

2145952

AUTOMATIC STUD DRIVER

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BACKGROUND OF THE INVENTION

This application together with our co-pending Patent Applications Nos. 8409178 and 8409180 was divided out of our earlier Patent Application No. 8107870.

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In the prior art, automatic stud drivers have been complicated devices in which a set of jaws were clamped onto the stud and then, while the jaws firmly and non-rotatably hold the stud, the stud was inserted into the workpiece. Once the stud was fully inserted in the workpiece, the stud driver automatically released the stud from the jaws and allowed the stud driver to be pulled away from the stud.

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U.S. Patent No. 2,743,639 to Lynch discloses a stud setter for automatically inserting studs. The stud setter disclosed in Lynch '639 is a very complicated device comprising numerous concentric cylinders, numerous metal balls within the cylinders, and a set

of jaws in the middle of all of the cylinders. Each of the balls within the concentric cylinders lies within holes in one of the cylinders and slide in and out of grooves in the other cylinders and grooves in the jaws. The various grooves in the cylinders and jaws caused the manufacture and assembly of the stud setter to be extremely difficult.

#### OBJECTS OF THE INVENTION

The principal objects of the present invention are to provide an automatic stud setter which can be easily and quickly assembled with a minimal number of tools, which is easier to manufacture than prior automatic stud setters, and which is of smaller maximum outside diameter than prior automatic stud setters for use in work areas where larger prior automatic stud setters could not be utilized.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of the stud driver; Figure 2 is a partially cut away view along line A-A of Figure 1, and in Figure 2 the jaws, the plunging means, and the top of the carriage are not cut away; Figure 3 is an exploded view of the stud driver driver;

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Figure 4 shows one half of a cross-sectional view of the body along the line C-C of Figure 3; and Figure 5 is a cross-sectional view along line B-B of Figure 2.

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#### DETAILED DESCRIPTION OF THE INVENTION

The automatic stud driver according to the present invention comprises a body 10; a collar 20; a driven head 30; a carriage 40; two sets of balls in the carriage (four retaining balls 44 and two latching balls 46); a set of jaws 50; a plunger 60; and a stud pick-up and aligning means 70. As shown in Figure 2, the assembled stud driver has three concentric cylinders; the body 10, the carriage 40 which is inside the body 10, and the driven head 30 also in the body 10.

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The driven head 30 and the carriage 40 are secured inside of the body 10 by the collar 20, which screws onto the exterior threads of the body 10. The driven head 30 and the carriage 40 are prevented from sliding through body 10 by the head ledge 12 and the carriage ledge 14 both on the body 10 (Figure 4). The carriage ledge 14 is far enough down into body 10 so as to allow the carriage 40 a limited range of sliding

between the bottom of the driven head 30 and the carriage ledge 14.

5 In operation, the driven head 30 is attached to a driving means. The driving means supplies rotary and reciprocal motion to the stud driver. The driven head 30 is also coupled to the carriage 40 so as to transfer the power and motion of the driving means to the carriage 40 but still allow the carriage 40 to  
10 slide in the body 10.

The carriage 40 is the envelope for the assembly of jaws 50. The jaws 50 grip the stud by a grooved threaded section 54 whose threads match those of the  
15 studs. The jaws 50 are assembled about the plunger means 60 forming a cylindrical shape which is held together by the hollow inside surface of the carriage 40 (Figure 2). A hole is formed by the grooved threaded section 54 in the bottom of the assembly of  
20 jaws 50. It is into this hole that the stud is inserted to be grasped by the jaws 50.

The assembly and disassembly of the stud driver has been greatly simplified in the present invention by  
25 the novel body, carriage, jaws, and stud pick-up and

aligning means. The jaws 50 are held around the  
plunger means 60 and then inserted into the carriage  
40. Then the retaining balls 44 and the latching  
balls 46 are placed into the retaining ball holes 45  
5 and latching ball holes 47 in the carriage 40. Before  
the carriage 40 is dropped into the body 60, either  
the jaws 50 must be closed to line up the latching  
ball groove 58 with the latching ball holes 47 or, the  
diametrically opposed cuts 57 in the side of the jaws  
10 50 which form grooves between the two jaws must be  
lined up with the latching holes 47, so as to provide  
a recess between the jaws 50 for the latching balls 46  
as they slide past the surface 15 on the body 10 and  
allow the carriage 40 to slide into the body 10. The  
15 grooves formed by the co-operating cuts 57 preferably  
have a substantially V-shaped cross-section. Once the  
carriage 40 is in the body 10, the driven head 30 is  
slid into the body 10 so that the post 41 on the  
carriage 40 slides into the slot 34 in the driven head  
20 30. The collar 20 is then slid over the driven head  
30 and screwed onto the body 10, and the collet 80  
(Figure 1) is tightened up against the collar 20 to  
lock the collar 20 on the body 60 to complete the  
assembly of the stud driver. The collet 81 can be

utilized to secure accessories, such as a dust cover or a trip gauge, to the tool.

5      Optionally, the stud pick-up and aligning means 70 may be slid onto the end of the carriage 40, the slots 71 in the stud pick-up and aligning means are aligned with the set screw holes 48 in the carriage 40, and the set screws 78 are inserted into the carriage 40.

10      To disassemble the stud driver, the reverse process is used. To remove the jaws 50 from the carriage 40 once the carriage 40 is out of the body 10, the jaws 50 need to be closed which requires a stud to be inserted into the jaws.

15      The assembly and disassembly of the stud driver requires only a stud, a hex end wrench for the set screws 78 if the optional stud pick-up and aligning means 70 is utilized, and a set of wrenches for the  
20      collar 20, collet 80 and optional collet 81, and driven head 30. The advantages of such a simple to assemble stud driver are enormous in saving time in maintaining the stud driver.

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In the stud setter, the means to grip the stud are the jaws 50. On the inside planar surface of each jaw 50 is a semicircular groove 51 extending the length of the jaw. The lower section of the groove 51 is threaded to match the threads on the stud. Thus, when the jaws are closed onto the stud, the threaded section 54 of the jaws 50 can grip the stud without damaging any of the threads on the stud.

Fitted into the upper section of the groove 51 above the threaded section 54 is the plunger means 60. The plunger means 60 is held in the groove 51 of the jaws 50 by a pivot cylinder 65. The pivot cylinder 65 is slidably mounted on a threaded shaft 66 of the plunger means. The pivot cylinder 65 fits in pivot grooves 55 of the jaws 50. The pivot grooves 55 are perpendicular to the lengthwise groove 51. The plunger means 60 biases the lower portion of the jaws 50 outwards to allow the jaws to slide over the stud. The jaws 50 are opened by an annulus 62 on the plunger means 60 which is biased towards the opening groove 53 of the groove 51 in the jaws and away from the closing groove 52. Since the closing groove 52 has a larger radius than does the annulus 62, the jaws can be closed while annulus 62 is in the closing groove 52 but since the

annulus 62 is biased towards the opening groove 53, which has a smaller radius than annulus 62, the lower section of the jaws are forced apart. The spreading out of the jaws 50 disengages the threaded section 54 from the stud and thus releases the stud. The lower section of the annulus 62 is tapered inward so as to allow the annulus 62 to smoothly slide from the closing groove 52 to the opening groove 53.

10 The annulus 62 along with the entire lower half of the plunger means 60 is biased downward in the jaws 50 towards the opening groove 53 by a helical spring 64. The helical spring 64 pushes up against the pivot cylinder 65, which is slidably mounted on the threaded shaft 66. The pivot cylinder 65 is prevented from sliding off the threaded shaft 66 by the hex end head on the threaded shaft 66. The bottom 63 of the plunger means 60 extends into the threaded section 54 of the jaws. As the stud is inserted into the jaws 20 50, the end of the stud presses up against the bottom 63 of the plunger means 60 and, by overcoming the biasing force, forces the plunger means 60, including the annulus 62, upwards in the groove 51. The annulus 62 slides into the closing groove 52 and allows the 25 jaws to close onto the stud.

The assembly of the jaws 50 and the plunger means 60 is enclosed in the carriage 40. The carriage 40 is a hollow cylinder with a closed top end 42. Although the jaws and plunger assembly can easily be slid into the carriage, once inserted, the jaws 50 cannot unintentionally slide out. The three means which prevent the jaws 50 from sliding out of the carriage are: the retaining balls 44 which ride in the peripheral wall of the carriage 40, the latching balls 46 which also ride in the peripheral wall of the carriage 40, and a locking groove 43 (Figure 2) around the inside surface of the carriage 40. The locking groove 43, which forms a circle perpendicular to the axis of the carriage 40 around the inside surface of the carriage 40, prevents the open jaws 50 from sliding out of the carriage 40 by acting as a stop for diametrically opposed bridges 58A on the jaws 50. When the carriage 40 is in the body 10, the retaining balls 44 prevent the jaws from sliding completely out of the body 10, regardless of whether the jaws 50 are closed or not.

The retaining balls 44 are held in the peripheral wall of the carriage 40 in the retaining ball holes 45. The retaining balls 44 have a diameter larger than the

thickness of the peripheral wall of the carriage 40.

Thus, when the carriage 40 is in the body 10 which brings the wall of the carriage 40 flush with inner surface 15 of the body 10, the retaining balls 44

5 protrude past the inside surface of the peripheral wall of the carriage 40 (Figure 2). The jaws 50, which fit snugly in the carriage 40, compete for space inside the carriage with the retaining balls 44. The only section of the jaws assembly which is thin enough

10 to fit between the protruding retaining balls 44 is the retaining ball groove 56. The retaining ball groove 56 is wide enough to allow the jaws 50 a limited range of sliding movement up and down within the carriage 40. Within this range, the jaws 50 can  
15 slide out of the carriage 40 until the bridges 58A engage with the groove 43 of the carriage 40 and the jaws 50 can slide into the carriage 40 until the bottom of the jaws 50 are approximately flush with the bottom of the carriage 40.

20 The jaws 50 are also held within the carriage by the latching balls 46. The latching balls 46 are held in the peripheral wall of the carriage 40 in the latching ball holes 47. As with the retaining balls 44, the  
25 latching balls 46 have a diameter larger than the

thickness of the peripheral wall of the carriage 40. Thus, when the carriage 40 is slid up into the body 10 such that the top 42 of the carriage 40 is up against the bottom of the driven head 30 bringing the latching ball holes 47 up next to and flush with the inner surface 15 of the body 10, the latching balls 46 are forced to extend past the inner surface of the peripheral wall of the carriage 40. Only the latching ball groove 58 can fit between the protruding latching balls 46. The latching ball groove 58 cannot slide past the protruding latching balls 46 because of the thicker portion of the jaws 50 just above the latching ball groove 58. Consequently, the jaws 50 cannot slide out of the carriage 40 when the latching balls 46 are forced into the latching ball groove 58.

All the means which prevent the jaws 50 from sliding completely out of the carriage 40 allow the jaws 50 a limited amount of sliding within the carriage 40. That limited amount of sliding of the jaws 50 in and out of the carriage is the means by which the jaws are closed and allowed to open. When the jaws have slid partially out of the carriage, as in Figure 2, the jaws 50 are biased open by the plunger means 60. When a stud is inserted into the jaws 50, the stud pushes

the jaws 50 up into the carriage 40 which brings the closing lip 59 on the jaws 50 into engagement with the tapered surface 49 on the carriage 40. Engagement of the closing lips 59 and the tapered surface 49 causes the lower half of the jaws 50 to come closer and closer together as the jaws 50 are slid further and further up into the carriage 40 until finally the jaws are closed firmly onto the stud which prevents the closing lips 59 from sliding any further up against tapered surface 49. Once this happens, the jaws 50 are fully closed onto the stud.

The insertion of the stud into the jaws 50 also forces the carriage 40 to slide up in the body 10 against the bottom of the driven head 30. Once the carriage is slid up into the body 10, the latching ball holes 47 are adjacent to the inner surface 15 of the body, which forces the latching balls 46 to protrude past the inner surface of the peripheral wall of the carriage 40 and into the latching ball groove 58. Since the latching ball groove 58 is bridged at 58A, the jaws can only rotate in the carriage 40 until the latching balls 46 are abutted with the side of the bridges 58A. Thus, when the stud is being spun into

the workpiece, the stud cannot force the jaws 50 to spin around in the carriage 40.

Power and motion is imparted to the stud driver through the driven head 30. The driven head 30 is rotatably held into the body 10 by the collar 20 by engaging with the lip 33 on the driven head 30. Through the bottom of the driven head 30 is the slot 34 perpendicular to the axis of the driven head 30. This slot 34 slidably but non-rotatably engages with the post 41 on the top of the carriage 40. The slot 34 and post 41 engagement allows the carriage 40 to slide up and down within body 10 but still be rotatably coupled with the driven head 30. The top end 31 of the driven head 30 is attached to some driving means, such as a drill press, which imparts reciprocal and rotary motion to the stud driver.

The collar 20 holds the driven head 30 in the body 10. The collar 20 screws on to the top end of the body 10. The collar 20 engages with lip 33 and bearing surface 35 on the driven head 30. The collar 20 holds the driven head 30 coaxial to the body by the engagement of the bearing surface 35 and a similar bearing surface on the inside of the collar.

Planar surfaces 32 have been cut out of the upper cylindrical surface of the driven head 30 so that a wrench can be used to tighten the driven head 30 onto the driving means. A similar planar surface has been cut out of the outer cylindrical surface of the collar 20 to also provide a grip for a wrench to tighten the collar 20 onto the body 10. Collet 80 has a planar surface for a wrench and is tightened up against the collar 20 as a locking mechanism to prevent the collar 20 from being shaken loose during operation of the stud driver.

The optional stud pick-up and aligning means 70 picks up and holds the stud until the stud is to be inserted into the jaws. The stud pick-up and aligning means 70 initially aligns the stud prior to its insertion into the jaws 50 so that the stud is coaxial with the jaws 50.

The bottom of the stud pick-up and aligning means 70 has an inverted table top section 74 having four holes 75 symmetrically disposed about its side, each of which holds one of a plurality of pins 73. The pins 73 each have a head 76 which prevents them from sliding through the holes 75. The pins 73 are biased inwards

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towards the axis of stud pick-up and aligning means 70 by a resilient O-ring 72. The pins 73 engage the end of the stud when the stud is inserted into the stud driver and position the stud towards the center of the jaws 50. The pins 73 do not firmly grasp the stud and thus allow the stud to slide past and rotate in the pins 73. The stud pick-up and aligning means 70 is held onto the carriage 40 by two diametrically opposed set screws 78 which are enclosed by corresponding slots 71 in the peripheral wall of the stud pick-up and aligning means 70. The set screws 78 are set in set screw holes 48 in the carriage 40 and protrude out from the peripheral wall of the carriage 40. The set screws 78 are inserted in the carriage 40 after the stud pick-up and aligning means 70 has been slid onto the end of the carriage 40. The slot 71 and set screw arrangement permits the stud pick-up and aligning means 70 to slide up and down a limited distance relative to the carriage 40.

In operation, the assembled stud driver is attached by the driven head 30 to the driving means. In the beginning of the sequence (as shown in Figure 2), the jaws 50 are open and partially out of the carriage 40 which has slid down away from the driven head 30 in

the body 10 to rest on the carriage ledge 14 in the body 10. When the stud driver has the optional stud pick-up and aligning means 70, the stud is inserted into the stud driver, by first passing through the stud pick-up and aligning means 70, which picks up the stud and holds the studs until the stud is to be inserted into the jaws. Usually the stud is held in the stud pick-up and aligning means 70 until the stud is brought into contact with the threaded stud hole, at which time the stud is pushed up into the jaws as the stud pick-up and aligning means 70 aligns the stud coaxial to the open jaws 50. As the stud is further inserted into the stud driver, the end of the stud abuts the bottom 63 of the plunger means 60. Once the stud overcomes the biasing force of the helical spring 64, the stud forces the annulus 62 to slide up into the jaws 50 from the opening groove 53 of the jaws into the closing groove 52. Once the annulus 62 of the plunger means 60 abuts up against the top of the closing groove 52 of the jaws 50, the upward movement of the stud forces the plunger means and jaws assembly up into the carriage. As the jaws 50 slide up into the carriage 40, the closing lips 59 of the jaws slide against the tapered inner surface 49 of the carriage 40 and force the threaded section 54 of the jaws 50 to

firmly close onto the stud. The upward movement of the stud will also force the carriage 40 to slide up into the body 10 until the top 42 of the carriage 40 is flush against the bottom of the driven head 30, thus bringing the latching ball holes 47 up flush with inner surface 15 of the body 10 and causing the latching balls 46 to protrude inwards past the inner surface of the peripheral wall of the carriage 40 and into the latching groove 58 of the jaws 50.

When the stud driver first starts rotating the stud down into the workpiece, the stud resists being screwed into the workpiece and rotates in the threaded section 54 of the jaws 50. However, as the stud rotates in the threaded section 54, it screws further and further up into the jaws 50 until it finally abuts the bottom 63 of the plunger means 60. The plunger bottom 63 is prevented from going any further up into the jaws 50 by the annulus 62, which is abutted up against the top of the closing groove 52. Once the stud is up against the bottom 63, the stud is prevented from rotating any further up into the jaws 50. At that point, the stud will then cause the jaws 50 to rotate within the cylinder 40 but the jaws can only rotate through a limited arc since the latching

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groove 58 in which the latching balls 46 ride is bridged at 58A. Once the stud is stopped from rotating in the jaws 50 by the plunger bottom 63 and the jaws 50 are stopped from rotating in the carriage 40 by the latching balls 46 binding against the bridges 58A, the stud is forced to rotate down into the workpiece.

After the stud is fully inserted into the workpiece, the stud driver, which is still grasping the stud, is pulled up away from the stud. The stud pulls the carriage 40 down away from the driven head 30 and into the body, which brings the latching ball holes 47 in the carriage 40 adjacent the larger diameter inner surface 16 of the body 10 and allows the latching balls 46 to come out away from the jaws 50 in the latching ball holes 47. Once the latching balls 46 have moved outwards in the wall of the carriage 40 out of the latching ball groove 58, the jaws 50 can be pulled by the stud down out of the carriage 40 until the closing lips 59 are disengaged from the tapered surface 49 of the carriage 40, which allows the plunger means 60 to bias open the jaws 50 and allow the stud to become disengaged from the stud driver,

thus completing the operation of inserting the stud  
into the workpiece.

CLAIMS

1. A stud driving device comprising:

5 a cylindrical hollow body, an interior surface of said body having a head ledge and a carriage ledge defined thereon;

10 a driven head attached to a driving means, said driven head being substantially cylindrical and having a lip running around its perimeter, said driven head being held partially in said body, said driven head engaging said head ledge of said body;

15 a collar of annular shape engageable with said body, said collar engaging with said lip around said driven head to hold said driven head in said body;

20 a one piece cylindrical carriage comprising a peripheral wall, a top of said carriage coupling slidably but non-rotatably with said driven head, said carriage engaging said carriage ledge so that said carriage is prevented from sliding through said body by said carriage ledge, a plurality of retaining ball holes in the peripheral wall of said carriage, a plurality of latching ball holes in the



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peripheral wall of said carriage, a radially outwardly tapered surface extending from the interior surface of the peripheral wall to the bottom edge of said carriage and a locking groove on the interior surface of said peripheral wall lying in a plane substantially perpendicular to the axis of said carriage;

a set of retaining balls which ride in the retaining ball holes in the carriage, the diameter of said retaining balls being larger than the thickness of the peripheral wall of said carriage;

a set of latching balls which ride in the latching ball holes in the carriage, the diameter of said latching balls being larger than the thickness of the peripheral wall of said carriage;

at least two diametrically opposed jaws, said jaws forming a cylindrical shape which is held together by the inside surface of the peripheral wall of said carriage; each of said jaws has an inside and an outside peripheral surface, a threaded groove extending in the axial direction along said inside surface, a closing lip on the outside peripheral surface for engagement with said tapered surface of said carriage, a retaining ball groove, extending circumferentially around said outside peripheral



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surface, in which said retaining balls partially  
ride, a latching ball groove, extending circumferen-  
tially around said outside peripheral surface  
displaced axially from the retaining ball groove, in  
5 which said latching balls partially ride, and a  
bridge across said latching ball groove, said bridge  
having a side against which said latching balls bind  
to prevent said jaws from rotating relative to said  
carriage, said bridge also having a bottom which  
10 engages said locking groove in said carriage to  
prevent said jaws from sliding out of said carriage.

2. A stud driving device as claimed in Claim  
1 comprising:

15 means defining a substantially cylindrical  
bearing surface on the exterior of the driven head;  
and

said collar having an internal cylindrical  
surface which abuts and is of substantially the same  
20 diameter as said cylindrical bearing surface of said  
driven head.

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