

[54] **FASTENER APPLYING TOOL**

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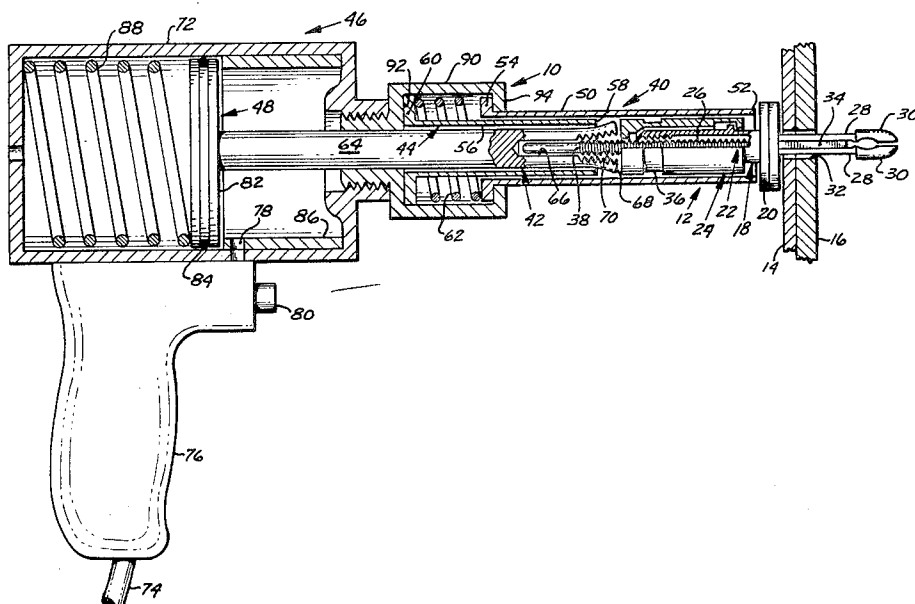
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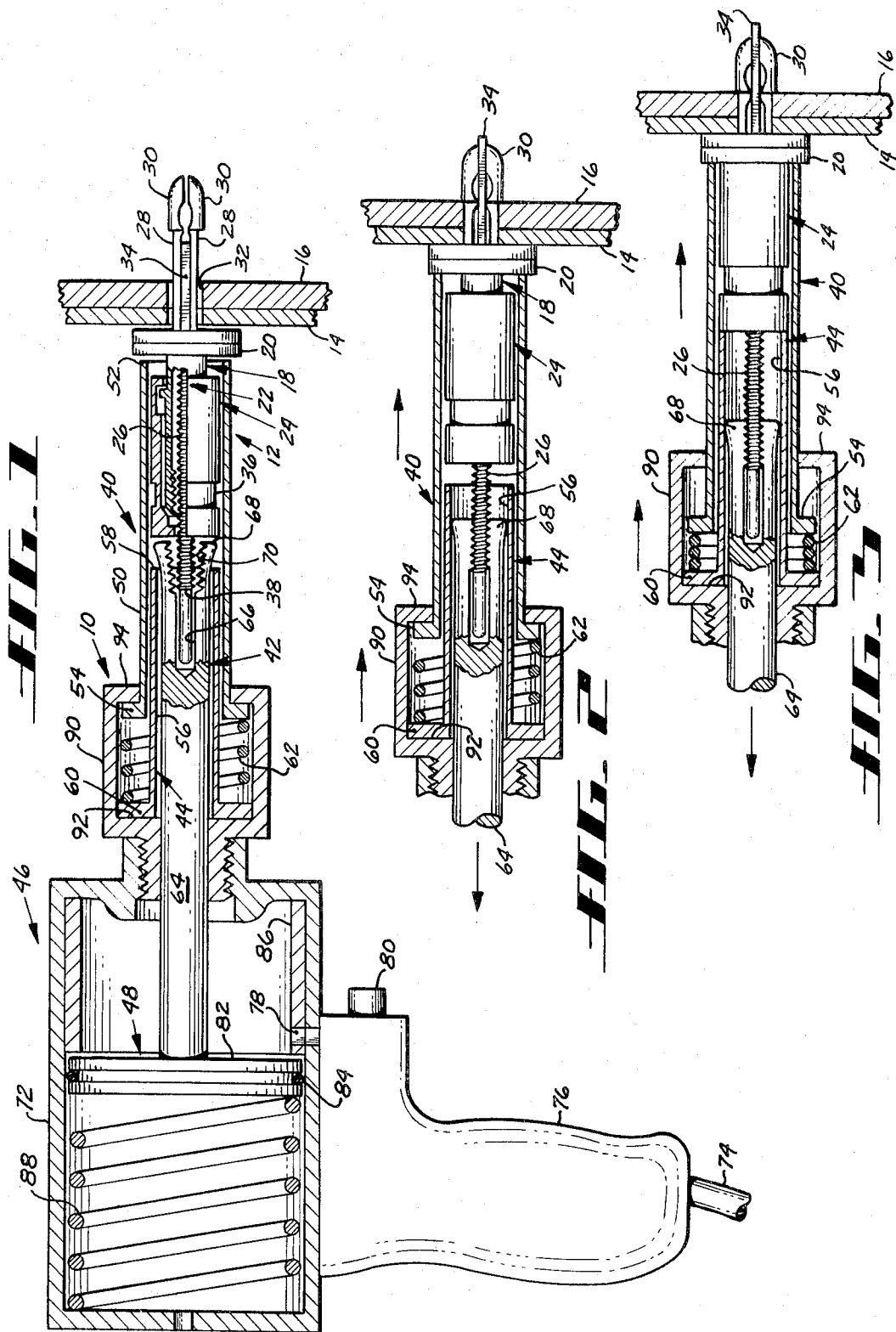
[57] **ABSTRACT**

The tool of this invention is specifically adapted to apply a novel clamping device or temporary fastener

which includes a body having an enlarged head end to engage the near side of work to be clamped, a tension member axially movable in the body and having a gripper head at its forward end to engage the remote side of the work and an aft end projecting from the aft end of the body to be engaged by a puller, and a locking actuator axially movable forward on the body to lock the tension member in clamping position. The tool includes a first barrel to surround the fastener body and engage the head end to push it against the work, a second barrel slidable in the first barrel to move the actuator, and a puller slidable in the second barrel to retract the tension member. The forward end of the puller has a gripping jaw to engage the tension member. A first reaction member in the form of a cylinder pushes solidly against the second barrel which pushes yieldingly through a spring against the first barrel. A second reaction member in the form of a piston retracts the puller under fluid pressure. The force applied first retracts the puller until a predetermined clamping load is achieved, and then forces the second barrel forward with respect to the first barrel to contact the actuator and lock the clamping device.

17 Claims, 3 Drawing Figures





FASTENER APPLYING TOOL

BACKGROUND OF THE INVENTION

This invention lies in the field of clamping devices of the type commonly known as temporary fasteners. Such fasteners may be used for many purposes but their most prevalent use is in fastening together two or more work pieces such as elements of aircraft structure to hold them temporarily in proper relation while permanent fasteners, such as rivets, are applied. The temporary fasteners are then removed and replaced by additional rivets. The present invention relates to a tool for applying a novel form of temporary fastener or clamping device.

An early type of temporary fastener comprised a body having a split pin slidably mounted therein the pin having an enlarged gripper head at its forward end, and spring means on the body to retract the pin. The head was small enough to pass through the apertures in the work but was deflected laterally by a cam formation upon retraction so that it engaged the remote side of the work and exerted clamping pressure. A simple plier-like tool was used to overcome the spring in applying and removing the fastener.

This device was suitable for light and thin sheets but became inadequate for more modern structures because the clamping force required to pull heavy plates or sheets together was more than could be developed by a spring which could be manipulated by a manual tool. For heavy work, another type of clamping device was developed which still utilized the split pin principle but was provided with single or multiple screw thread mechanisms to advance and retract the tension member. These devices were operated by complicated rotating tools using air or electric motors. While these fasteners can apply very high positive clamping forces they are expensive to make and have a relatively short life. In addition they require complicated and expensive tools both to apply them and to remove them.

A new fastener has recently been developed which can apply the same high clamping forces and yet is relatively simple and inexpensive and much more durable. It is applied with a direct retracting force and is locked in clamping position with an axially sliding locking actuator, and yet is releasable instantly by using the old plier-type tool. Basically, the new fastener comprises a body with an enlarged head end, a tension member slidable in the body and having an expandable gripper head at its forward end to engage the remote side of the work, and an aft end to be engaged by a puller to exert clamping force. A sleeve-like actuator slides axially on the body to a forward position to lock the tension member.

SUMMARY OF THE INVENTION

The present invention provides a simple and reliable tool for exerting the clamping force on the new fastener and for moving the actuator to locking position. Generally stated, it includes a first barrel which surrounds the body and actuator and engages the head end to force it against the work, a puller to grip the aft end of the tension member to pull it to clamping position, and a second barrel slidable forward in the first barrel to contact the actuator and move it axially to locking position.

The second barrel is slidable in the first barrel and the puller is slidable in the second barrel. A cylinder serves as a first reaction member and a piston in the cylinder serves as a second reaction member. The piston is connected to the aft end of the puller. The cylinder is slidably connected to the aft end of the first barrel and in positive pressural engagement with the second barrel, and a heavy coil spring is connected between the two barrels. When fluid pressure is applied to the cylinder, the piston moves aft to retract the puller and the tension member and apply clamping force to the work. The reaction of the cylinder pushes the two barrels forward, and the first barrel pushes the head end of the fastener body against the near side of the work. Continued application of the reaction force overcomes the spring and causes the second barrel to move forward with respect to the first barrel until it contacts the actuator and moves it to locking position. Once the fastener is locked, the fluid pressure is released and the tool is removed.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other advantages and features of novelty will become apparent as the description proceeds in conjunction with the accompanying drawing, in which:

FIG. 1 is a schematic elevational view in section showing the tool applied to a fastener;

FIG. 2 is a fragmentary schematic view in section showing the tool after clamping pressure has been applied; and

FIG. 3 is a view similar to FIG. 2 showing the tool after the spring has been compressed and the actuator moved to locking position.

DESCRIPTION OF PREFERRED EMBODIMENTS

The total tool incorporating the invention, together with a typical fastener to which it is applied, is shown schematically in FIG. 1, in which the fastener applying tool 10 is in position to secure fastener 12 in clamping relation with work pieces 14 and 16. In order to clarify the nature and function of the various components of the tool, it is desirable to briefly describe the structure and operation of a typical fastener which the tool is suited to operate.

Fastener 12 basically includes a body 18 having an enlarged head end 20, a tension member 22 slidable in the body, and an axially slidable locking actuator 24. The tension member includes a stem 26 bearing screw thread serrations over a substantial portion of its length. Needles 28 secured to the forward end of stem 26 have enlarged gripper heads 30 which may pass through apertures 32 in the work pieces to the position shown in FIG. 1. When stem 26 is retracted, the needles are cammed apart by spreader 34 so that gripper heads 30 engage the remote side of the work and clamp sheets 14 and 16 between themselves and head end 20. The aft end of stem 26 is gripped by a puller to cause the retracting movement.

The aft end of body 18 is split into tongues having internal screw thread serrations to engage stem 26 and provided with a cam surface confronting a cooperating internal cam surface in actuator 24 which is in the form of a sleeve sliding on body 18. After stem 26 has been retracted to clamping position, actuator 24 is moved forward and the interaction of the cam surfaces springs the tongues on body 18 inward so that their serrations positively engage those on the stem and lock it in

clamping position. For release, a plier-like tool has a jaw to engage groove 36 in the actuator and another jaw to engage the aft free end 38 of the stem. A squeeze on the plier-like tool forces the actuator rearward, and the tension member is released instantly.

The applying tool comprises three primary components, a first, clamping, barrel 40, a puller 42, and a second, locking, barrel 44, together with first and second reaction members 46 and 48 to produce the clamping and locking forces. The first barrel comprises a sleeve 50, the forward end 52 of which terminates in a transverse plane to engage head end 20 and force it against the near side of the work, the aft end of the sleeve being formed with an external flange 54.

The second barrel comprises a sleeve 56 having a forward end 58 in a transverse plane and formed at its aft end with an external flange 60. Barrel 44 is slidably mounted in barrel 40 and is considerably shorter so that the forward end 52 of barrel 40 extends well beyond the forward end 58 of barrel 44. A coil spring 62 having a high spring rate surrounds the aft portion of barrel 44 and is compressed between flanges 54 and 60 for a purpose described hereinafter.

Puller 42 comprises a shank 64 which may be solid or hollow and is connected at its aft end to reaction member 48. The forward end of shank 64 is split as indicated at 66 to form a plurality of tongues or jaws 68 provided with axially spaced serrations 70, preferably in the form of an internal screw thread. The puller is slidably mounted in barrel 44 and, in its inoperative position as shown in FIG. 1, jaws 68 extend forward out of the barrel. In this position, the internal thread is large enough to move axially over the aft end of stem 26 without binding. This may be achieved by bending the jaws outward as shown, or the jaws may be straight and annularly enlarged, with the screw thread formation initially formed large enough to pass over stem 26. In either form, when the puller is retracted the jaws are deflected radially inward as they move within the barrel, and they grip the free end of stem 26 to pull the tension member into clamping position.

While the reaction members may take various forms and be operated by manual or power means, the arrangement shown in FIG. 1 is preferred. In this form, the first reaction member 46 comprises a cylinder 72 to receive hydraulic or pneumatic pressure fluid supplied by conduit 74 from a source, not shown, through handle 76 and port 78. The supply and release of fluid is controlled by valve 80. The second reaction member 48 comprises a piston 82 provided with a sealing ring 84 and axially slidable in the cylinder. Its forward movement is limited by stop ring 86. When fluid pressure is applied, it is driven toward the aft end of the cylinder against the pressure of spring 88 and, since it is connected to shank 64, it retracts the puller and the tension member to produce the desired clamping action.

Reaction member 46 is provided at its forward end with a generally cylindrical housing 90 having an internal abutment 92 at its aft end and an inwardly directed flange 94 at its forward end. Flanges 54 and 60 of the first and second barrels are located within the housing so that flange 60 is in positive engagement with abutment 92 and flange 54 is in engagement with flange 94. Coil spring 62 surrounds barrel 44 and abuts flanges 54 and 60. It is initially highly compressed to a point where the force necessary to cause it to yield is somewhat

greater than the force required to produce the desired clamping pressure on the work. Consequently, when member 46 interacts with member 48, the axial force of abutment 92 against flange 60 will be transmitted through spring 62 to flange 54 to force end 52 of barrel 40 firmly against head end 20 while needles 28 are being retracted.

Turning to FIG. 2, it will be seen that as puller shank 64 was retracted the jaws 68 were drawn within the forward end of sleeve 56 and deflected radially inward to grip the aft end of stem 26 and pull it rearwardly, drawing gripper heads 30 into contact with the remote side of the work to clamp the sheets tightly together. At this moment the force at abutment 92 has not yet risen to a level which will compress spring 62, and therefore the fastener is not yet locked.

The final step is shown in FIG. 3, where the force at 92 has increased sufficiently to overcome the resistance of spring 62. Therefore barrel 44 has advanced within barrel 40, contacted the aft end of actuator 24, and moved it forward to locking position. The fluid pressure is now released, and spring 88 moves the piston 82 forward to its inoperative position. Shank 64 accordingly moves forward in sleeve 56 and jaws 68 spring apart to release stem 26. The tool is now free to be removed, and the fastener will remain tightly locked in clamping position until deliberately released and removed.

It will be understood that the steps illustrated in FIGS. 2 and 3 take place in sequence but that there is no appreciable pause between them. As the pressure builds up, the piston retracts the puller until the preload of spring 62 is reached, and the spring immediately begins to compress and permit the locking action to take place. Once the tool is positioned on the fastener the clamping and locking action take place in about a second. Thus the operation of the tool is far more rapid than previous devices and the tool itself is far simpler in construction, less expensive to make, and more durable in use.

I claim:

1. An applying tool for use with a clamping device having an elongate body with an enlarged head end to engage the near side of work to be clamped, a tension member axially movably mounted in the body and having a gripper head at its forward end to engage the remote side of the work and a formation at its aft end for connection to a puller, and a locking actuator movable axially forward on the body to lock the tension member in clamping position, the tool comprising:

a first, clamping, barrel sized to fit freely over the body of the clamping device and engage the enlarged head end to force it axially against the work; an elongate puller having a formation at its forward end to engage the aft end of the tension member to pull it into clamping position;

and a second, locking, barrel slidable within the first barrel and movable forward therein to engage the actuator and move it forward to locking position.

2. A tool as claimed in claim 1; wherein

first and second reaction members are provided and are connected to the aft ends of the first barrel and the puller respectively;

the reaction members being relatively movable in axially opposite directions to apply opposing axial forces of equal magnitude to retract the tension

member with respect to the head end of the clamping device.

3. A tool as claimed in claim 2; wherein the second barrel is movable with the first barrel during the clamping operation and is further movable forward with respect to the first barrel to contact the actuator and move it forward to locking position. 5
4. A tool as claimed in claim 2; wherein the first reaction member is axially slidably connected to the first barrel and in positive pressural engagement with the second barrel; and the second barrel is in yielding pressural engagement with the first barrel to yieldingly apply the force of the first reaction member to the first barrel. 15
5. A tool as claimed in claim 2; wherein the puller is slidably mounted within the second barrel with its forward end extending beyond the forward end of the barrel in inoperative position; the forward end of the puller is divided into a plurality of jaws defining a central passage to move axially over the aft end of the tension member; and the outer diameter of the jaws is greater than the inner diameter of the second barrel to cause the jaws to be deflected radially inward upon retraction of the puller with respect to the second barrel and grip the aft end of the tension member. 25
6. A tool as claimed in claim 5; wherein the inner gripping surfaces of the jaws are formed with axially spaced serrations to positively engage corresponding serrations on the tension member. 30
7. A tool as claimed in claim 6; wherein the serrations are in the form of an internal screw thread. 35
8. A tool as claimed in claim 1; wherein the forward end of the first barrel extends well beyond the forward end of the second barrel; the puller is slidably mounted within the second barrel with its forward end projecting beyond the forward end of the second barrel in inoperative position; 40
- a first reaction member is axially slidably connected to the first barrel and in positive pressural engagement with the second barrel; 45
- the second barrel is in yielding pressural engagement with the first barrel;
- a second reaction member is connected to the aft end of the puller;
- and the reaction members are movable in axially opposite directions to apply retracting force to the puller and extending force to the second barrel. 50
9. A tool as claimed in claim 8; wherein the forward end of the puller is divided into a plurality of jaws defining a central passage to move axially over the aft end of the tension member; 55

- and the outer diameter of the jaws is greater than the inner diameter of the second barrel to cause the jaws to be deflected radially inward upon retraction of the puller with respect to the second barrel and grip the aft end of the tension member.
10. A tool as claimed in claim 9; wherein the inner gripping surfaces of the jaws are formed with axially spaced serrations to positively engage corresponding serrations on the tension member.
11. A tool as claimed in claim 10; wherein the serrations are in the form of an internal screw thread.
12. A tool as claimed in claim 8; wherein the aft end of the second barrel is axially rearward of the aft end of the first barrel; abutments are provided at the aft ends of each barrel; and a high spring rate compression spring is located between the abutments to transmit clamping force from the second barrel to the first barrel.
13. A tool as claimed in claim 12; wherein the reaction members are adapted to develop sufficient axial force to overcome the compression spring and move the second barrel forward to clamping position.
14. A tool as claimed in claim 8; wherein the first reaction member is provided at its forward end with a generally cylindrical housing having an internal abutment at its aft end and an inwardly directed flange at its forward end; the aft end of the second barrel is axially rearward of the aft end of the first barrel and is provided with an external flange in positive engagement with the internal abutment of the housing; the aft end of the first barrel is provided with an external flange located within the housing and in engagement with the housing flange; and the yielding pressural engagement between the barrels is provided by a coil spring surrounding the second barrel and axially compressed between the flanges of the barrels.
15. A tool as claimed in claim 14; wherein the first reaction member is an elongate body having an axial passage therein; and the second reaction member is axially movably mounted in the passage.
16. A tool as claimed in claim 14; wherein the first reaction member is a cylinder; the second reaction member is a piston slidable in the cylinder; and a source of fluid pressure is connected to the forward portion of the cylinder to move the piston aft.
17. A tool as claimed in claim 16; wherein a compression spring is located in the cylinder aft of the piston to return the piston to inoperative position when the fluid pressure is released.

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