9***a*.

The vice according to the present invention furthermore comprises a bearing plate **10** having journalled therein a clutch shaft **11** by means of a needle bearing **10***a*. Furthermore displaceably mounted in bearing plate **10** is a guiding bushing **12** which in its turn has movably mounted therein one end portion **13***b* of a control shaft **13** while the other end portion of said control shaft is slidably mounted in a bore **1***b* of the movable jaw **1***a*. A compression spring **14** is interposed as yieldable member between the end member **13***b* of the control shaft **13** and the guiding bushing **12**.

The clutch shaft **11** has its right-hand portion with regard to the drawing journalled on a thrust bearing **15** which is acted upon by a spring **16** that has that end thereof which is remote from the thrust bearing **15** rest upon a lid **17**. The jaw shaft **11** has a circumferential groove **11***b* which is engaged by a flange, disc, or collar **13***a* of control shaft **13**.

The guiding bushing **12** is adapted to engage and act upon a ball **18** which is located in an abutment bushing **19**, said ball being acted upon by a spring **20**. This spring **20** rests against a valve disc **21** connected to a valve disc **23** through the intervention of the valve shank **22**. Valve disc **23** is acted upon by a spring **24**.

The valve block **5** has mounted therein a nipple **35** to which is connected the mouth of a hose **25**, said nipple and hose being shown in the drawing turned by 90°.

The clutch shaft **11** is adapted to receive a manually operable crank **26** for actuating the same.

The operation of the vise according to the present invention is as follows:

If a work piece is to be clamped between the stationary jaw **1** and the movable jaw **1***a*, first the crank **26** is turned manually whereby due to the jaw clutch engagement of clutch shaft **11** with the spindle **8** also the latter will turn. Rotation of the spindle **8** will move the member **9** and thereby the movable jaw **1***a* in clamping direction assuming a corresponding direction of rotation of the handle **26**. When the movable jaw **1***a* has engaged the

work piece to be clamped and a torque resistance is encountered by the crank **26**, a further rotation of crank **26** in the same direction will cause the jaw clutch member **33** to ride on the corresponding surface **11***a*, **27** of another clutch member forming part of or being connected to the spindle **8**. As a result thereof, the clutch shaft **11** will move axially away from the spindle **8** against the thrust of compression spring **16**. Due to this axial movement of the clutch shaft **11**, also the control shaft **13** is, due to the engagement of disc **13***a* with groove **11***b* of clutch shaft **11**, axially moved in the same direction as clutch shaft **11**. This movement of control shaft **13** is conveyed through pressure spring **14**, ball **18** and pressure spring **20** to the valve disc **21** so as to move the latter in rightward direction with regard to the drawing against the valve seat **28** while overcoming the thrust of pressure spring **24**. Simultaneously with the seating of valve disc **21** upon valve seat **28**, valve disc **23**, through valve shank **22**, is lifted off its seat **29**. The stroke of the guiding bushing **12** is limited by the abutment bushing **19**.

Due to the lifting off of valve disc **23** from its seat **29**, compressed air will pass through hose **25** into the passage **4** leading to piston **3** thereby actuating the pressure transformer **3**, **6**.

In conformity with the ratio between the effective area of piston **3** and the effective area of the hydraulic plunger **6**, the pressure in the oil chamber **30** will increase. This increase in pressure will be conveyed to the effective surface of the clamping piston **7** with the result that the movable jaw **1***a* is pressed in clamping direction indicated by the arrow A whereby the work piece will be firmly clamped between the jaws of the vise. It will be appreciated that during this clamping operation, the axial position of the mechanical drive is not changed, and that merely the spring **14** is compressed and thus serves as compensating device.

If the movable vise jaw is now to be moved away from the fixed jaw, it is merely necessary to turn the crank **26** in a direction opposite to its clamping direction whereupon the jaw member **33** will slide off the inclined surface **27** of the other jaw member. The clutch shaft **11** will in this way by means of spring **16** be displaced in axial direction (toward the left with regard to the drawing). In view of the connection of the control shaft **13** with the jaw shaft **11** through the intervention of the collar or disc **13***a*, also control shaft **13** will move in leftward direction with regard to the drawing. Consequently, valve disc **23** will, due to the thrust of pressure spring **24** again become seated on valve seat **29** with the result that the supply of further compressed air to the passage **4** will be blocked. Valve disc **21** will, during this movement release a discharge opening **34** through which the air from the pressure transformer can escape toward the outside through passage **4**. By further rotating crank **26**, it is then possible to open jaw **1** to the desired extent. This unclamping operation takes about one second.

It is, of course, to be understood that the present invention is, by no means, limited to the particular construction shown in the drawing but also comprises any modifications within the scope of the appended claims. Thus, for instance, instead of mechanically driving the spindle **8** by hand, it is, of course, also possible to drive the spindle by an electric motor. In such an instance, the control shaft **13** would be provided with limit switches for controlling the drive motor for the spindle **8**.

What I claim is:

1. In a vise: a stationary jaw, a movable jaw for cooperation with said stationary jaw, mechanical means mechanically drivingly connected to said movable jaw and operable mechanically to move said movable jaw selectively toward and away from said stationary jaw, said mechanical means comprising a first member with a first jaw clutch element and also comprising a second member movable relative to said first member and provided with a second jaw clutch element for engagement and cooperation with said first jaw clutch element, said second jaw clutch element being adapted in response to a certain torque acting thereupon to ride on said first jaw clutch element to thereby impart a certain axial movement upon said second member, fluid operable pressure transformer means operatively connected to said movable jaw and operable in response to fluid pressure acting upon said transformer means to move said movable jaw toward said stationary jaw, conduit means leading to said pressure transformer means and arranged for connection with a pressure fluid source, and valve means interposed in said conduit means and movable into a first position for conveying pressure fluid to said pressure transformer means and also being movable into a second position for preventing the supply of pressure fluid to said pressure transformer means while releasing the fluid pressure thereon, said valve means including control means operatively connected to said second member and responsive to said axial movement in view of said certain torque for moving said valve means into said first position.

2. A vise according to claim 1, in which the clutch element of said second member is provided with a radial groove and in which said control means includes means engaging said radial groove and being movable thereby in axial direction of said second member.

3. In a vise: a stationary jaw, a movable jaw for cooperation with said stationary jaw, mechanical means mechanically drivingly connected to said movable jaw and operable mechanically to move said movable jaw selectively toward and away from said stationary jaw, said mechanical means comprising a first member with a first jaw clutch element and also comprising a second member movable relative to said first member and provided with a second jaw clutch element for engagement and cooperation with said first jaw clutch element, said second jaw clutch element being adapted in response to a certain torque acting thereupon to ride on said first jaw clutch element to thereby impart a certain axial movement upon said second member, a pneumatic cylinder piston system arranged within said movable jaw, a hydraulic cylinder piston system operatively connected to said pneumatic cylinder piston system and likewise located in said movable jaw and operable to actuate the latter in response to the operation of said pneumatic cylinder piston system, conduit means leading to said pneumatic cylinder piston system for connection with a source of compressed air, and valve means interposed in said conduit means and movable into a first position for conveying compressed air to said pneumatic cylinder piston system and also being movable into a second position for preventing the supply of compressed air to said pneumatic cylinder piston system while releasing the pneumatic pressure thereon, said valve means including control means operatively connected to said second member and responsive to said axial movement in view of said certain torque for moving said valve means into said first position.

4. An arrangement according to claim 1, in which said pressure transformer means is arranged adjacent said movable jaw.

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