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(54) **Pneumatic vice with incorporated control and safety device**

(57) These vices consist of a base (1) containing special single-action pneumatic groups (2) acting on a slide (3) that slides in a channel machined on the back of the base. Contained in the base, without requiring any increase in size, is the command (4) for the adjustable loads of pre-clamping and clamping and of a check valve located before the pistons.

The groups transmit to the slide their thrust, multiplied by the 90° levers (5) with fulcrum in the base, and push the slide through cylindrical surfaces centered at the ends of the short arms and a minute travel (Δ) in such a way that the mating points between the 90° levers and the slide remain always on the same plane. The mobile shoulder (7) can be locked onto the back of the slide through special means in adhesion to the part to the clamped.

Lateral springs (10) in the slide provide for its return. A screw (18) serves to push the slide by (Δ) in the absence of air.

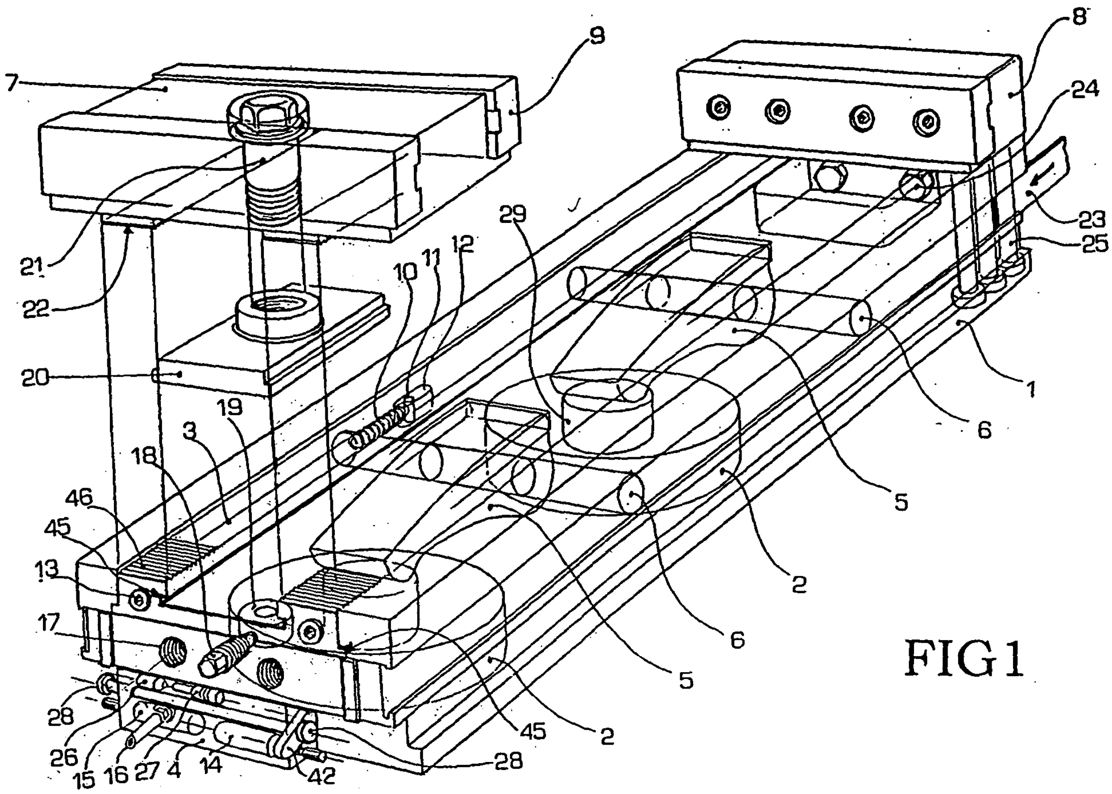

FIG1

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Description

[0001] This invention consists of pneumatic vices able to replace, with great advantages, all of the currently used types of vice (mechanical screw, hydraulic, or pneumatic) for clamping place parts to be processed on automated process machines.

[0002] On these machines, up to now, the only important operation that has remained manual is the clamping of the parts. The operator mounts the part to be processed on a screw vice, pre-clamps it lightly and beats it to settle it on the rests, then clamps it definitively, frequently with the aid of a maul. This operation requires extensive time, is physically fatiguing, and does not guarantee perfect repeatability of clamping on a series.

[0003] Consequently, there is a strong demand on the international level for a system of automating this important operation too, preferably with pneumatic vices, since all of the machines have compressed air available for tool changing and other functions and considering that work benches are already predisposed for the arrival of compressed air for blowing away chip after machining.

[0004] The present-day pneumatic and hydraulic vices have not managed, except in a few special cases, to replace mechanical screw vices, due to the following five disadvantages:

1) Danger of ruining a part due to loosening of the clamping caused by sudden pressure drop due to breakage in the pipes, given that the commands are generally outside of the machine; or due to the inevitable slow pressure drop if the parts must remain clamped for long periods (work shifts, weekends, etc.).
2) Complicated, expensive connections between the work benches on which the vices are placed and the outside of the machine where the controls must be placed, connections made even more complicated by the fact that these vices are usually double-action, by the difficulty of traversing the shields placed around the work bench as seal for the cooling jets, and by the translation and rotation movements of the bench during machining. These problems become even greater for hydraulic vices, which almost always operate above 200 atmospheres and have much stiffer, bulkier pipings and which, moreover, require the installation of expensive pumping units.
3) Much larger overall dimensions of mechanical vices (almost triple the size, at the same performance level).
4) Excessive weight (almost triple) with consequent difficulty in handling.
5) Excessive costs (almost quadruple) as compared to screw vices with equivalent force and clamping length.

[0005] Up to now these five disadvantages have restricted the application of pneumatic vices to a limited number of small process machines (e.g., for the production of window frames) and that of hydraulic vices to heavy machines or for very large series.

[0006] The new solution, subject of this patent application, resolves the 5 points listed and thus makes it possible to fabricate vices that perform automated clamping of parts with a single internal connection with the air that is present on all work benches for blowing away chip.

[0007] It also presents a further advantage as compared to mechanical screw vices, given that, length being the same, it can be used to clamp parts twice the size (for vices of medium length), thus upgrading the production capacity of the machines, since very large parts can be processed in a shorter time and with adjustable preloading and loading that is precise and repetitive.

[0008] Moreover, it can advantageously replace the present-day hydraulic vices since, overall dimensions being the same, it provides much higher clamping forces, nearly double the clamping length, and requires much shorter working times, with decidedly lower costs of the vice and its installation.

[0009] This result has been made possible by:

1) A special pneumatic group, preferable simple-action with piston, arranged with the axis perpendicular to the plane of the vice's base and acting on the long end of a 90° lever with fulcrum in the base, which pushes with the end of the short arm a slide moving in a guide machined on the back of the base, transmitting to it a slight movement (Δ) and the load multiplied by the ratio of the arms.

[0010] A fundamental characteristic of this group is that, thanks to the particular geometry of the load transmission between 90° lever and slide, and to its reduced dimensions, it is possible to have several pneumatic groups operating in series on the same vice, so as to exploit for the clamping of the parts the sum of the forces transmitted by the various groups to the slide and from it to the part.

[0011] Already with two groups, loads approximately 40% higher than those required for the most demanding processes can be obtained. With 3 groups the loads obtainable are so high as not even to be hypothesized in the reasonable future.

[0012] Basically, the short arms of the 90° levers act like the teeth of large toothed wheels that engage and push the slide, which may be compared to a rack with very particular toothing, given that the contacts remain always on the same plane as the axis of the slide.

[0013] Each group consists of a piston having a disk of minimum thickness, since it must house a single gasket (but of the highest quality) followed by a central guide appendix of minimum axial dimensions, since the thrusts transmitted to the piston by the end of the 90° lever are always coincident with its axis. This is because the end of the 90° lever arm describes a circle tangent to the piston axis with the travel astride the point of tangency.

The end of the short arm too describes a circle tangent to the longitudinal axis of the slide and the short travel (Δ) transmitted by the short arm of the 90° lever to the slide is astride the tangency point, half before and half after, and may thus be considered as a straight line coincident with the axis itself. The mating surfaces between 90° lever and slide consist of a portion of cylinder with axis in the end of the short arm and a portion of cylinder of much larger diameter on the slide. Since the 90° lever is treated for the maximum hardness attainable in the current state of technology and is perfectly polished while the slide is hardened to a lesser degree, for a reduced thickness and with rather tender core, at the first clamping the high loads transmitted by the 90° lever produce on the slide a minor permanent set and an initial polishing without further bedding or wear. This behavior has been verified on a number of 90° levers in experimentation of 500,000 cycles with clamping force of 100,000 Newtons.

[0014] The slide returns to its original position when the part is unlocked, through the action of two springs of small diameter but notable length housed in two holes drilled in the two outer edges of the slide. The holes terminate in two slots machined in the face of the slide turned toward the base. Two pins fixed on the base and extending into the two slots serve as the fixed points on which the forces of the two springs are released. The latter are assembled when the slide is already positioned on the vice, and are loaded by means of two dowels screwed at the ends of the holes turned toward the outside of the vice.

[0015] With this solution we obtain strong, practically constant forces for the slide's return, so as to ensure constant contact between the cylindrical surfaces thrusting on the 90° lever-slide. No additional dimensions are required for the arrangement; it is easy to assemble and contributes substantially to reducing the size of the vice and to the adoption of single-action pistons, which is in turn determinant for reducing the axial dimensions of the pistons and the pneumatic groups as well as for allowing compressed air to be brought easily to all of the pistons through a single hole in the center of the base.

[0016] The pneumatic groups described above can also be realized reversed, that is, with the pressurized chamber located above in the vicinity of the slide. This solution has the advantage of eliminating the seals used to keep fluid from the cooling jets from entering the piston chambers, as well as eliminating the need to discharge air from the chamber opposed to that of thrust when the piston moves; this is because, in this solution, the chamber is not closed but open and in communication with the recesses housing the 90° levers.

[0017] With this solution it is possible to realize self-centering vices with much smaller vertical dimensions, by placing at the sides of an upside-down piston two upside-down, specular 90° levers. The piston drives the ends of the two long arms downward while the short arms command two opposed slides, also specular, which, through two mobile shoulders lockable on the slides through the means described below, ensure self-centering clamping of the part.

2) Designing a command and safety unit so compact as to be housed in the body of the vice at the operator's end, that is without adding any further length to the vice.

[0018] The dimensions of this device, suitable also for vices of large size (clamping of 100,000 Newtons) are smaller than those of a packet of cigarettes, giving it a volume that is smaller by almost two orders of magnitude than that of the equivalent command units serving the same functions now available on the market.

[0019] There are 2 opposed micro pressure reducing valves providing continuous regulation of pressure as well as bedding loads and final clamping loads, a small manometer to display the regulated pressure values, an axially guided check valve of extreme sensitivity and perfect seal with O-ring placed near the exit of the regulated air to the pistons to prevent any lowering of pressure during machining or in any case with the vice pressurized. Coaxial with the valve is a micro piston that keeps it forcibly open when the vice is discharging.

[0020] The device also includes a 3-position distributor:

A) Position (A) corresponds to open vice, i.e., with discharging pistons. This is possible because this position of the distributor cylinder also allows the plant pressure to arrive at the micro piston that keeps forcibly open the check valve placed on outlet to the command device prior to the piston intake. This position is guaranteed against accidental actuation by a lever-actuated safety device.

B) Position (B) puts the pistons in connection with the first pressure level obtained by means of the first micro pressure reducing valve and corresponding to the desired bedding load.

Contemporaneously, this position of the distributor cylinder puts in discharge the micro piston coaxial to the check valve. The micro piston withdraws and the check valve is enabled and ready to intervene against any drop in pressure.

C) Position C connects the pistons with the second pressure level obtained by means of the second micro pressure reducing valve and corresponding to the final clamping load.

[0021] In this position too, the check valve is enabled and a lever-actuated safety device ensures against accidental actuation.

[0022] With this device incorporated in the vice without adding any dimensions, since due to its extremely compact size it can be placed under the slide at the operator's end of the vice, all of the operations can be controlled directly from the vice and thus several vices can be mounted on the machine tool's work bench, all fed by the compressed air that arrives at the table for blowing away machining chip. Consequently, there are no additional connections outside of the machine.

3) Elimination of the thrust body utilized in present-day vices as fixed point starting from which, by means of a screw, the mobile shoulder is pushed against the part to be clamped, after having approached the thrust body quite close to the part using holes, notches or slots machined in the base at wide intervals.

[0023] Eliminating the thrust body frees a portion of the vice's length, making it available to increment the portion dedicated to clamping the part. This has been achieved by machining in the upper part of the slide, for its entire length, a groove in which slides an appendix of the mobile shoulder which, through the means described below, serves to lock the mobile shoulder at any point on the slide in adhesion to the part to be machined, after which pneumatic clamping is performed. Locking the shoulder in adhesion to the part to be clamped is fundamental to reduce the clamping travel to minimum values, which in turn make possible the small Δ and to keep the contacts between 90° levers and slide always on the same plane (α).

[0024] In a first solution, highly innovative but rather expensive, the mobile shoulder is locked onto the slide through a conical wedge with the lower part turned toward the slide having sharp-edged transverse grooves designed to augment the friction coefficient, and with the upper part inclined downward toward the part to be clamped which cooperates with a parallel surface of the mobile shoulder, with two lateral rows of rollers interposed to eliminate friction on the inclined plane. Two lateral springs push the wedge to engage between the shoulder and the guide, thus provoking immediate locking of the shoulder onto the guide. A central screw serves to unlock the wedge, freeing the shoulder at the end of a machining cycle. With this screw it is even possible to eliminate the springs, which however are more practical to use. It is also possible to adapt for this function a cam between shoulder and wedge.

[0025] Determinant factors for ensuring immediate locking of the mobile shoulder without slipping at the moment of pneumatic clamping as well as to allow easy release of the wedge at the end of the processing cycle on a series of parts are:

a) the grooves transverse to the direction of clamping which significantly augment the friction coefficient between the base of the wedge and the slide, located at the two outer edges; they can also be used to collect any oil expelled from the mating zones during clamping.

b) The two rows of rollers that practically eliminate friction between the inclined faces of the wedge and the mobile shoulder.

c) An appropriate value for the inclination of the wedge.

[0026] Obviously, all of the surfaces are hardened and proportioned to have elastic deformation only.

[0027] A second solution, simpler and more compact that the one described above, has also been devised. Although it involves loss of a small fraction of the travel (Δ) exploitable for clamping, it is however valid for most cases in which series of parts having quite precise dimensions are to be clamped. According to this solution, on either side of the slide are machined two parallel micro-toothed tracks, while at the center of the slide in a reverse Tee channel runs a cursor with a large threaded hole in the center. The mobile shoulder bears matching micro-toothed zones and at the center a large screw whose axis is misaligned by half the pitch of the micro-toothing in the direction of clamping and which screws into the threaded hole in the cursor to ensure, once the shoulder has been brought as close as possible to the part, locking of the shoulder on the slide. The pitch of the micro-toothing (p) is much less than (△) but it may happen that the shoulder remains separated by (p) from the part. In this case the shoulder can be turned over 180° so that, due to the misalignment of (p/2) of the screw in the shoulder, the latter can be approached to the part by (p/2) ad thus even in the most unfavorable situation the slide's travel (Δ) is reduced only by (p/2). Obviously the mobile shoulder is equipped with clamps on the two opposed faces.

4) Positioning at the operator's end of the slide a cylindrical appendix fixed with a bolt to its lower face and which can be pushed by a central threaded screw at the center of the base for a short travel (△) in the absence of air without adding further dimensions.

5) Fixed shoulder of size reduced to almost half that of the currently used vices so as to increment the working length for clamping.

This is achieved by positioning the ends of the fastening bolts in the base and increasing the number of bolts from 4 to 6, and by adopting parallelepiped clamps without a wedge. In this way the axis of the first two bolts, those near the edge of the fixed shoulder, can be brought just under the clamp, in order to obtain through the effect of maximizing the lever arm between the furthest bolts and increasing the number of bolts from 4 to 6, the same anti-turnover momentum with a shoulder that is axially narrower.

6) Parallelepiped clamps without wedge to reduce costs and dimensions. The clamps rest on the teeth machined in the shoulder and bear on the face in contact with the shoulder a central track of the same length as the clamp, shallow in depth and sharp-edged, capable of substantially incrementing the coefficient of friction and thus making it unnecessary to adopt wedges to keep the clamp from moving dur-

ing the operation.

7) Possibility of joining several vices with end bolts to obtain a clamping length that will be the sum total of those of the joined vices. This characteristic, realized in some present-day mechanical vices through pairs of lateral joining blocks fitting in tracks machined in the sides at the ends can instead, in the vices described here, be realized through simple butt joints. This solution is allowed by the body of these vices, since having eliminated the thrust body and the large central opening with slots or holes for its fastening, it is possible to machine holes for butt joint fastening with a pair of bolts.

8) Lateral data plates consisting of two strips of work-hardened stainless steel bearing the operating data inserted in two guides running along the sides in coincidence to the pins of the levers, and providing in the most economical manner for keeping these pins in position. The data plates can be removed, allowing rapid assembly and disassembly.

9) A variation of the above solutions has also been devised for those particular situations in which processing causes significant weakening of the clamped part, which could become deformed after machining. In these very rare cases, screw clamping is preferable because it subjects the part to constant deformation rather than to a constant load. Thanks to the solutions described, it is possible to automate this situation too, obviously to the detriment of cost and clamping length. In fact, utilizing the basic system with slide and mobile shoulder lockable on the slide in adhesion to the part to be machined, as described above, clamping takes place through a rotation of the screw placed in the base at the end of the slide so slight that it can be effected pneumatically through a special pneumatic group located at the end of the base and consisting of 2 pairs of double-action pistons in opposing positions. Each pair of pistons is fixed to the end of a cylindrical stud bolt, toothed in the middle so as to drive a central toothed wheel integral with the slide's command screw. The two upper pistons push in fact in the opposite direction of the two lower pistons, transmitting the desired rotation and momentum to the toothed wheel and the screw. For unlocking, the pressures in the pistons are inverted and a reverse rotation and torque is produced.

10) Lastly, it is possible with the solutions described here to produce mechanical vices consisting of the basic system of slide with clamping by means of a screw that from the base pushes the slide to perform clamping. These vices, useful in situations in which no compressed air is available, have the significant advantage of great clamping length, length of the vice being the same (about double that of present-day screw vices).

[0028] To make concretely evident the advantages of the vices subject of this patent application as compared to mechanical ones, we report the characteristics of a line of these vices that is one of the most widely diffused and currently appreciated, having width of clamps 200 millimeters and clamping force with screw approximately 70000 Newtons. The lengths of the shortest and the longest model are approximately 550 and 750 millimeters, with clamping length of 200 and 400 millimeters respectively.

[0029] The equivalent vice constructed according to this patent with clamps and body 200 millimeters wide and continuing two pneumatic groups in series has a length of 530 millimeters, that is, less than the smallest of the mechanical vices, clamping length of 400 millimeters, i.e., equal to that of the largest mechanical vices, and clamping force of 100,000 Newtons with eight atmospheres. Clamping times are shorter by several orders of magnitude, with absolute precision and repetitiveness of clamping loads.

[0030] As compared to one of the best-known hydraulic vices, manufactured abroad, it is sufficient to note that, with width of clamps 200 millimeters, it has a declared force of 70,000 Newtons and significantly less clamping length. The hydraulic vices considered obviously feature a single piston with the axis parallel to the clamping direction.

[0031] The invention will now be further clarified with reference to the attached drawings which illustrate some preferential forms of practical realization given merely by way of example but not as limitation, since technical, geometrical, technological or structural variants can always be made while remaining within the sphere of this invention.

[0032] In these drawings:

- Fig. 1 is a partially exploded perspective view of the vice constructed as per this invention with two pneumatic groups (2) in series that drive two 90° levers (5) upward, with the command group (4) positioned on the body at one end under the slide (3) and with exploded view of mobile shoulder with the system of locking on the slide by means of opposed sets of micro-toothing (22-46). Furthermore, (1) indicates the base body, (8) the fixed shoulder, (9) the clamps, (10) the lateral springs for the slide's return, (11) the pins of the springs fixed to the base, (12) the slots on the slide, (13) the dowels for spring loading, and (14) the micro pressure reducing valve for regulating pre-loading, (15) the micro pressure reducing valve for regulating final clamping, (16) the compressed air arrival, (17) the threaded holes for joining to another vice, (18) the screw for manual clamping of the part, (19) the slide's appendix that is pushed by the screw for this clamping, (20) the slide's cursor, (21) the cursor's screw, (23) the pin-stay data plates, (24) the joining screws, (25) the fixed shoulder fastening screws, (26) the check valve, (27) the micro-piston driven by the distributor to open the check valve during the discharge stage, and (28) the three-position command distributor

- Fig. 2 is a perspective view of a vice as per this invention but with the pistons (2) and the 90° levers (5) reversed in comparison to the preceding solution and with the mobile shoulder that locks onto the slide (3) in continuous manner at any point along its length through the system of self-locking wedge (31) with two rows of teeth (32) in the lower part where contact between wedge and slide takes place, and two rows of rollers (30) in the inclined plane area where the wedge (32) cooperates with the mobile shoulder (7), and (40) indicates the flat surface against which the wedge (31) stops without slipping when a central screw (not shown) is loosened, lateral springs (not shown) push the wedge to forcefully fit (I) between the shoulder and the aforesaid surface (40) of the slide (3), to allow pneumatic clamping with force (f).
- Figs. 3-4-5 are section views of the detail of the mating surfaces of the 90° lever's short arm (5) and the slide, according to three practical realizations of the invention.
- Fig. (3') shows enlarged the detail of the trajectory in section view of the mating points (A' B') between 90° lever and slide. If in fact we consider the trajectory (AB) of the end of the short arm (A), we see that, being a small section of a circle tangent to the axis of the slide's displacement astride the tangency point, half before and half after, it can be considered practically straight, with deviations of a few hundredths of a millimeter.
  It is then obvious that the trajectory of the contact (A') between the cylindrical surface of with radius R (50) of the 90° lever and the plane of the recess (51) in the slide, orthogonal to the slide itself, is equally a straight segment (A' B') always on plane (α).
- Fig. 6 is a section view of a self-centering vice as per this invention.
- Fig. 7 is a section view of the effect of elastic deformation obtained with the shallow, sharp-edged grooves utilized in this invention to obtain high coefficient of friction with elastic deformation of the surfaces.
- Fig. 8 shows six sections (a, b, c, d, e, f) of the command group (4) incorporated in the base (1).
- Fig. 8 (a) shows the position of the distributor (28) corresponding to piston discharge (2) with connection of the pistons (2) through the hole (47) machined in the body (1) to the ambient through the hole (E) at the end of the distributor. In this position, there are also closed the holes in the distributor (W-Z) at the opposite end that discharged the micro piston (27), while holes (P-Q) are connected with the plant air, through the connection described in section 8 (f). The micro piston (27) presses upon the check valve (26) and keeps it open, allowing the discharge of air from the vice's pistons (2).
- Fig. 8 (b) shows the distributor (28) in the intermediate position with feed at the pressure of the micro pressure reduction valve (14) to the vice's cylinders (2), to the bedding preloading and the check valve (26), operative since the micro piston's chamber (27) is discharging and the feed at plant pressure has been interrupted. Section 8 (e) shows the screws that fasten the command group (4) to the base (1).
- Fig. 8 (c) shows the distributor (28) in the final clamping position connecting the vice's pistons (2) with the micro pressure reduction valve (15) adjusted to the pressure that ensures final loading and with the check valve (26) always operative.
- Fig. 8 (d) is an external view showing the safety lever.
- Fig. 9 (a) shows a section of the wedge (31) which effects, through the release of the springs (not shown) (1) immediate locking without slipping of the wedge (31) onto the slide (3) due to the friction of the sharp-edged grooves (32) while at the moment of pneumatic clamping with force (f) the mobile shoulder (7) will withdraw for a few tenths of a millimeter sliding on the rollers (30) until it creates vertical forces (F) capable of balancing with their components force (f) as illustrated in section 9 (b). A central screw (not illustrated) in the drawings, acting between (7) and (31) allows, upon completion of the machining of a batch of parts, the unlocking of the mobile shoulder as well as easy sliding, since it nullifies the action of the trigger springs.
- Fig. 10 is a perspective view of a vice with base (1), slide (3), mobile shoulder (7) lockable to the slide and end screw (18) which pushes the slide's appendix (19) driven by the four opposed pistons (34) which command rotation through a toothed wheel integral with them.
- Fig. 10 shows the chambers (33) of the 4 pistons (34) in which the pressure acts to create the two opposed thrusts (P) that produce on the gearing (35) the torque and rotation to move the slide (3) by means of the screw (18).

Claims

1. A vice with a fluid, preferably pneumatic, comprising a base (1) and a pair of opposed shoulders (7) or (8) designed to clamp a workpiece, **characterized by** the fact that at least one of the shoulders (7) can be fixed by suitable means to a slide (3) having the same length as the base and sliding in the direction of the other shoulder (8) in a guide machined on the back of the base; the shoulder (7) can be fixed to the slide (3) at any point on the slide (3) in adhesion to the part to be clamped, a thrust means, preferably pneumatic jack type, being provided to move the slide and shoulder assembly (7) toward the other shoulder (8) for an extremely short tract (Δ) but with the maximum required clamping force, force multiplier (5.35) between the aforesaid jacks (2, 34) and the slide (3)

being included.

2. Vice as claimed in claim 1, **characterized by** the fact that the aforesaid jack systems include at least one jack (2) with axis orthogonal to the direction of motion of the slide (3) and that between this jack (2) and the slide (3) there is interposed a 90° multiplication lever (5) with fulcrum in the base (1) which receives the force of the jack and transmits it multiplied to the slide (3).

3. Vice as claimed in claim 2 **characterized by** the fact that the thrust surfaces (50) of the 90° lever (5) against the corresponding surfaces (51) of the slide (3) consist of cylindrical surfaces with central radius (R) in the ends of the short arms of the levers; these ends describe circular trajectories tangent to the axis of motion of the slide to which they transmit the clamping force and a minor displacement (Δ) astride the point of tangency, half before and half after, and thus practically rectilinear so that the contact through which the very high forces are transmitted remains always on the same plane (α) during the entire movement (Δ),

4. Vice as claimed in claims 2 and 3 **characterized by** the fact of including at least two of the aforesaid jack systems (2) arranged with their respective axis parallel and acting on recesses (51) or appendixes to the slide (3) by means of their respective 90° levers (5) in such a way their forces are added together to act on the slide (3).

5. Vice as claimed in claim 4 and preceding **characterized by** the fact that the pistons are single-action and it is thus possible to reach all of the thrust chambers with a single hole at the center of the base (1) orthogonal to the axis of the pistons and traversing all of the chambers (2) of the various jacks up to the last, so as to pressurize or discharge all of the jacks contemporaneously.

6. Vice according to the above claims **characterized by** the fact that the mobile shoulder (7) guided and sliding in two grooves in the slide (3) bears inside it a conical wedge (31) with the narrowest part turned toward the part to be clamped and with the lower face sliding against the flat, smooth surface (40) of the slide (3) fitted with two lateral series of sharp edge transverse toothings (32) and with the inclined upper face that cooperates with a parallel surface of the mobile shoulder with the interposition of two rows of rollers (30), lateral springs pushing the wedge to stick between the shoulder and the slide when the mobile shoulder has been brought into contact with the workpiece, triggering immediate locking, the springs during the movement of the shoulders being rendered ineffective by a central screw that acts between shoulder and wedge and allows easy unlocking at the end of each work cycle.

7. Vice as claimed in claims 1, 2, 3, 4 and 5, **characterized by** the fact that the slide bears two micro-toothed tracks (46) running beside a central channel in the shape of a reversed Tee (45) in which slides a cursor appendix (20) of the mobile shoulder which presents at the center a large threaded hole, the shoulder being fitted with two matching micro-toothed zones (22) and a central stay bolt (21) which screws into the cursor (20) sliding through the channel in the slide, tightening the stay bolt when the shoulder has been brought near to the part to be clamped, the shoulder is locked onto the slide, the axis of the stay bolt being displaced by half a pitch of the micro-toothing in the clamping direction and the shoulder being fitted with clamps (9) on both faces so that it can be rotated 180° when, as the mobile shoulder is approached to the part to be clamped, there is excessive clearance due to the pitch of the micro-toothing.

8. Pneumatic vice as claimed in claim 2 and following, **characterized by** the fact that the command and security device (4) placed at one end without additional longitudinal dimensions comprises two opposed micro pressure reduction valves (14) and (15) for continuous adjustment of the pre-clamping ad clamping load, a check valve (26) located immediately prior to the piston air discharge (2) guided axially and a micro piston (27) placed on the same axis, which keeps it forcibly open by exploiting the plant air pressure during the stage of piston discharge, a three-position distributor (28) corresponding to discharge, pre-clamping and final clamping; a safety lever (42) that locks the distributor in the two extreme positions as protection against accidental actuation.

9. Pneumatic vice according to the above claims **characterized by** the fact that, at the end of the slide (3) is fixed an appendix, preferably cylindrical (19) turned toward the base which can be pushed for a travel (Δ) by means of a screw (18) placed in the base without creating additional longitudinal dimensions.

10. Vice as claimed in the above claims **characterized by** the fact that, to bring the slide (3) back to its original position after each clamping procedure, two springs of limited diameter but notable length (10) are used, housed in two holes drilled in the two outer edges of the slide, these holes terminating in two slots (12) machined in the face of the slide turned downward, two pins (11) being fixed in the base and extending into the two slots to realize the points where the forces of the two springs discharge.

11. Vice as claimed in the above claims **characterized by** the fact that the fixed shoulder (3) is tightened against the base by means of 6 screws with their ends in the base and two screws turned toward the mobile shoulder placed at the extreme edge of the fixed shoulder beneath the clamp (9) on the fixed shoulder (8).

12. Vice as claimed in the above claims, **characterized by** the fact that the clamps (9) are simple parallelepipeds that rest on teeth machined on the shoulders and that present on the face that is tightened against the shoulder a central trace as long as the clamp, shallow in depth and having sharp edges.

13. Vice as claimed in the above claims **characterized by** the fact that, at the end opposite the one in which the command unit is placed, there is a recess with two holes that allows the joining of two vices with two butt-joint bolts (24).

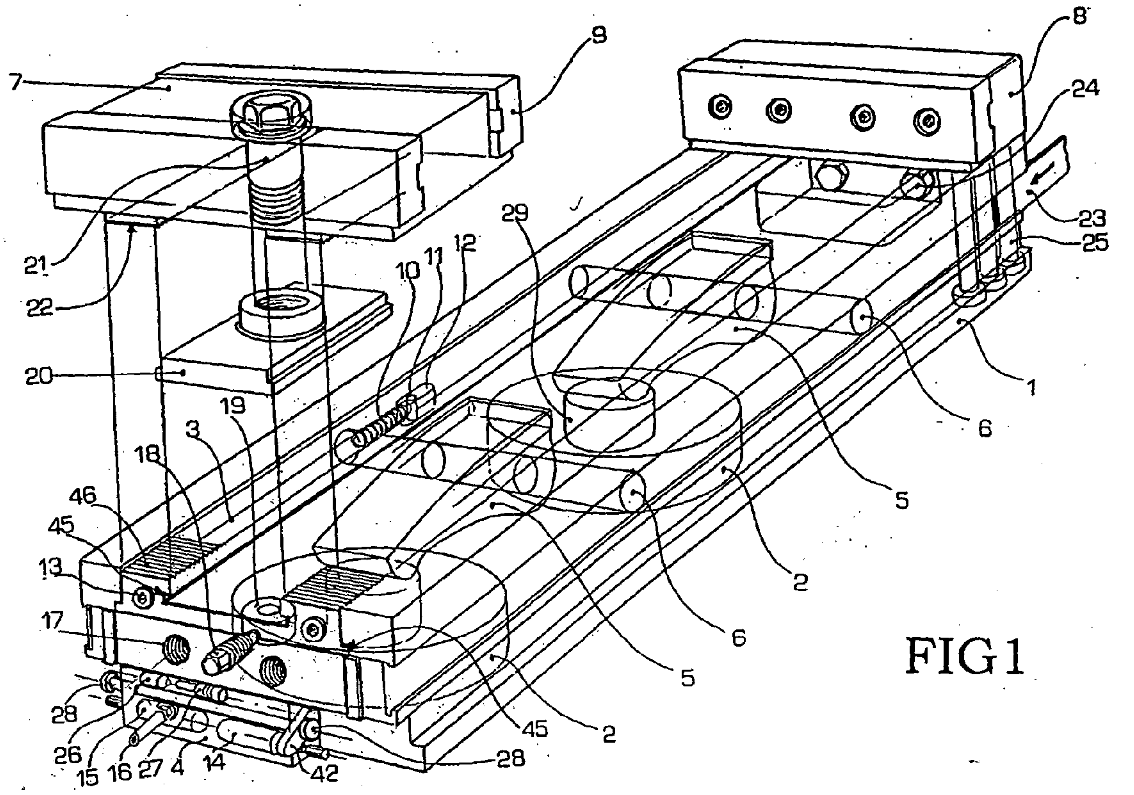
14. Vices as claimed in the above claims **characterized by** the fact that the pins (6) that ensure rotation of the multiplier levers are kept in position on the base by two strips of workhardened stainless steel housed in two grooves of the same length as the vice bases, placed in correspondence to the holes for the pins.

15. Vices as claimed in the above claims **characterized by** the fact that a central piston, with pressurized chamber near to the slide, drives downward the long arms of two 90° levers placed specular in respect to the piston, the short arms of said 90° levers driving two specular slides bearing two specular mobile shoulders so as to lock the parts in a centered manner.

16. Vices as claimed in the above claims **characterized by** the fact that, being without the pneumatic groups, they retain their extensive clamping length in relation to length for those situations in which compressed air is missing.

17. Vice as claimed in claim 1 and following but with the screw (18) that from the base commands the slide (3) through the appendix (19) transmitting to it the slight displacement (Δ) and the clamping load, driven by 2 pairs of double-action pistons, equal and opposed (34), the four pistons being fixed to the ends of two cylindrical stud bolts (44), toothed in the central part, acting contemporaneously but each pair in the direction opposite that of the other, transmitting a rotation and a twisting moment to a toothed wheel overgear (35) positioned between the opposed toothings of the two stud bolts and fixed to the screw (18) that pushes the slide, thus transmitting the clamping load and the displacement (Δ), inverting the pressure in the piston chambers, the system returns to its original position.

18. Vices, preferably pneumatic, as substantially described and illustrated herein.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6

FIG1

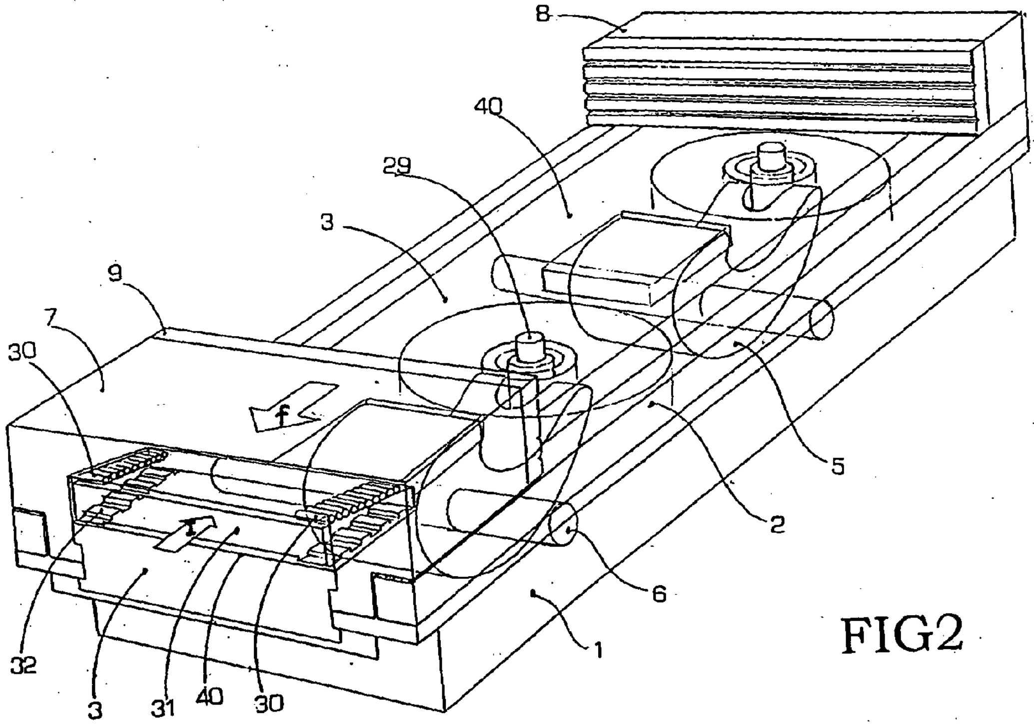
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FIG2

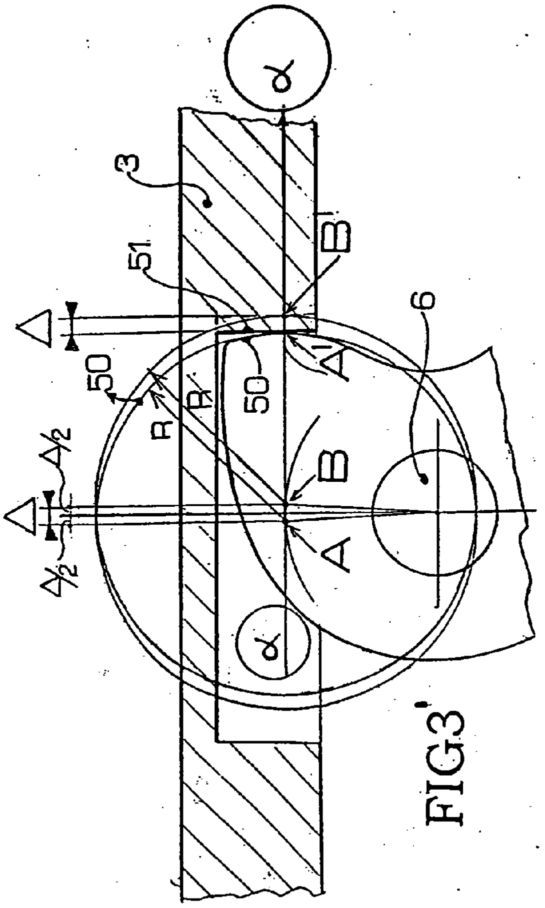

FIG3'

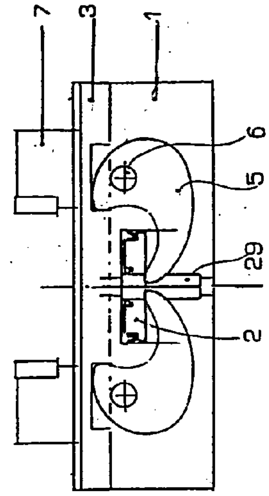

FIG6

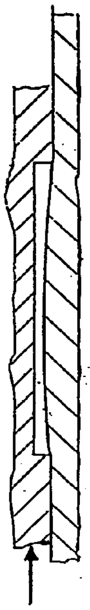

FIG7

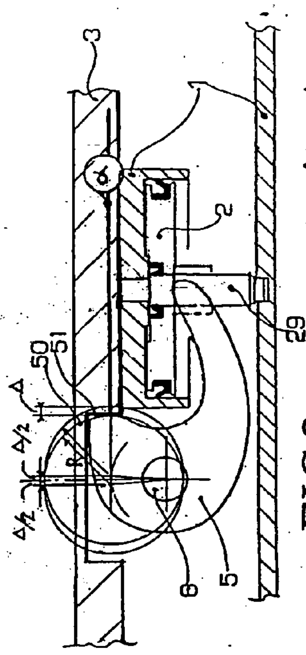

FIG3

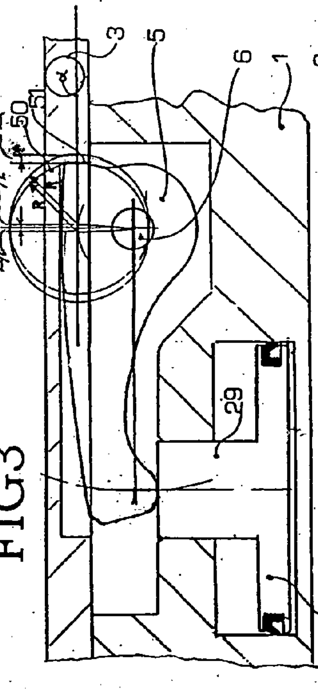

FIG4

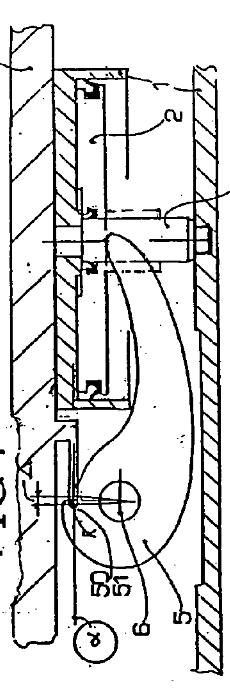

FIG5

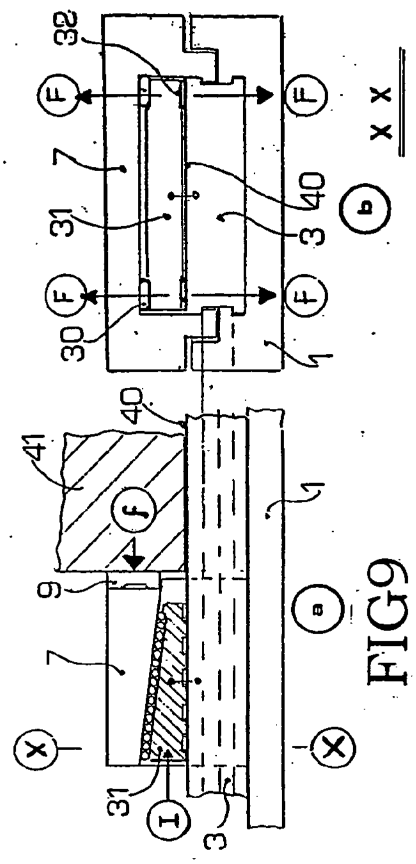

FIG9

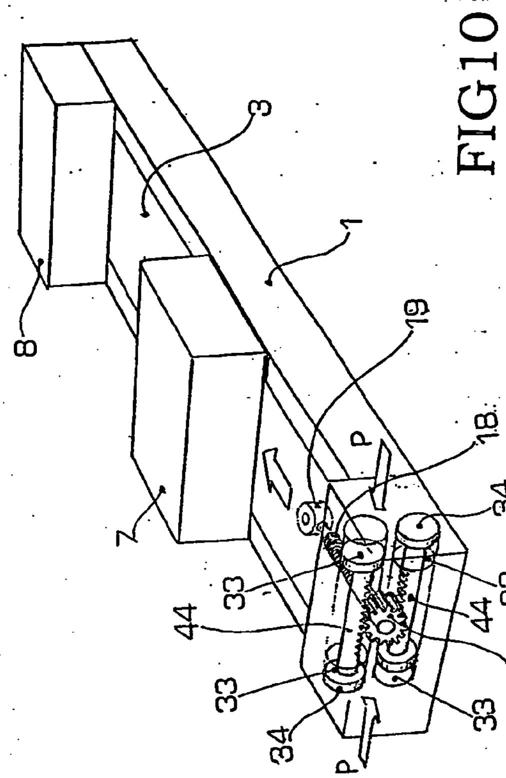

FIG10

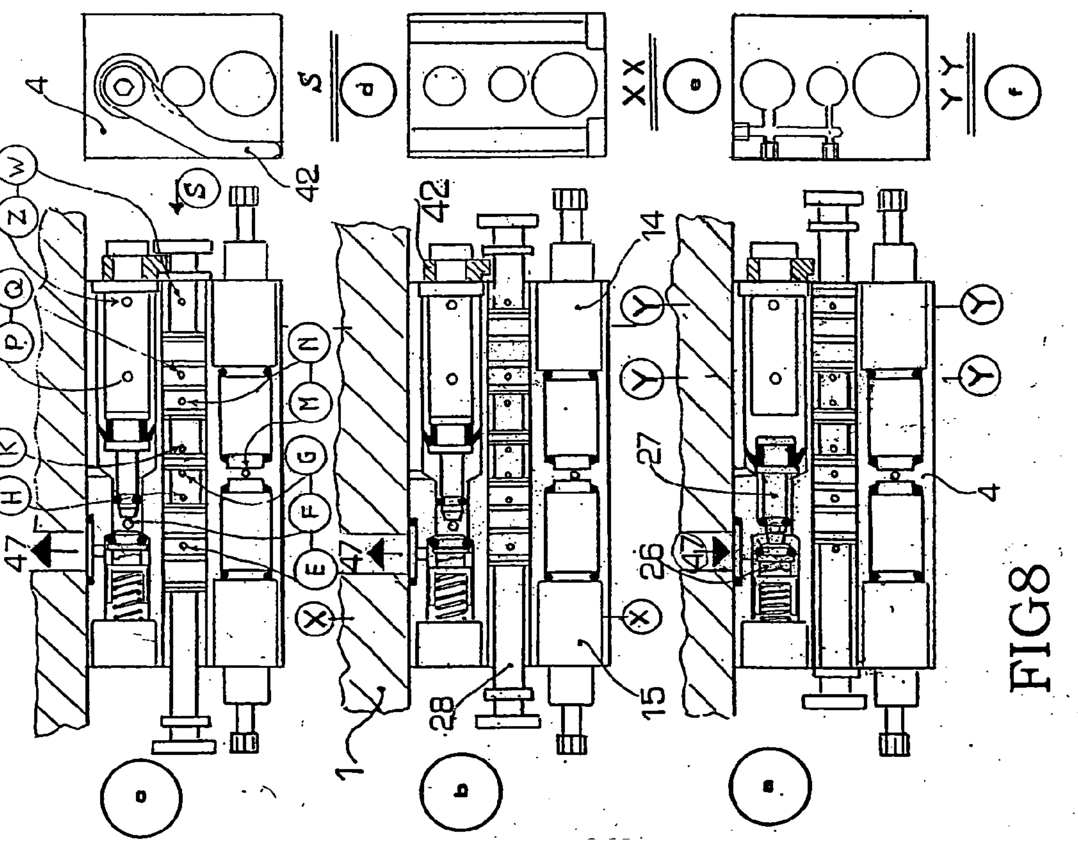

FIG8