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Pevar

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[54] **CONTOUR-CONFORMING CLAMPING DEVICE**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 237,111, April 27, 1972, abandoned.

[52] **U.S. Cl.** **269/26,** 269/266, 269/267

[51] **Int. Cl.** **B23q 3/00**

[58] **Field of Search** 269/24, 26, 35, 266, 267, 269/309, 310, 311, 314

[56] **References Cited**

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[57] **ABSTRACT**

This application discloses a clamping device for efficient application and distribution of clamping forces over engaged flat and contoured objects by utilization of multiple, movable engaging elements and thereby rendering more efficient use of the total applied force and avoiding harmful concentrated loads against objects being held. It includes adjacent gripping jaw members having closed-end bores in which tubular arbors supply pressure fluid, such as hydraulic liquid, from a common manifold and pressure reservoir for supplying member-distending fluid, together with means for controlling fluid flow and means providing for fluid supply from outside the internal fluid system.

10 Claims, 6 Drawing Figures

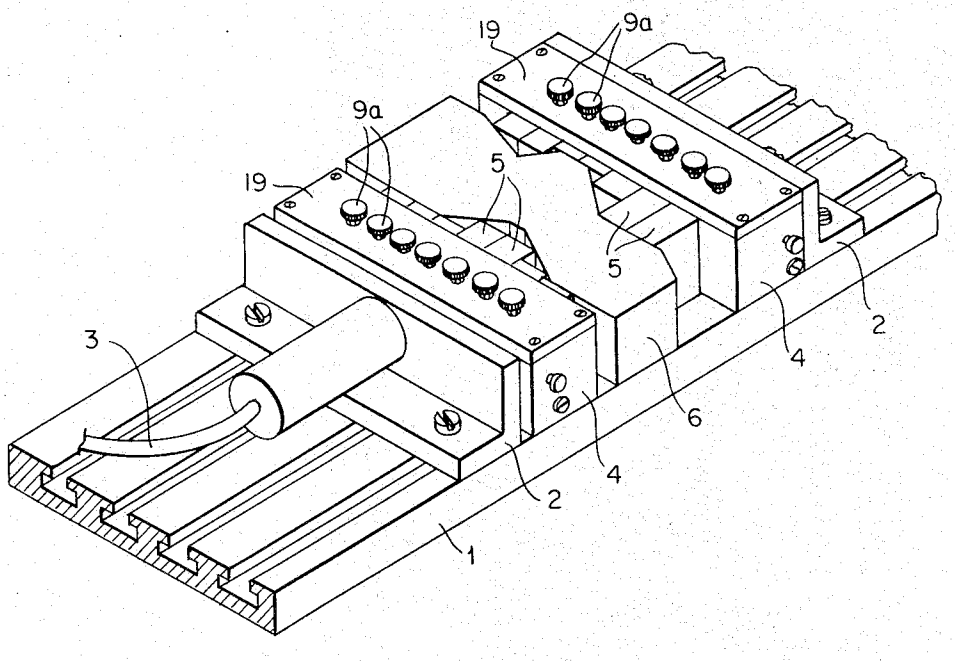
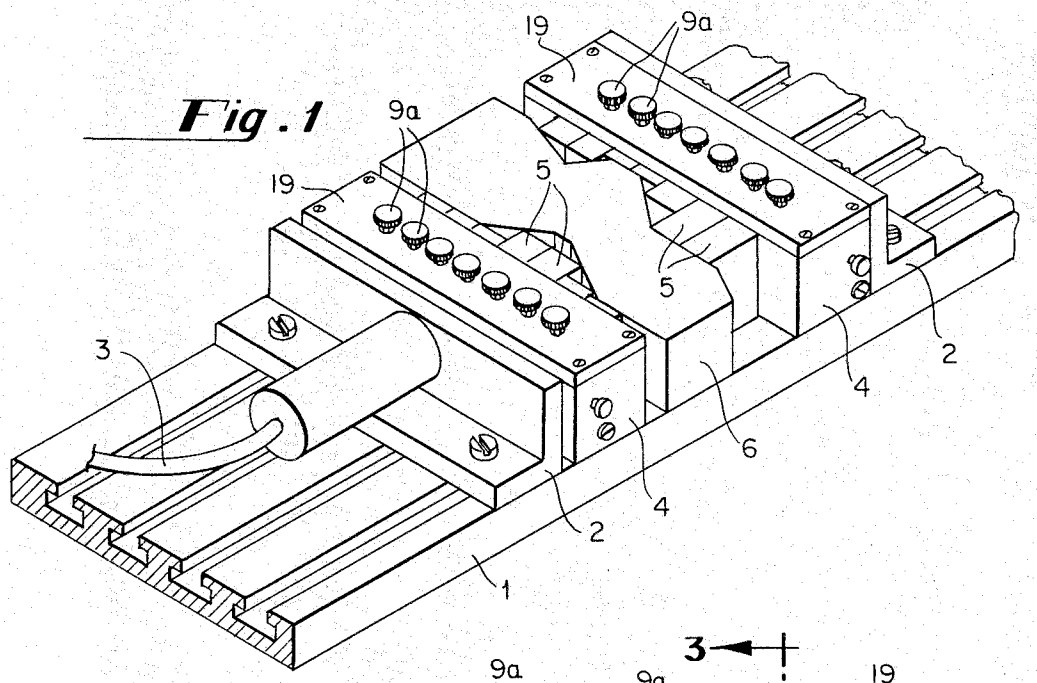


Fig. 1



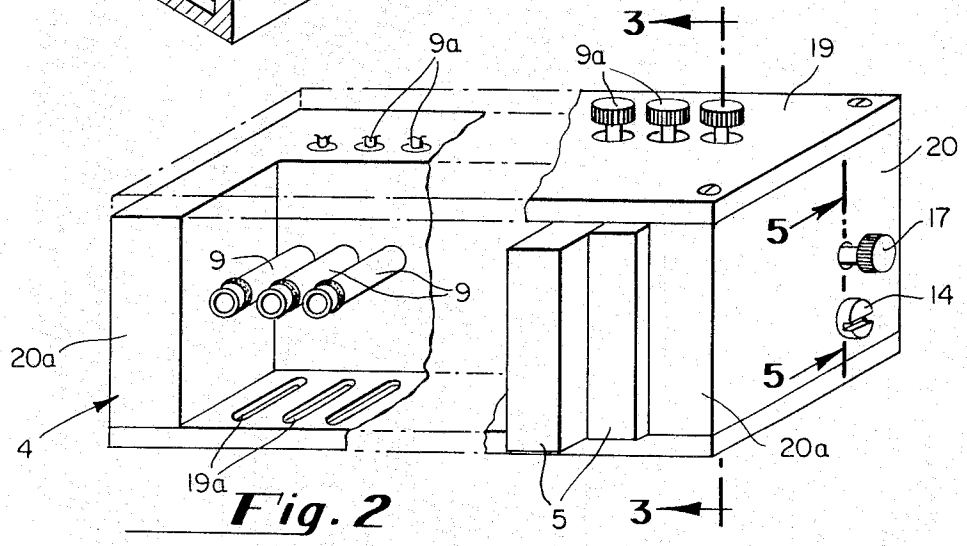


Fig. 2

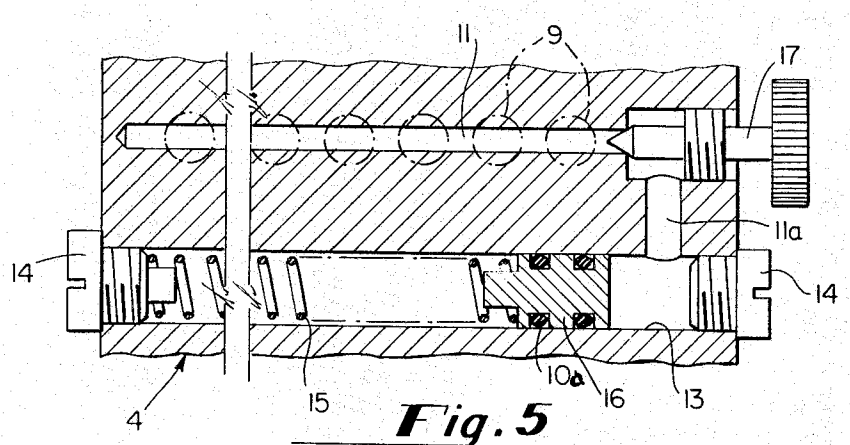


Fig. 5

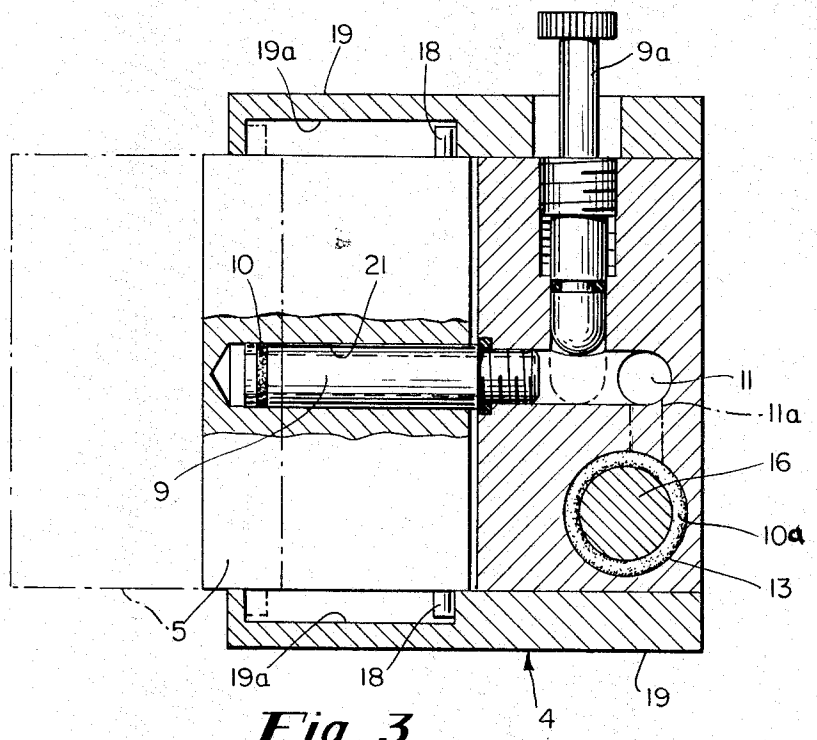


Fig. 3

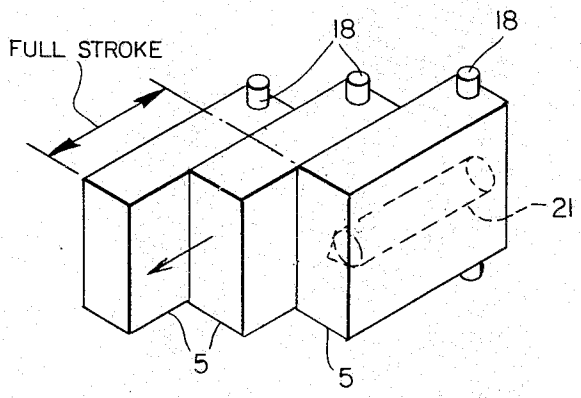


Fig. 4

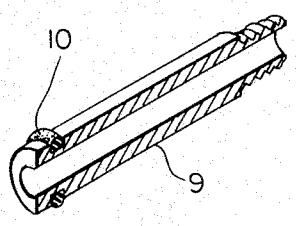


Fig. 6

CONTOUR-CONFORMING CLAMPING DEVICE

RELATED APPLICATIONS

This application is a continuation-in-part of my pending application, Ser. No. 237,111, filed Apr. 27, 1972, now abandoned.

BACKGROUND AND SUMMARY OF INVENTION

The present invention relates to contour-conforming clamping devices which apply distributed force, especially to devices for holding objects firmly to permit work to be done on them, and has for an object the provision of improvements in this art.

The devices disclosed herein may have a great variety of uses but one use which may be mentioned as particularly suited for the use of the present device is for holding parts for machine shop operations, such as drilling, milling and planing.

In recent years considerable effort has been placed on adapters and jigs to provide greater holding force on objects in bench vises, milling machine bed vises, magnetic chucks, etc. This effort is demonstrated by the large variety of adapters presently being marketed. The basic problem is that a contoured part when placed between the flat jaws of vises is contacted by point and line engagement. Therefore, when the vise is closed on the object greater loads than desirable are concentrated in these points, often marring the surface of parts and often brinelling them when the object is made of material softer than the jaws of the vises.

This need for better distribution of load is exemplified by the present use of metal powder-filled plastic molds cast to object contours wherein the mold when set up is placed between the object and the vise jaw and when the vise is closed the load is distributed through the plastic mold against the object. Also material such as low melting point castable metal alloys are used for mold material. The problem with these methods is that an individual mold must be cast for each different shaped part. Also, such mold materials often break and deform under load. They also require time and labor to prepare.

Devices for engaging object contours have been produced in recent years. One such device uses adjustable sliding wires for tracing a variety of contours for lofting purposes. It does not apply holding force against the object. Another such device, shown in my U.S. Pat. No. 3,363,209, Contour Conformable Magnetic Adapter Device, Jan. 9, 1968, uses sliding ferromagnetic laminates to transmit magnetic flux into contoured parts of ferromagnetic material more efficiently. Application of force is not easily achieved by this device and large forces would require extremely large electrical equipment. The device is not suitable for applying force to non-magnetic objects such as aluminum and titanium.

None of the aforesaid devices have as objects those of the present patent disclosure which shall be demonstrated by the following objects of the present invention.

One of the particular objects of the invention is to provide adapter devices comprised of multiple jaw members activated by an internal hydraulic system thereby providing equal load to each engaging jaw member and distributing the holding force over the surface of the object.

Another object of the invention is to utilize these adjustable hydraulic activated jaw members in the design of vises, grinding chucks, two and three axis table holding arrangements, and the like.

Another object of the invention is to utilize existing shop air and hydraulic lines directly into the housing and jaw arrangements to directly apply the force against the jaw members thereby forcing them against the object being held.

Another object of the invention is to utilize various hydraulic and accumulator arrangements in these devices with valving controls to allow for the rigidizing or maintaining of the set contour and thereby be able to place part after part of the same geometry within the jaws with least effort and maximum ease in positioning for similar operations.

Another object of the invention is to provide means wherein the stroke of the jaw members is of controlled distance and that the jaw members are restrained from being extended excessively to get out of operative position or be separated from the assembly.

The above and other objects of the invention, as well as various novel features and advantages, will be apparent from the following description of an exemplary embodiment, reference being made to the accompanying drawings, wherein:

DRAWINGS

FIG. **1** is an isometric view of a pair of self-aligning jaw devices of the present invention adapted to a milling machine vise and applying a distributed holding force on a contoured part;

FIG. **2** is an isometric view of a cut-away section of a single self-aligning device with a view of arbors, jaw, and jaw retaining arrangement;

FIG. **3** is a cut-away section taken on line **3—3** of FIG. **2** with the jaw partially extended;

FIG. **4** is a view of three adjacent jaw members at zero, half and full stroke;

FIG. **5** is a cut-away view along line **5—5** of FIG. **2** of the manifold arbor and accumulator arrangement;

FIG. **6** is a sectional view of an arbor along line **6—6** of FIG. **3.**

SPECIFIC DESCRIPTION

As shown in FIG. **1,** a workpiece **6** of varying geometry or contour is held for a machine shop operation on a milling machine bed **1,** as by positioning the workpiece between a pair of self-aligning clamping devices **4** with self-aligning jaw members **5** engaging the workpiece along its contoured surface. The self-aligning clamping device **4** is positioned on the sliding vise **2** by bolts, set screws or the like. The sliding vise **2** is adjustably positioned to the machine bed **1** by bolts, set screws or the like. The sliding vise uses fluid from an external hydraulic system fed by line **3,** FIG. **1,** to apply force against the face of the vise.

A feature of the present invention is to utilize this pressure fluid applied force to activate the self-aligning jaw members **5** by means of the hydraulic system.

Tubular arbors **9** are fitted into openings to a housing base **20** and these openings connect with a manifold chamber **11.** Manifold chamber **11** is connected by a by-pass passage **11a** controlled by a valve **17** to accumulator or reservoir chamber **13.** The reservoir chamber **13** is shown as extending completely through the housing base **20** and having threaded end openings

which are shown to be closed by removable plugs **14** which may be removed and replaced by external pressure fluid line connections for filling the system with fluid under pressure when desired. The arbor of this embodiment has an O-ring seal **10** which engages in a bore **21** of the jaw member **5.** The jaw member is slidable along the arbor, being moved outward by means of the hydraulic fluid applied through the end of the arbor within the bore of the jaw member, and being moved inward by force applied against the end of the jaw member in any suitable manner, as by hand, by engagement with a workpiece, or otherwise.

Another feature of this invention is to include a controlled stroke distance by geometrically fixing the length of the arbor **9** to the depth of the bore **21** within the jaw member. Retaining lips or projections **18** on the jaw members **5** slide along closed end grooves **19***a* in the top and bottom lids or covers **19.**

When adapting the present invention to standard bench vises with limited opening within the vise, the accumulator feature, shown herein, becomes significant. Full utilization of the jaw stroke is achieved by retracting all jaw members **5** by externally applied force with the accumulator by-pass valve **17** open. The long-stroke accumulator spring **15** behind piston **16** with O-ring seals **10**a is thereby compressed. The jaw members **5** remain in the retracted position if the valve **17** is closed. A part to be held is placed in the vise and the valve **17** is opened. The accumulator spring **15** extends, forcing liquid out of the tubular arbors and moving the jaw members **5** into engagement with the work. The accumulator valve **17** is then again closed. The vise **2** is then actuated, applying force against the work. The hydraulic system herein shown distributes the force to all jaw members thereby applying uniform force against the work.

It will be apparent that within the range of permissible movement between the jaw members **5** the jaw members will fit any article curvature, positive or negative, or partly both, and thereby the holding force against the part will be distributed uniformly between the jaw members. The external force applied to the vise may be by screw, as in conventional vises, or by air and hydraulic pressure and other means apparent to those skilled in the mechanical arts.

If desired, an entire vise or work bench may be outfitted with self-aligning jaw clamping arrangements of the present invention, making the jaws integral with the construction of such vises and benches and the like.

The arrangement of FIG. **1** may be adapted to grinding chucks, and may be constructed vertically to provide up or down force for deep drawing and hold-down operations. Another such utilization is to construct a flat table with vertical sides wherein the jaws protrude from the bottom and sides, thereby providing three-axis holding of difficult to hold items.

If desired, the arbor can be manufactured from high strength heat treated alloy steel in order to sustain higher bending moments.

Another feature of the invention is to utilize replaceable jaws which can be of various hardness depending on the hardness of the work to be held. Tool steel jaws are suitable for hard steel whereas mild steel and aluminum jaws might be favored for holding aluminum and brass parts. Hard rubber and plastic jaws might be more favored for holding glass and ceramic parts. The present arrangement provides ready exchange of jaw members, as by removing the covers **19,** pulling the jaw mambers off the arbors and putting on other jaw members.

Multiple valving can be accomplished at the jaw members to allow each jaw member to be locked individually in position after adjustment and prior to applying force against the work by closing the passages to the arbors by valves **9***a*.

The arrangement of tubular arbors within the bores of the clamping jaw members has a number of important advantages over prior arrangements in which the jaw members were carried by the piston members of cylinder-piston actuating devices. It serves as a structural support within the jaw member. It reduces the axial space because the power-actuating device is disposed within the jaw member instead of being external to it. It allows the inner ends of the jaw members to be of non-round shape, here rectangular, so as to be readily arranged in guides to hold the workpiece for close working tolerances. And it allows the inner ends of the jaw members to fit closely against each other and against retaining guide means and side retaining means, here the end projections **20**a of the housing and the retaining cover plates **19,** to hold the workpiece more firmly for greater precision in maching operations.

If the fluid is confined in the manifold chamber **11,** as by having the by-pass valve **17** closed, the jaw members **5** can have some adjustment by transfer of fluid between each other through the common manifold chamber. However, for this to be permissible the jaw members must initially be in an intermediate position, preferably near their mid-height position, because if they are all in the innermost position, none can be moved down further relative to the others, and if they are all in their outermost position, none can be moved out further to provide space for fluid forced back by other jaw members.

However, by providing an ample accumulator chamber, by-pass or main control valve, and separate jaw member valves, a wide range of adaptation and control and locking in position can be achieved. The vise parts, fixed and movable, provide for exerting any desired force on the jaw devices, jaw members, and workpiece after the jaw members have properly engaged the workpiece.

The internal accumulator reservoir chamber is handy but it can be seen that, with the main supply valve **17** and the individual jaw member valves **9***a* hereby provided, the same measure of control can be achieved by using direct connection to external pressure fluid lines instead of using the accumulator, as stated above, as by removing a plug **14** at the by-pass end and connecting a pressure fluid line to the threaded opening for the plug.

While one embodiment of the invention has been illustrated by way of example, it is to be understood that there may be various embodiments and modifications within the general scope of the invention.

I claim:

1. A contour-conforming clamping device for applying uniformly distributed clamping engagement with contoured objects, said device comprising a housing base provided with a plurality of pressure fluid supply passages, a plurality of tubular arbors affixed to the housing base and having their interior tubular spaces separately in fluid connection with said supply passages, a plurality of closely adjacent vise jaw members

having outwardly-closed inwardly-open bores slidably receiving said tubular arbors interiorly thereof, said tubular arbors and the bores of said jaw members having sealing means therebetween, and openings in the arbors beyond said sealing means for supplying fluid within the bores of said vise jaw members in chambers of variable length between the ends of said arbors and the ends of said bores to urge the jaw members outward, and means for retaining said vise jaw members in sliding operative position on said tubular arbors.

2. A clamping device according to claim **1,** wherein said base is provided with a common manifold chamber, the tubular spaces within all tubular arbors and their fluid passages communicate with said common manifold chamber, and which further includes a separately operated cut-off valve for each supply passage which admits fluid to or from said manifold chamber to extend the vise jaw member or allow its retraction when the valve is open and which locks fluid within the member bore when the valve is closed to hold the vise jaw member against yielding return movement.

3. A clamping device according to claim **1,** wherein said base is provided with a common manifold chamber, the tubular spaces within all tubular arbors and their fluid passages communicating with said common manifold chamber, a fluid supply reservoir chamber in said base, a by-pass passage between said fluid supply reservoir chamber and said manifold chamber, and a cut-off valve for said by-pass passage which admits the passage of fluid through said by-pass passage for extension or retraction of said vise jaw members when the by-pass valve is open and which locks fluid in said manifold chamber and bores to hold the vise jaw members against group retraction when the by-pass valve is closed.

4. A clamping device according to claim **1,** wherein a removable jaw-retaining side cover plate is provided for said vise jaw members, said side cover plate having means which cooperate with means on said vise jaw members for retaining said vise jaw members in sliding operative position on said tubular arbors.

5. A clamping device according to claim **4,** wherein said retaining means for said vise jaw members comprises cooperating projections and closed-end grooves on said vise jaw members and side cover plate.

6. A clamping device according to claim **3,** wherein each of said arbor passages is provided with a cut-off valve to allow passage of fluid when the valve is open and to lock fluid in the bore of a vise jaw member to hold the vise jaw member against yielding return movement when the valve is closed.

7. A clamping device as set forth in claim **3,** which further includes means in said supply reservoir chamber for urging the flow of fluid from said supply reservoir chamber into said manifold chamber.

8. A clamping device as set forth in claim **6,** which further includes means in said supply reservoir chamber for urging the flow of fluid from said supply reservoir chamber into said manifold chamber.

9. A clamping device as set forth in claim **7,** in which said means for urging fluid from said supply reservoir chamber comprises a piston and resilient means urging said piston in the direction to force fluid from said supply reservoir chamber toward said by-pass passage and manifold chamber.

10. A clamping device as set forth in claim **4,** wherein said sealing means comprises sealing rings carried by said arbors adjacent their outer ends.

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