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Fraser et al.

[11] **3,912,251**

[45] **Oct. 14, 1975**

[54] **TOGGLE CLAMPS**

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[30] **Foreign Application Priority Data**

Mar. 28, 1973 United Kingdom..... 14899/73

[52] **U.S. Cl.**..... **269/228;** 74/106

[51] **Int. Cl.**[2]..... **B25B 1/14**

[58] **Field of Search** 269/201, 228, 91, 94; 74/106

[56] **References Cited**

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Assistant Examiner—Neil Abrams
Attorney, Agent, or Firm—Scrivener Parker Scrivener and Clarke

[57] **ABSTRACT**

In a linear plunger type of toggle clamp the rear pivot for the toggle is supported on a web between the rear ends of two elongated supporting members extending rearwards from the guide for the plunger and placed symmetrically on opposite sides of the plunger axis so that the loads are taken directly in tension or compression.

11 Claims, 12 Drawing Figures

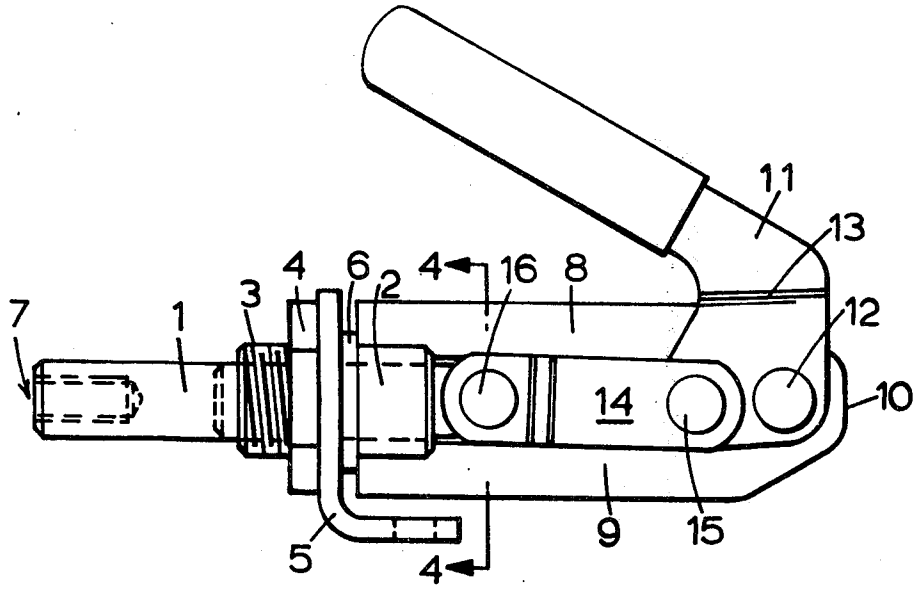
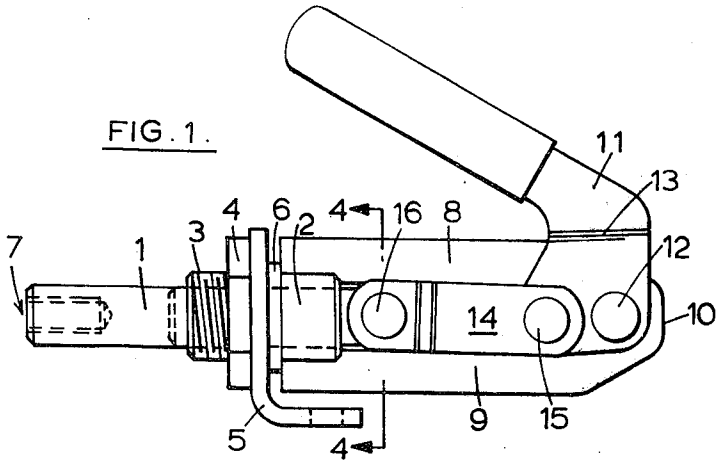


FIG. 1.



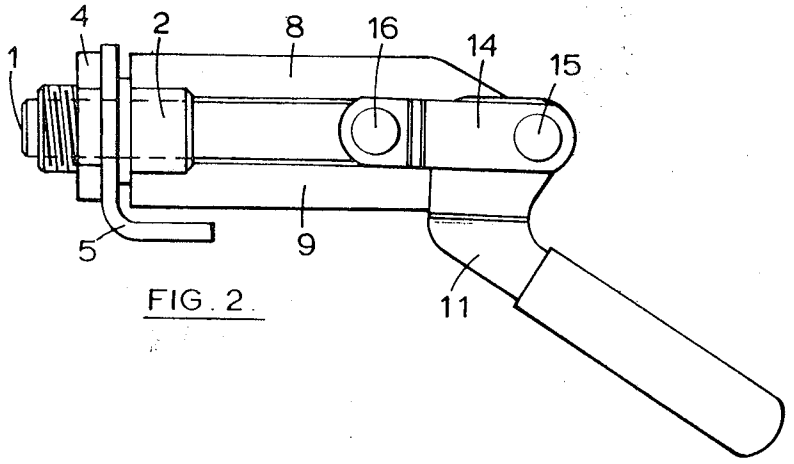


FIG. 2.

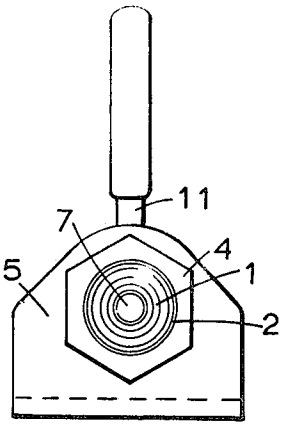


FIG. 3.

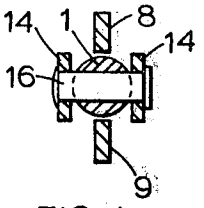


FIG. 4.

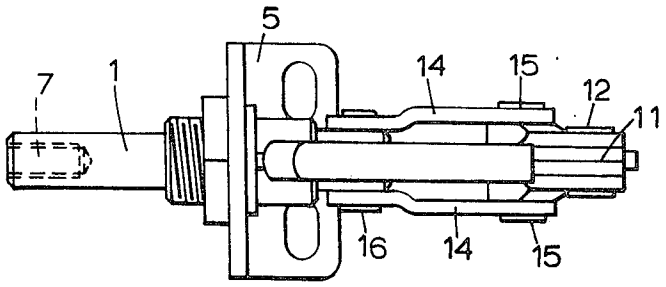


FIG.5.

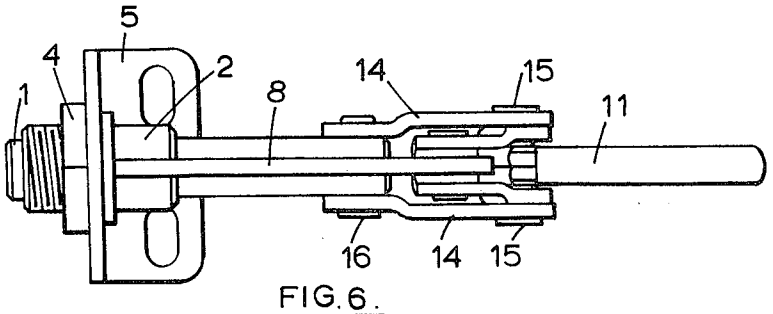


FIG.6.

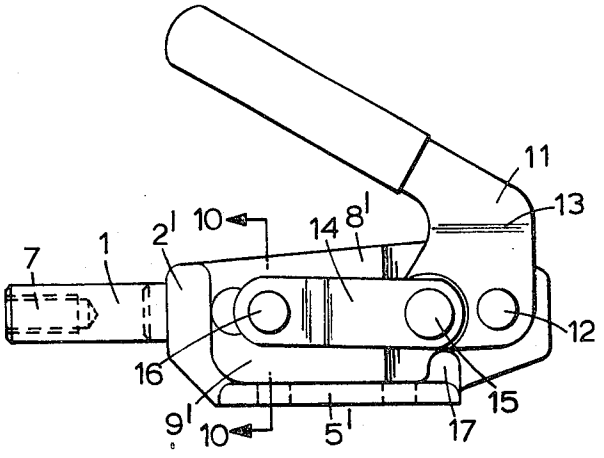


FIG.7.

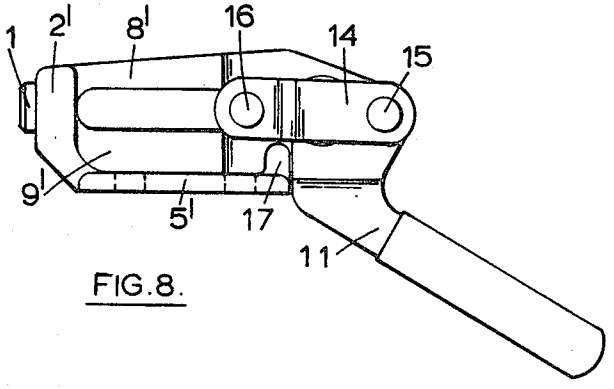


FIG.8.

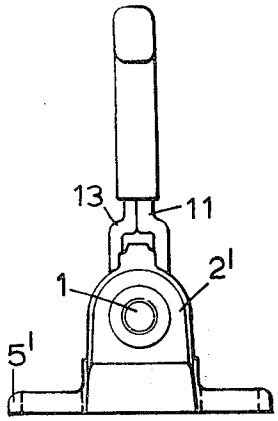


FIG. 9.

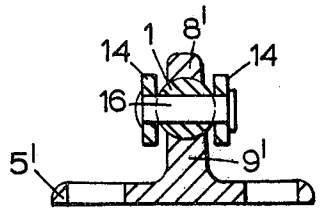


FIG. 10.

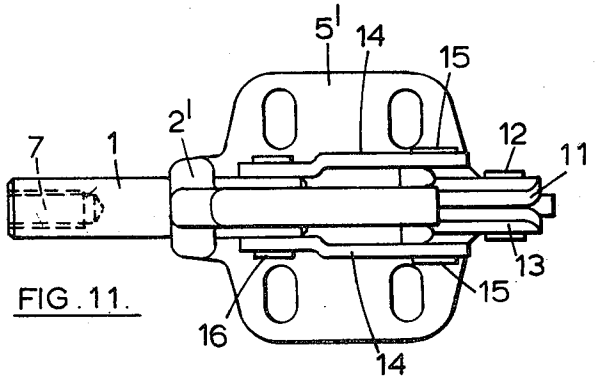


FIG. 11.

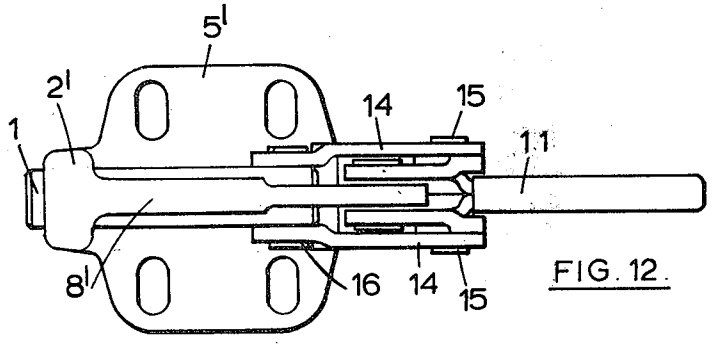


FIG. 12.

TOGGLE CLAMPS

This invention relates to toggle clamps. Such clamps are widely used in workshops for holding down workpieces during welding, machining and other operations and comprise a base for securing to a bench or jig or to the bed of a machine tool, a clamping plunger and a handle pivoted to the base and connected to the plunger by a link to form an over-centre or toggle linkage.

In one known form of toggle clamp the base comprises a flat plate with a guide for the plunger at one end and an upstanding lug at the other end. The handle is pivoted at its lower end to a point on the lug and extends upwards. At an intermediate point on its length the handle is pivotally connected to one end of each of a pair of laterally spaced links, the other ends of which are pivoted to the rear end of the plunger, one on each side.

Geometrically this is straightforward, but the high stresses that can be generated very easily with a toggle linkage reveal certain weaknesses. In particular the upstanding lug to which the handle is pivoted is subjected to high bending loads during the locking and unlocking motions, these loads acting in a sense trying to break the lug from the base. Also the presence of a hole for the pivot pin necessarily weakens the lug.

For lateral stability the plunger is a close fit in its guide but because of the non-axial forces that act on it as a result of the toggle action, this close fit can cause the travel of the plunger in the guide to become unduly stiff or even cause the plunger to jam.

Another known form of toggle clamp employs an alternative linkage in which the handle, which again extends upwards with respect to a base, is pivotally connected at its lower end to the rear end of the plunger itself. A link connects an intermediate point on the handle to the guide for the plunger. This arrangement results in a very compact clamp, much shorter (for a given plunger travel) than the arrangement described above; in fact the overall length of the clamp is the length of the plunger guide. However with this layout there is no support below the pivotal connection between the handle and the plunger, and the toggle action can again cause the plunger to stick in its guide.

The aim of the present invention is to provide a toggle clamp of which the mechanical design is such that the stresses resulting from the toggle action are adequately absorbed and also that the plunger is fully guided and supported with the danger of jamming reduced to a minimum.

According to the invention a toggle clamp comprises a plunger sliding linearly in a guide and the guide has two supporting members extending rearwards from it, both parallel to the axis of thrust of the plunger and on opposite sides of it, the rear ends of the supporting members being joined by a web which carries a pivot point lying on the axis of thrust of the plunger for a handle, the handle being pivoted to this point and being connected to the rear end of the plunger through a link to form a toggle linkage.

Such a clamp may be designed to be single-acting (i.e., in which it only clamps on one direction) or double-acting, in which it can clamp a workpiece equally well by thrust or by tension in the plunger. In each case, in the locked condition, the axis of thrust or tension of the plunger passes through two of the three pivot points

of the toggle linkage, so the loads are taken by direct tension and compression, with little or no bending.

To maintain symmetry and avoid bending loads either the link or at least that part of the handle which forms one of the operative components of the toggle linkage must be split into two components lying on opposite sides of the axis of the plunger. Preferably the link is split into two side-links, sandwiching the handle between them at one end and sandwiching the rear end of the plunger between them at the other.

Where a base is required, this can be secured to, or formed integrally with, the plunger guide.

The invention will now be further described by way of example with reference to the accompanying drawings which illustrate two embodiments of the invention, and in which:

FIGS. **1** and **2** are side views of the first embodiment, showing the clamp in the closed and open positions respectively;

FIG. **3** is a front view of the clamp of FIGS. **1** and **2**, shown in the closed position;

FIG. **4** is a section on the line **4—4** in FIG. **1**;

FIGS. **5** and **6** are views of the first embodiment looking from above, in the closed and open positions respectively; and

FIGS. **7** to **12** are views exactly corresponding to FIGS. **1** to **6** respectively but showing a second embodiment, FIG. **10** being a section on line **10—10** in FIG. **7**.

In the version of FIGS. **1** to **6** a plunger **1** slides in a guide **2** which is of circular cross-section and is screw-threaded at **3** to receive a nut **4** by which one limb of an L-section bracket **5**, formed as a heavy-gauge sheet-metal pressing, is clamped against a flange **6** on the guide **2**. The other limb of the bracket **5** forms the base of the clamp and has holes in it to allow the clamp to be bolted or otherwise secured to a bench, jig or machine-tool bed.

The forward end of the plunger **1** is tapped at **7** to receive a jaw or hook-like claw if desired for use when the clamp is to be used in the pulling rather than the pushing mode.

Above and below the rear end of the guide **2** (we are assuming here for convenience that the axis of the plunger and the plane of the base are horizontal) are welded the leading ends of two supporting members **8** and **9** which extend rearwards parallel to each other and to the axis of the plunger **1**. The members **8** and **9** are joined by an integral web **10** at their rear ends, all three parts being formed from a single stamping or flame-cut plate. The members **8** and **9** thus lie symmetrically on opposite sides of a plane that contains the axis of thrust of the plunger **1** and is parallel to the axes of the pivots of the toggle linkage, to be described below.

A handle **11** is pivoted to the web **10** about a horizontal axis by means of a pivot pin **12**. The handle is made from two pressings, face to face but both joggled at **13** so that their lower ends are spaced apart to form a fork, one pressing lying on each side of the web **10**. Thus the pin **12** is loaded symmetrically in pure shear. A pair of side-links **14**, one on each side, have their rear ends pivoted by means of separate short co-axial pins **15** to the two pressings of the handle. Their front ends are connected by a single common pivot pin **16** to the rear end of the plunger **1** (see FIG. **4**).

The clamp described is used in the same way as orthodox toggle clamps, with the handle pivoting between the positions shown in FIG. 2 and 1 to clamp and unclamp the work (where the clamp is used with the plunger in compression). In a situation where the clamp is to be used in tension, the open or unlocked position would be that shown in FIG. 1 and the closed or clamped position would be that of FIG. 2.

An advantage of the use of an L-shaped bracket 5 clamped by a nut 4 is that, by loosening the nut and turning the guide 2 about the axis of the plunger 1 one can lay the clamp on its side, or at any intermediate angle, allowing it to be used in situations where the clearance needed for the handle 11 is restricted.

The main advantage however, over known constructions is that of substantial symmetry (from the load-taking point of view) about a horizontal plane containing the axes of the pivot pins 12 and 16, in that the loads on the pin 16 are taken through supporting members 8 and 9, each in direct tension or compression, above and below this plane. The web 10 can be made as strong as necessary to take the load and there are components subjected to major bending loads. The fact that the toggle linkage lies on the axis of thrust of the plunger 1 makes the overall height of the clamp small as no clearance has to be left below it for the linkage, so the bracket 5 can be compact, with the plane of its base close to the axis of thrust.

In many situations the bracket 5 can be omitted altogether, the clamp being mounted by allowing the guide 2 to project through a hole provided for it in a jig or fixture, where it is held by the nut 4, or if the hole is tapped the nut 4 can be omitted as well.

Another advantage of the fact that the line of action of the toggle linkage coincides with the axis of thrust of the plunger 1 is that, at least in the locked condition, which is the only condition in which jamming could have been a problem, there is little or no side thrust on the plunger 1 and so little or no risk of jamming.

The version shown in FIGS. 7 to 12 works on exactly the same principles as that of FIGS. 1 to 6 and exactly the same reference numerals have been used for parts which are virtually identical, but reference numerals with indices have been used for parts which correspond in function but differ in construction. Primarily this second version is designed for heavier duty than that of FIGS. 1 to 6 and the assembly fabricated from parts 2, 4, 5, 8, 9 and 10 is replaced by a single casting 2' having a base flange 5' by which it is mounted and an upstanding web which is slotted to provide clearance for the travel of the rear end of the plunger 1 and defines rearwardly extending integral supporting members 8' and 9'.

In this case the gap between the members 8' and 9' not only provides clearance but also provides positive additional guidance and support for the rear end of the plunger 1. For this purpose the mutually opposed faces of the members 8' and 9' that define this gap are of part-cylindrical shape, centred on the axis of the plunger, so as to embrace the plunger as seen in the cross-section of FIG. 10. In this way the rear end of the plunger is guided by bearing surfaces that extend even behind its pivot 16 throughout its travel.

Bosses 17 formed in the casting in the sides of the member 9' form stops that limit the travel of the toggle linkage to a locking position just over centre.

This cast version of the clamp has all the advantages of that of FIGS. 1 to 6 except that it lacks the freedom to tilt about the axis of thrust, but it has added advantages of the above-mentioned further improvement in guiding of the plunger 1, which also reduces wear. Also, as it omits the screw-threaded front end of the fabricated version, this cast version is of even shorter overall length for a given plunger travel.

We claim:

1. A toggle clamp comprising an apertured guide having front and rear ends and a first axis therethrough, a plunger slidable in said guide along said axis, first and second elongated supporting members, said members extending in spaced relation rearwardly from the rear end of said guide parallel to said axis and symmetrically on opposite sides thereof to lie in a plane containing said axis, a web joining said members at the ends thereof remote from said guide, said web and said members defining a rearwardly extending slot-like opening co-axial with said guide, the transverse dimension of said slot-like opening being of a size enabling said plunger to be moved axially in said opening between said members, and a toggle linkage comprising first link means having first and second ends and second link means having first and second ends, said first end of said first link means being pivoted to said web about a second axis, said second end of said first link means being pivoted to said first end of said second link means about a third axis, and said second end of said second link means being pivoted to said plunger about a fourth axis, said second, third and fourth axes being mutually parallel and being each perpendicular to said first axis and moreover being perpendicular to said plane, and said second and fourth axes intersecting said first axis, and manually operable handle means associated with one of said link means.

2. A toggle clamp as set forth in claim 1 including a mounting bracket having a flange, said mounting bracket being attached to said guide and said flange extending parallel to a plane containing said first, second and fourth axes.

3. A toggle clamp as set forth in claim 2 wherein said guide, said first and second elongated supporting members, said web and said mounting bracket comprise a single integral casting.

4. A toggle clamp as set forth in claim 3 wherein said flange lies in a plane parallel to said first axis and perpendicular to said first-mentioned plane.

5. A toggle clamp as set forth in claim 1 wherein said handle is associated with and formed integrally with said first link means, said first link means being formed by a bifurcated portion of said handle embracing said web.

6. A toggle clamp as set forth in claim 1 wherein said guide has an external screw thread thereon, coaxial with said first axis and a shoulder at one end thereof.

7. A toggle clamp as set forth in claim 6 including a mounting bracket, said bracket being of L-shape with first and second limbs, said first limb being apertured to fit over the screw thread on said guide and engage said shoulder and said second limb forming a mounting flange.

8. A toggle clamp as set forth in claim 1 wherein said supporting members have mutually opposed faces shaped to engage and guide a portion of said plunger.

9. A toggle clamp as set forth in claim 8 wherein said plunger is cylindrical and said faces are part-cylindrical and are centered on said first axis.

10. A toggle clamp as set forth in claim 1 wherein said first and second supporting members and said web are in one piece, and are attached to said guide by welding.

11. A toggle clamp as set forth in claim 5 wherein said second link means comprises a pair of identical link members on opposite sides of said slot-like opening with their second ends embracing said plunger, pin means extending transversely through said slot-like opening and connecting the second ends of said link members to said plunger, said fourth axis being defined by the axis of said pin means, the first ends of each of said link members being pivotally connected by separate co-axial pins to the respective limbs of the bifurcated portion of said handle defining said first link means.

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