May 25, 1954 F. G. GEPFERT 2,679,177

PRECISION VISE OF THE DOUBLE-ACTING TYPE

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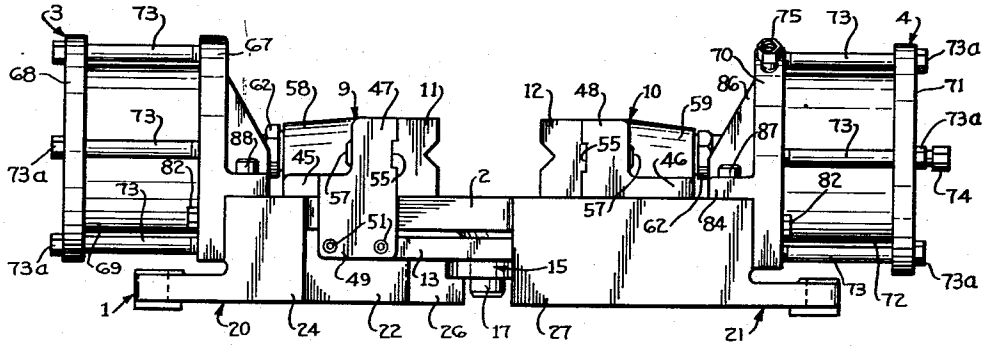


Fig. 1.

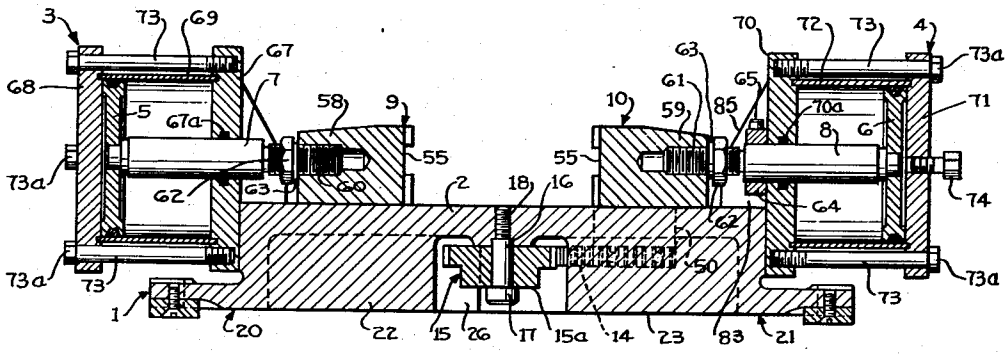


Fig. 2.

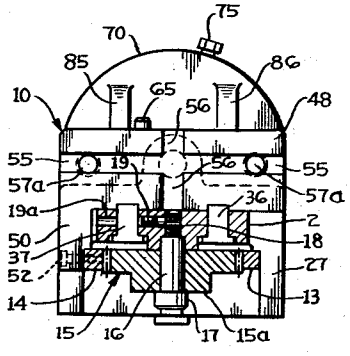


Fig. 6.

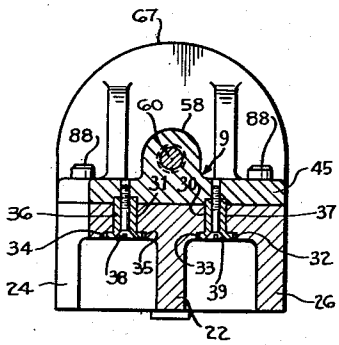


Fig. 7.

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Fig. 3.

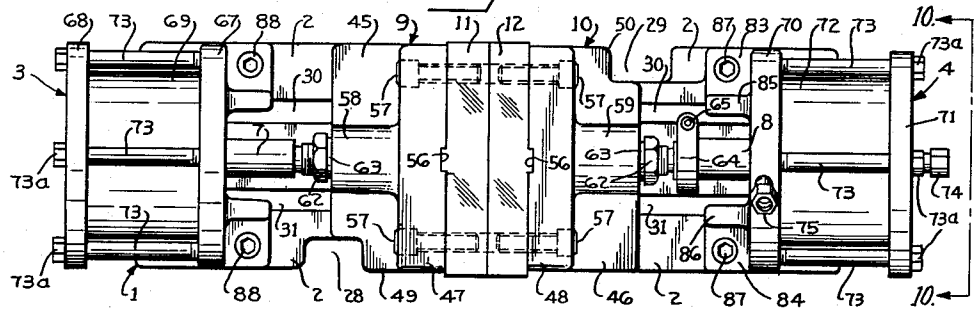
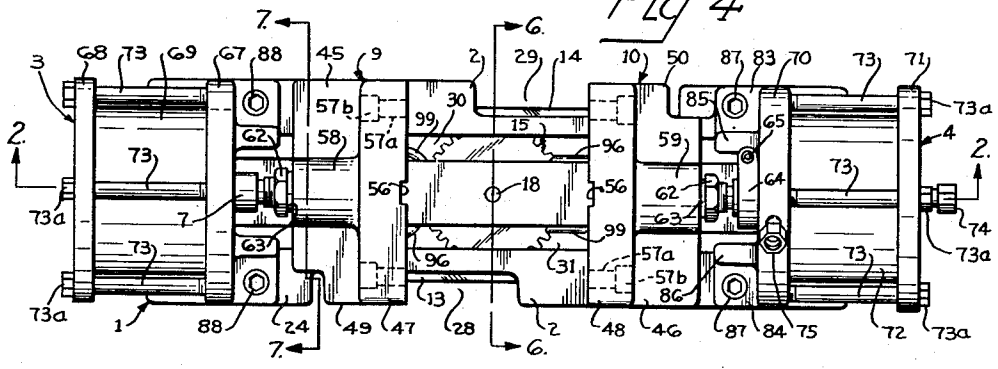


Fig 4



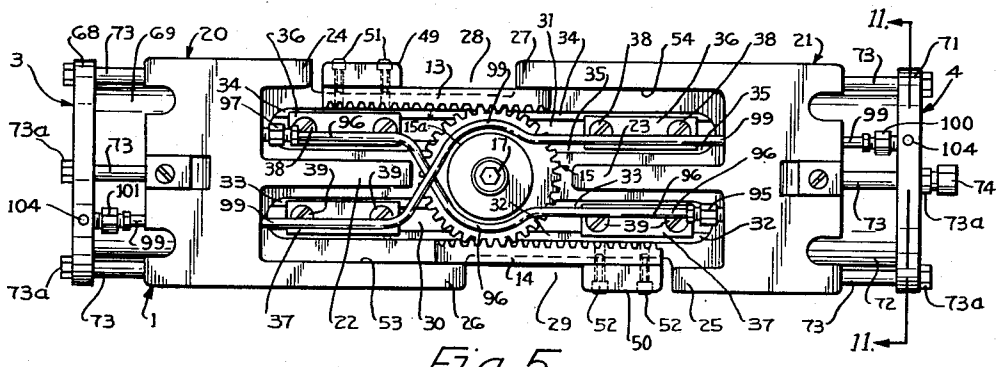
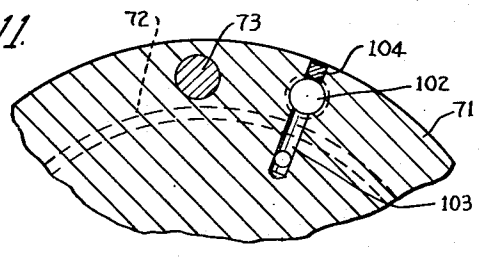


Fig 5.

Fig. 11.



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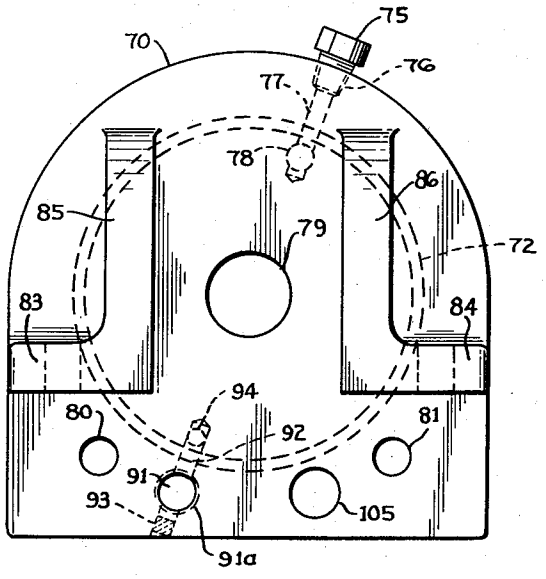


Fig. 8.

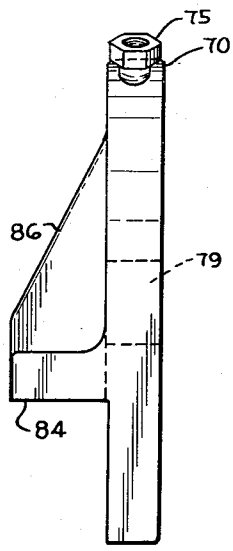


Fig. 9.

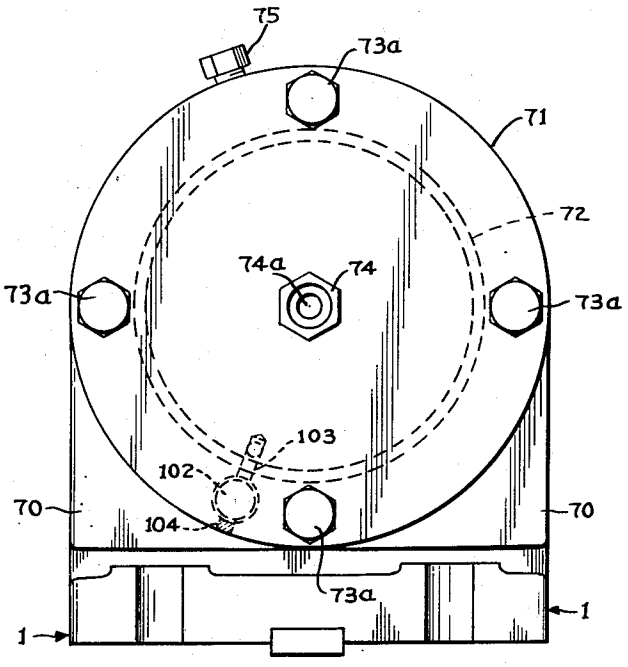


Fig. 10.

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PRECISION VISE OF THE DOUBLE-ACTING TYPE

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Application May 13, 1953, Serial No. 354,849

9 Claims. (Cl. 81—17.2)

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This invention relates to a precision vise of the double-acting type and, in particular, to a vise of this kind in which the jaws are moved by fluid pressure motors.

It has been known heretofore that under some circumstances one or both of the jaws of a vise may be moved by means of fluid pressure, but prior vises of these types have not so far as known afforded the advantages that result from having two fluid pressure motors in alignment with the jaws of the vise, particularly with the jaws so arranged as to act in synchronism with each other. According to the present invention, a pressure fluid from a common source is supplied simultaneously to two fluid pressure motors of the nature of power cylinders provided with pistons and piston rods on which the jaws of the vise are mounted. By aligning the jaws with the power cylinders in this manner, unnecessary power losses and leakage of pressure fluid can be precluded. At the same time, the synchronizing mechanism, which forms part of the preferred embodiment of the present invention, serves to maintain the jaws in the desired relation to each other and to the base of the vise regardless of whether the jaws are in open position, in closed position, or in any intermediate position.

One of the objects of the invention, therefore, is to provide a vise of the type described in which two aligned fluid pressure motors operate directly on the jaws of the vise with the intervention of only such indispensible connecting elements as piston rods, couplings, etc. Another object of the invention is to provide a vise of this kind in which the work piece may be located in the vise within a tolerance, plus or minus, of about .001 inch of the intended center. Another object of the invention is to provide a precision vise of this kind in which either or both of the jaws may be adjusted to accommodate unsymmetrical work pieces, this without sacrifices of the advantages that inure from the direct application of the motive force to the jaws of the vise. Still another object of the invention is to provide a precision vise of this kind in which relatively high clamping forces may be obtained, as, for example, clamping forces up to and above 2000 pounds. Still another object of the invention is to provide novel ways and means for guiding the jaws over the platform and along the sides of the base forming part of the vise.

Other objects and advantages of the invention will be apparent from the description which follows and from the accompanying drawings, in which:

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Figure 1 is a side elevation of the vise in open position, the pressure fluid lines being omitted in the interests of clarity.

Figure 2 is a corresponding central vertical section through the longitudinal axis of the vise, the false jaws shown in Figure 1 being omitted.

Figure 3 is a top plan corresponding generally to Figure 1 but showing the jaws in closed position.

Figure 4 is a top plan corresponding generally to Figure 2.

Figure 5 is a bottom plan corresponding to Figures 2 and 4 but showing the pressure fluid lines.

Figure 6 is a transverse vertical section on lines 6—6 of Figures 2 and 4.

Figure 7 is a transverse vertical section on line 7—7 of Figure 4.

Figure 8 is a front elevation showing the forward face of the inner cylinder head.

Figure 9 is a corresponding side elevation.

Figure 10 is an elevation of the outer cylinder head and base as seen from the rear of the vise; i. e., from line 10—10 of Figure 3.

Figure 11 is a fragmentary section through part of the outer cylinder head on line 11—11 of Figure 5.

Figures 1 to 7 are on a much reduced scale; Figures 8 to 11, on a somewhat larger scale but less than full scale.

The vise shown in the drawings includes an oblong base 1 best seen in Figures 1, 2 and 5. It incorporates a slotted platform 2 at the ends of which are mounted two fluid pressure motors 3 and 4, the same taking the form of power cylinders. Within the power cylinders are the pistons 5 and 6, to which are respectively connected piston rods 7 and 8. At the forward ends of the piston rods 7 and 8 are the master jaws 9 and 10, on which may be mounted false jaws 11 and 12 respectively. Connected to master jaws 9 and 10 are two racks 13 and 14 (Figure 5), one on each side of the vise. Located between racks 13 and 14 and co-operating with them is a stepped gear 15 mounted for rotation on a cap screw 16 the cap 17 of which bears against the narrow lower face 15a of the gear 15 and the threaded upper end 18 of which is screwed into platform 2. See Figures 2 and 6. A set screw 19 in a tapped access opening 19a (Figure 6) operates on threaded portion 18 to hold cap screw 16 in place.

As appears from Figure 5, base 1 is characterized by the two symmetrical end portions 20 and 21 from which longitudinally extending central webs 22 and 23, respectively, project toward the center of the vise. Each of the two central webs

22 and 23 is flanked by a short web on one side and a long web on the other, the short webs being designated 24 and 25 and the long webs being designated 26 and 27. As further shown by Figure 5, short web 24 is in alignment with long web 27; short web 25, with long web 26. Between them on opposite sides of the vise are formed the open areas indicated at 28 and 29 in Figures 4 and 5, such open areas being provided to accommodate hereinafter described portions of master jaws 9 and 10. As previously mentioned, platform 2 is slotted: as shown in Figure 4, it has two longitudinally extending machine-finished slots 30 and 31, one on each side of the longitudinal axis of the vise.

Along the long edges of slots 30 and 31 the lower face of platform 2 is machined to provide recessed guideways (Figure 5) which guideways parallel slots 30 and 31 throughout the lengths of the slots. As indicated in Figure 7, slot 30 is flanked by recessed guideways 32 and 33; slot 31 by recessed guideways 34 and 35. Co-operating with guideways 32 and 33 and guideways 34 and 35, respectively, are slideable keys 37 and 36, best seen in Figure 7, which keys are machined to fit accurately into the slots and guideways. Screws 38 and 39 hold the keys to master jaw 9, while similar screws hold two like keys to master jaw 10. The keys are T-shaped in transverse cross-section, their shanks projecting upward through the slots and their heads bearing against the recessed guideways that flank the slots. The threaded ends of screws 38 and 39 are received in tapped openings in overlying portions of master jaws 9 and 10.

As appears from Figures 1, 4 and 7, master jaws 9 and 10 are respectively characterized by horizontally extending portions 45 and 46, such horizontally extending portions 45 and 46 projecting rearwardly from vertically extending portions 47 and 48 to which false jaws 11 and 12 are applied as shown in Figure 3. The lower surfaces of longitudinally extending portions 45 and 46 and vertically extending portions 47 and 48 are machined to facilitate smooth movement of master jaws 9 and 10 across the machined upper face of platform 2. Master jaws 9 and 10 are further characterized by depending portions 49 and 50, seen in Figures 1 and 6, which portions depend below the level of platform 2 into the open areas 28 and 29 along the sides of the vise. Depending portion 49, seen in Figure 1, is integral with horizontally extending portion 45 and vertically extending portion 47 of master jaw 9; similarly, depending portion 50, seen at the left in Figure 6, is integral with horizontally extending portion 46 and vertically extending portion 48 of master jaw 10. Depending portion 49 is on the near side and depending portion 50 on the far side of the vise as seen in Figure 1.

Rack 13 is held in horizontal relation to depending portion 49 of master jaw 9 by screws 51 (Figure 5); similarly, rack 14 is held in horizontal relation to depending portion 50 of master jaw 10 by screws 52. The projecting portions of racks 13 and 14 are machined and extend forwardly into contact with machined inner surfaces 54 and 53 on long webs 27 and 26, respectively, such inner surfaces acting as guides for the racks in the manner indicated in Figure 6. As in the case of the upper face of the platform and the contacting portions of the master jaws, the webs and racks are preferably machined to close tolerances to facilitate smooth movement of racks 13 and 14 toward and from webs 27 and 26.

The vertical portions 47 and 48 of master jaws 9 and 10 are provided as shown in Figures 1 and 2 with horizontally extending slots 55 and, as shown in Figure 3, with vertically extending slots 56. The horizontally and vertically extending slots intersect as shown in Figure 6. To the rear of horizontally extending slots 55, master jaws 10 and 11 are drilled as indicated at 57*a* in Figures 4 and 6 to provide passages to accommodate the cap screws 57 that are employed to hold false jaws 11 and 12 in place. Cap screws 57 appear in Figures 1 and 3. They extend from openings 57*b* at the rear of vertically extending portions 47 and 48 into passages 57*a* and thence into tapped openings in false jaws 11 and 12. The relationship between cap screws 57, master jaws 9 and 10 and false jaws 11 and 12 is best seen in Figure 3.

Extending rearwardly from vertically extending portions 47 and 48 of master jaws 9 and 10 are the integral hub-like projections 58 and 59 which are provided to accommodate the threaded portions 60 and 61 of piston rods 7 and 8. Lock nuts 62 and metal washers 63 (Figure 2) are provided to keep master jaws 9 and 10 from working loose from piston rods 7 and 8. A stop collar 64 taking the form of a clamping ring is mounted on piston rod 8 as shown in Figures 2, 3 and 4. Stop collar 64 is held in place by a clamping screw 65. If such a stop collar is provided on either of the two piston rods, it is unnecessary to provide a similar stop collar on the other piston rod if, as in the preferred embodiment of the invention, the jaws are synchronized with each other.

Fluid pressure motor 3 at the left hand end of the vise as seen in Figure 1 is made up of an inner cylinder head 67, an outer cylinder head 68, and a cylinder wall 69, the latter being mounted in circular grooves on the inside faces of cylinder heads 67 and 68. Fluid pressure motor 4 at the opposite end of the vise is similarly constructed of an inner cylinder head 70, an outer cylinder head 71 and a cylinder wall 72. Stay bolts 73 are provided to hold the parts together and are so arranged that their heads 73*a* are accessible from the ends of the vise. If desired, they may take the form of studs mounted on inner cylinder heads 67 and 70, in which vase heads 73*a* will take the form of nuts threaded onto the outer ends of the studs. By these or similar means, fluid pressure motors 3 and 4 can be held together in a manner minimizing the possibility of leakage of the pressure fluid. Where piston rods 7 and 8 pass through inner cylinder heads 67 and 70, suitable seals of resilient material are provided as indicated at 67*a* and 70*a* in Figure 2. Where pistons 5 and 6 come into contact with cylinder walls 69 and 72, the pistons are provided with conventional O-ring seals held in suitably formed grooves, this construction of the pistons being illustrated in Figure 2.

As indicated in Figure 10, the rear face of outer cylinder head 71 has a tapped central bore 74*a* for receiving the threaded portion of a conventional metal coupling 74 through which a pressure fluid such as compressed air or oil under pressure may be supplied from an external source (not shown) including a connecting fluid line, a four-way valve, and a tank of the nature of a reservoir. As appears from Figure 8, inner cylinder head 70 is similarly provided with a radially mounted coupling 75 threaded into a tapped opening 76 communicating with a radial passage 77 extending to a point located interiorly of cylinder wall 72 and there it self communicat-

ing with a port 78 in open communication with the space between piston 6 and the inner face of inner cylinder head 70. By means of port 78, passage 77, opening 76 and coupling 75, the pressure fluid may be exhausted from the space between piston 6 and cylinder head 70 during the time when pressure fluid is being supplied to the space on the opposite side of piston 6, thus forcing piston 6 from right to left as seen in Figure 2.

When the four-way valve is reversed, pressure fluid is admitted to fluid pressure motor 4 through coupling 75 and exhausted from fluid pressure motor 4 through coupling 74, thus forcing piston 6 from left to right as seen in Figure 2. It is this movement of piston 6 that is limited by contact between stop collar 64 and the forward face of inner cylinder head 70. Thus the introduction and withdrawal of pressure fluid from opposite sides of piston 6 determines the position of the piston 6, piston rod 8, and master jaw 10.

Similar means, including couplings similar to couplings 74 and 75, may be used in the case of fluid pressure motor 3, but in the preferred embodiment of the invention such are not necessary and therefore are not shown in the drawings.

Whereas outer cylinder head 71 is circular as seen in end elevation, as in Figure 10, inner cylinder head 70 has the shape shown in Figures 8 and 9. In addition to a central bore 79 for piston rod 8, cylinder head 70 is provided with bores 80 and 81 for cap screws 82 which, as shown in Figure 1, help hold inner cylinder head 70 to base 1. The forward face of inner cylinder head 70 has two forwardly extending brackets formed integrally with the cylinder head itself, such brackets being seen in each of Figures 8 and 9. They consist of the horizontal projections 83 and 84 and reinforcing webs 85 and 86. As shown in Figures 1, 3 and 4, hold-down screws 87 serve to locate inner cylinder head 70 and hold it firmly in place on base 1, to which end forwardly extending projections 83 and 84 are provided with openings accommodating hold-down screws 87. Similar hold-down screws 88 are employed for inner cylinder head 67 of fluid pressure motor 3.

Referring again to Figure 8, which shows the forward face of inner cylinder head 70, it will be noted that a port 91 extends inwardly from the forward face of cylinder head 70. Port 91 does not pass completely through inner cylinder head 70 but terminates approximately midway between the forward and rear faces thereof. It is in communication with a radial passage 92, plugged as at 93 at its outer end, which is itself in communication with a port 94 that extends rearwardly from radial passage 92. Port 94 is in open communication with the space between piston 6 and the rear or inner face of inner cylinder head 70. Port 91 is tapped as indicated at 91*a* to accommodate the threaded portion of the external metal coupling 95 shown in Figure 5.

Attached to coupling 95 is a line 96 of copper, brass or the like which extends longitudinally toward the central zone of the vise, then curves around the edge of the narrow portion 15*a* of gear 15, and continues longitudinally toward the opposite end of the vise, where it is received in a similar coupling 97 at the base of inner cylinder head 67 of fluid pressure motor 3. Cylinder head 67 is provided with a threaded opening, an externally plugged radially extending passage and a port that are respectively similar to opening 91, passage 92 and port 94 in cylinder head 70. Thus the two fluid pressure motors are in constant communication with each other by means of line 96, such line equalizing the pressures obtaining in the spaces between the pistons and the inner cylinder heads.

A similar line 99 extends as shown in Figure 5 from a coupling 100 mounted at the base of the inner face of outer cylinder head 71 to a like coupling 101 mounted at the base of the inner face of outer cylinder head 68. As in the case of line 96, line 99 circles part way around gear 15. It crosses line 96 in the manner shown in Figure 5. Line 99 is used after the fashion of line 96 to equalize the pressures which obtain in the two fluid pressure motors in the spaces between the pistons and the inner faces of the outer cylinder heads. Where line 99 is coupled to the outer cylinder head, the latter has a threaded opening 102 extending part way through the cylinder head which threaded opening 102 is in communication with a radial passage 103 that is plugged as at 104: see Figures 10 and 11.

The construction shown in dotted lines in Figure 10 in the case of outer cylinder head 71 of fluid pressure motor 4 is duplicated in outer cylinder head 68 of fluid pressure motor 3. Where line 99 passes through inner cylinder head 70, the latter is provided with an opening 105 (Figure 8). There is a counterpart opening for line 99 in inner cylinder head 67. Immediately to the rear of such openings for line 99, base 1 is provided with similar openings (not shown).

It is the construction just described, making use of crossed lines 96 and 99, that makes it possible to dispense with couplings on fluid pressure motor 3 analagous to couplings 74 and 75 on fluid pressure motor 4. While external connections to couplings 74 and 75 are necessary, the need for like external connections to fluid pressure motor 3 is obviated. In lieu thereof, the two fluid pressure motors are interconnected by lines 96 and 99, the former of which presents less of a problem than the latter in view of the fact that it extends from coupling 95 to coupling 97 without having to pass through the base or any of the various cylinder heads. Line 99 of course requires that the end portions of the base and the two inner cylinder heads be provided with aligned openings at each end of the vise through which line 99 can pass from coupling 100 to coupling 101.

With the apparatus illustrated in the accompanying drawings, either a gaseous or a liquid pressure fluid may be employed, although preferably it is compressed air under a pressure of from about 5 to about 100 lbs. per square inch. By suitably varying the pressure within these or other limits, a force of varying magnitude can be developed in the zone where the work piece is grasped by false jaws 11 and 12. In a typical case, the piston has a diameter of 3½ inches exclusive of the O-ring seal, so that clamping forces of magnitudes up to about 2000 lbs. may be obtained without difficulty. These forces are exerted in such a way that the resultants of all forces acting on the two jaws are not only in opposition to but also in perfect alignment with each other.

The incorporation in the assembly as a whole of gear 15 and racks 13 and 14 introduces a synchronizing mechanism into the vise. Although preferably present, such synchronizing mecha-

nism may be omitted if desired. At no time is any clamping pressure transmitted through the synchronizing mechanism. Its function is to provide uniformity of travel between the two extreme positions of the jaws illustrated in Figures 1 and 3, in the former of which the jaws are fully open and in the latter of which the jaws are closed together.

Where, as in the described embodiment of the invention, the parts experiencing relative movement are machined to close tolerances, the center of the work piece may be located within plus or minus .001 inch of the established center lines, both horizontally and vertically. In the embodiment of the invention shown in the drawings, each jaw is independently adjustable with relation to such center line, as by means of lock nuts 62 and washers 63 on threaded portions 60 and 61 of piston rods 7 and 8. Thus the jaws can be readily moved as needed to accommodate unsymmetrical work pieces. If desired, the same result may be obtained by using non-identical false jaws in place of the identical false jaws 11 and 12.

Thus the vise of the present invention is a precision tool adapted to locate centers or other predetermined points regardless of the shape or varying size of the work. As a result of the construction of the base and the manner of mounting the fluid pressure motors, the vise is strong and sturdy. By virtue of the manner in which the jaws are guided on the platform, lost motion is virtually an absent factor. The close limits of accuracy required for fine work are met; in consequence, the vise may be used for such precision operations as chamfering, countersinking, counterboring, end milling, drilling, tapping, reaming, etc., as well as for various unrelated operations such as tube spinning and tube expanding. In ordinary circumstances not more than about two square feet of bench space are required and, unless otherwise desired, only four bolts art the four corners of the base are necessary to hold it in position.

It is intended that the patent shall cover, by summarization in appended claims, all of the various features of patentable novelty that reside in the invention.

What is claimed is:

1. A precision vise of the double-acting type comprising an elongated base; two opposed fluid pressure motors on said base, one at each end thereof, with their axes of reciprocation disposed above the top portion of the base, parallel to the axis of the base, and in alignment with each other; opposed jaws mechanically connected to the two motors, one to each thereof, in such manner that simultaneous movement of the motors simultaneously urges the jaws toward or from each other; depending portions on said jaws formed integrally with the jaws themselves, said depending portions projecting downward below the bottom of the top portion of the base; and, between the depending portions of the jaws, means for synchronizing movement of the jaws, said means comprising two oppositely projecting racks carried by the depending portions of the jaws the ends of which racks are guided by rack-guiding surfaces on the base and an intervening gear on the bottom face of the top portion of the base which gear cooperates with the racks to synchronize the movement of the jaws.

2. A precision vise of the double-acting type comprising an elongated base that is slotted lengthwise of the base on each side of its longitudinal axis; two opposed reciprocatory motors on said base, one at each end thereof, with their axes of reciprocation disposed above the top portion of the base, parallel to the axis of the base, and in alignment with each other, opposed jaws mechanically connected to the two motors, one to each thereof, in such manner that simultaneous movement of the motors simultaneously urges the jaws toward or from each other; depending portions on the jaws projecting downward below the bottom of the top portion of the base, said depending portions carrying oppositely projecting racks parts of which are in contact with rack-guiding surfaces on the base; a gear intervening between and cooperating with the racks to synchronize the movement of the jaws, said gear being mounted for rotation about a vertical axis below the bottom of the top portion of the base; guideways on the bottom of the top portion of the base; and, projecting downward from the two jaws through the slots in the base, a plurality of guide members each of which coacts with at least one of the guideways.

3. A precision vise as in claim 2 in which the motors are fluide pressure motors.

4. A precision vise as in claim 3 in which the fluid pressure motors take the form of power cylinders.

5. A precision vise of the double-acting type comprising an elongated base; two opposed fluid pressure motors on said base, one at each end thereof, with their axes of reciprocation disposed above the top portion of the base, parallel to the axis of the base, and in alignment with each other; opposed jaws mechanically connected to the two fluid pressure motors, one to each thereof, in such manner that simultaneous movement of the motors simultaneously urges the jaws toward or from each other; depending portions on the jaws projecting downward below the bottom of the top portion of the base, said depending portions carrying oppositely projecting racks parts of which are in contact with rack-guiding surfaces on the base; a gear intervening between and cooperating with the racks to synchronize the movement of the jaws, said gear being mounted for rotation about a vertical axis below the bottom of the top portion of the base; fluid pressure lines connecting the near ends of the motors with each other and connecting the far ends of the motors with each other; and, at opposite ends of one of the motors, connections for admitting and exhausting pressure fluid.

6. A precision vise as in claim 5 in which the fluid pressure lines are located within the base itself below the bottom of the top portion of the base.

7. A precision vise as in claim 6 in which the fluid pressure lines cross immediately below the gear in the central zone of the vise.

8. A precision vise of the double-acting type comprising an elongated base; two opposed fluid pressure motors on said base, one at each end thereof, with their axes of reciprocation disposed above the top portion of the base, parallel to the axis of the base, and in alignment with each other; opposed jaws mechanically connected to the two motors, one to each thereof, in such manner that reciprocatory movement of the motors urges the jaws toward or from each other; depending portions on the jaws projecting downward below the bottom of the top portion of the base, said depending portions carrying oppositely projecting racks parts of which are in contact with rack-guiding surfaces on the base; a gear intervening between and cooperat-

ing with the racks to synchronize the movement of the jaws, said gear being mounted for rotation about a vertical axis below the bottom of the top portion of the base; guideways on the bottom of the top portion of the base; and, co-acting with said guideways, guide means projecting downward from the two jaws into proximity to said guideways.

9. A precision vise of the double-acting type comprising an elongated base that is slotted lengthwise of the base on each side of its longitudinal axis; two opposed fluid pressure motors on said base, one at each end thereof, with their axes of reciprocation disposed above the top portion of the base, parallel to the axis of the base, and in alignment with each other; opposed jaws mechanically connected to the two motors, one to each thereof, in such manner that simultaneous movement of the motors simultaneously urges the jaws toward or from each other; depending portions on the jaws projecting downward below the bottom of the top portion of the

base, said depending portions carrying oppositely projecting racks parts of which are in contact with rack-guiding surfaces on the base; a gear intervening between and cooperating with the racks to synchronize the movement of the jaws, said gear being mounted for rotation about a vertical axis below the bottom of the top portion of the base; double guideways flanking the slots on the bottom of the top portion of the base; and, projecting downward from each of the two jaws through the slots in the base, a plurality of inverted T-shaped guide members, each of which co-acts with one of the double guideways.

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