

April 18, 1967

KARL HEINZ WEBER

3,314,458

AUTOMATIC SCREWING DEVICE

Filed Oct. 9, 1964

2 Sheets-Sheet 1

Fig. 1

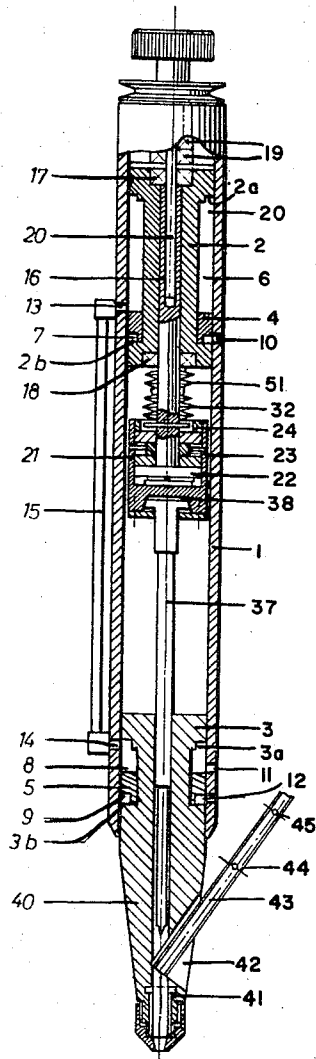


Fig. 2

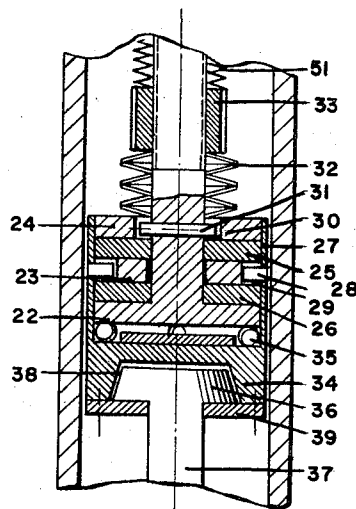
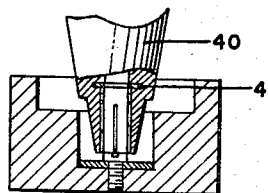


Fig. 3



INVENTOR:
Karl Heinz Weber
By *Walter Ducky*

April 18, 1967

KARL HEINZ WEBER
AUTOMATIC SCREWING DEVICE

3,314,458

Filed Oct. 9, 1964

2 Sheets-Sheet 2

Fig. 4

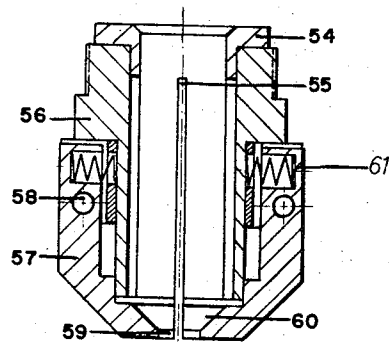
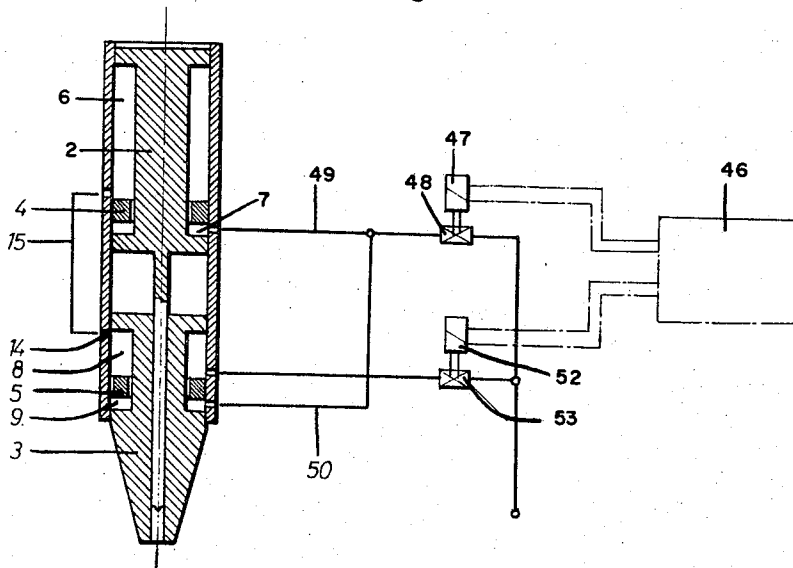


Fig. 5

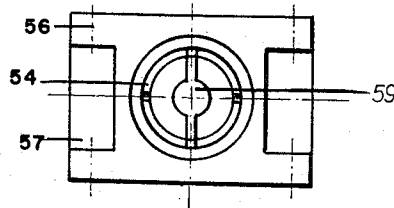


Fig. 6

INVENTOR
Karl Heinz Weber
By *Walter Reubing*

1

2

3,314,458

AUTOMATIC SCREWING DEVICE

Karl Heinz Weber, Ulrichstrasse 51, Icking, Germany

Filed Oct. 9, 1964, Ser. No. 402,754

Claims priority, application Germany, Oct. 9, 1963,

W 35,393

8 Claims. (Cl. 144—32)

The invention relates to an automatic screwing device with a feeding means and two pistons arranged coaxially in a common cylinder and driven by pressure medium, e.g. compressed air. One of the pistons shifts the screw driver, the shaft of which is fastened on a sleeve pivotally arranged in the piston and sliding of the drive shaft and taken along by this latter. The other piston applies the screws, which are singly supplied to it, to the work piece. The stroke movements of the piston are controlled by means of valves in such a manner that after each end of a screwing cycle the return of the piston shifting the screw driver follows that of the other piston in a time interval predetermined in such a manner that a defective screw is ejected from the clamping chuck. In this manner a continuous and trouble-free operation is possible also if a screwing process is unsuccessful, e.g. because of a defective screw or because a thread is missing in the bore.

The present invention is an advantageous further development of such a screwing device. According to the invention the piston carrying the clamping chuck serves as a control organ for the retarded return of the piston shifting the screw driver in such a way that the first piston leaves open in its starting position the opening of a tube by which the pressure medium is supplied to the latter piston. When using double pistons, the spaces enclosed by their active piston surfaces are subdivided by an annular disc each fastened on the cylinder wall, there is provided an opening in the cylinder above the annular disc shifting the screw driver, which opening is connected by a tubing with the opening in the cylinder controlled by the other piston. By these measures a simpler and more reliable control of the pistons is obtained, which saves, simultaneously, much time.

The course of the piston movements in their predetermined order and time sequence can be controlled by two preferably electromagnetically operated valves, controlled by means of an adjustable time piece through a relay. One of these valves is mounted in a branching line for feeding the pressure medium into the lower spaces between the piston and the other in a line for feeding the pressure medium into the upper space of the piston carrying the clamping chuck. Thus both pistons are driven simultaneously.

Thus the circumstance that the piston connected with the screw driver has to cover a longer distance than the other piston, is made use of for shortening the work cycle. There is, besides, the already cited saving of time because of the renouncing to one valve made possible by the invention. This shortening of the screwing cycle, which is important for a manufacture in series can, however, have its full effect only if the slipping-clutch necessary for limiting the torque of the screw driver responds quickly and exactly.

This is obtained, according to a further feature of the invention by the fact that the slipping-clutch is arranged between the two pistons as a last member in front of the screw driver. Because of the small mass of the screw driver the momentum of inertia acting on the clutch disks is small, so that in connection with a suitable configuration of the clutch the screw driver comes immediately to a standstill, when reaching the adjusted torque.

For giving a further explanation of the invention refer-

ence is made to the embodiment shown in the drawings.

FIG. 1 shows the screwing device in section with the exception of its upper part.

FIG. 2 shows in an enlarged scale a longitudinal section of the slipping clutch,

FIG. 3 shows the lower part of the screwing device with two work pieces screwed together,

FIG. 4 shows diagrammatically the wiring diagram for the control of the pistons,

FIGS. 5 and 6 show in longitudinal section and plan view a particular embodiment of the clamping chuck.

In the cylinder 1 there are the two double pistons 2 and 3, the spaces limited by the active surfaces 2a, 2b and 3a, 3b are subdivided by annular discs 4 and 5 fastened on the cylinder wall into the spaces 6, 7, 8, and 9. 10 is the connection of the pressure medium pipe for the piston 2, while 11 and 12 are the tube connections for the piston 3. The further connections 13 and 14 are connected to each other through the tubing 15. In the piston 2 there is journaled by means of antifriction bearings 17 a sleeve 16, which is solid in its lower part. This sleeve is slidable on the drive shaft 20 rotating in the antifriction bearings 19. The drive shaft 20 is driven by a not represented electric motor. The positive and/or non-positive connection between the sleeve 16 and the drive shaft 20 can be made by means of groove and groove-and-tongue or in any other manner.

The lower end of the sleeve 16 is configured as a disk 22 forming a component of the slipping clutch 21. Further components of this clutch are the metallic ring discs 23 and 24 and the ring discs 25 and 26 arranged loosely between the form discs and made of a suitable material in order to be used as a clutch lining. On the clutch housing 27, pins 28 are arranged which engage into recesses 29 of the annular disc 23. In similar manner the annular disc 24 is provided with the recesses 30 into which engages a pin 31. These recesses allow an axial play of the annular discs. The positive and/or non-positive connection between the annular discs and the clutch housing on the one hand and the shaft of the sleeve 16 on the other hand may also be obtained by toothing. 32 is a clutch spring, the tension of which is adjustable by means of a ring nut 33. The pressure of the spring 32 is absorbed by a ball bearing 35 arranged between the disc 22 and the bottom 35 of the clutch housing. The shaft end 36 of the screw driver 37 forms together with the conical recess 38 in the bottom of the clutch housing 27 a conical clutch. As long as the screw driver is not in work position, it is loosely attached by means of an annular plate 39 at the bottom 34. The purpose of this measure will be explained later.

The piston 3 protrudes with a conical extension 40 from the cylinder 1. In the extension there is pivotably mounted a clamping chuck 41 shown in FIG. 3 which is elastically configured by longitudinal slots. The lower part of the piston 3 has a recess 42, which is dimensioned in such a way that the mouth of the tube 43 serving to feed the screws is above the clamping chuck. The tube is pivotably arranged around the point 44. The tube is connected with a tubing 45 for the automatic feeding of the screws obtained e.g. by means of a vibrator and a sorting device.

The screwing device works as follows:

After switching on the drive motor, the automatic feeding device is put into operation, which feeds a screw for each work cycle into the tubing 45 and 43. The screw falls finally by its own weight into the clamping chuck 41. In this moment a correspondingly adjusted time piece arranged in the box 46 shown in FIG. 4 in dashed lines operates a relay arranged in the same box, which relay excites the coil 47 of the magnetic valve 48. The

valve opens so that the pressure means can flow through the lines 49 and 50 into the spaces 7 and 9 of the cylinder. Both pistons move downward. The piston 3 applies the screws to the workpiece and remains first in this position. The screw driver 37 shifted by the piston 2 pivots by direct engagement the tube 43. As soon as there is a counter pressure against the shifting of the screw driver 37 the frictional engagement is obtained with the clutch housing 27 through the conical clutch 36, 38. The engagement of the screw driver 37 on the head of the screw is cushioned by the spring 51 (FIG. 1). The screw is screwed in and tightened, whereby the slipping clutch 21 working very precisely in the described arrangement and embodiment takes care that the screw is tightened to a predetermined torque.

The duration of the screwing cycle is given. The time piece adjusted to this duration switches on after the end of the screwing device, the coil 52 of the magnetic valve 53 through the time relay and switches out simultaneously the coil 47 of the other valve. The pressure means flows into the space 8 of the cylinder. The piston 3 is brought back into the starting position. In this position it gives free the tube connection 14, so that the pressure means flows through the tube 15 into the space 6 with the consequence that also the piston 2 returns again. This time delay of the piston 2 effects the ejection of the screw from the clamping chuck by the screw driver, if the screwing cycle was unsuccessful for any reason. Thus an interruption of the work is avoided. As soon as the screw driver 37 is withdrawn, the conical clutch 36—38 is released. The screw driver 37 does not rotate any longer so that no damage can be caused to the screw head. This is an advantage, which is very important, because just with very small screws as they are used e.g. for the screwing of clock plates, spectacle frames etc. the danger that the screw heads are damaged by the rotating screw driver, is great. Instead of a conical clutch also a clutch with front toothing may be used, because it fulfills the same purpose.

With screws having counter-sunk or fillister heads it may happen that they are not absolutely vertical in the clamping chuck, as the screw heads have little guide surface or none at all. A bad or unsuccessful screwing may be the consequence. This disadvantage is eliminated by the clamping chuck shown in FIGS. 5 and 6. It consists of the clamping sleeve 54 with longitudinal slots 55, parts 56 receiving the sleeve 54 and the tongue members 57, which are pivoted on the pivots 58 arranged on part 56. The tongue members are configured in such a way that they surround the screw shaft and thus form a guide for the screw. The opening 59 of the tongue members surrounding the screw shaft merges into a conical recess 60, so that towards the end of the screwing process the screw head pivots automatically the tongue members. If after the end of the screwing the clamping chuck is lifted from the screw head, the springs 61 return the tongue members in their starting position. Any screws lying possibly obliquely in the clamping chuck 54 are brought automatically into a vertical position by the screw driver in its downward movement.

I claim:

1. In a power screw driver for presenting screws to a workpiece and for driving the screws into the work piece and for ejecting screws from the driver which are not accepted by the workpiece; cylinder means, a first piston in said cylinder means having first and second fluid operable areas responsive to fluid pressure to advance the first piston toward the work and retract it therefrom respectively, a screw holding clamp chuck on the workpiece end of said first piston, a central axial bore in said first piston, a second piston in said cylinder means spaced from said first piston on the side thereof opposite said workpiece and having first and second fluid operable areas responsive to fluid pressure to advance the second piston toward said first piston and to retract it therefrom re-

spectively, a rotatable sleeve carried by said second piston and projecting toward said first piston, a driven shaft engaging said sleeve to drive it in rotation, a driver shank coaxial with said sleeve and extending from the end of the sleeve toward said first piston and adapted for passing through the said bore in said first piston, a clutch interconnecting the adjacent ends of said sleeve and driver shank for driving the shank by the sleeve, first means for supplying pressure fluid to both of said first fluid operable areas at one time to cause said chuck to present a screw therein to a workpiece and to cause said driver shank to engage the screw through said bore in the first piston and drive the screw into the workpiece and for interrupting the said supply to said first areas at the end of a driving operation, second means for supplying pressure fluid to the second fluid operable area of said first piston only to cause it to retract from the workpiece, and a passage leading from said second fluid operable area of said second piston to a point in said cylinder means which is covered by said first piston when the latter is advanced and which is uncovered by said first piston when the latter moves to its retracted position whereby the retraction of said second piston is delayed until said first piston has retracted and whereby a screw retained in said clamp chuck will be ejected therefrom by said driver shank.

2. A power screw driver according to claim 1 in which each said piston comprises a spool member having larger end portions and a smaller connecting portion extending between the end portions, an annular disc fixed in the cylinder means and surrounding each said connecting portion, said fluid operable areas of each said piston comprising those sides of the said end portions thereof which face the pertaining said disc.

3. A power screw driver according to claim 1 in which said first and second means comprise first and second solenoid operated valves, relay means controlling said valves, timer means controlling said relay means, a source of pressure fluid connected to said valves, said first valve being connected to both of said first fluid operable areas and said second valve being connected only to the second fluid operable area of said first piston.

4. A power screw driver according to claim 1 in which said clamping chuck comprises a body, a chuck sleeve in the body for receiving the screws to be driven and including longitudinal slots so the chuck sleeve is radially resilient, a pair of tongue members pivoted on said body and including end parts adapted to embrace the shank of a screw in the chuck while the screw head is disposed in said chuck sleeve, and spring means biasing said tongue members in a direction to cause their end parts to engage a screw shank and hold it on the axis of the chuck sleeve while permitting the tongue members to yield outwardly when the screw is driven into the work and the screw head passes from the chuck sleeve into said end parts of the tongue members.

5. A power screw driver according to claim 1 in which said clutch is in the form of a slip clutch so as to limit the driving torque that can be applied to said driver shank.

6. A power screw driver according to claim 5 in which said slip clutch is of the disc type and the end of said sleeve adjacent the driver shank is in the form of a disc and forms one element of said slip clutch.

7. A power screw driver according to claim 6 in which the slip clutch includes other discs in the form of rings surrounding said sleeve in spaced relation and friction rings disposed between said discs, a spring surrounding said sleeve and having one end bearing on the discs to press them together, an abutment nut on the sleeve abutting the other end of the spring, said clutch comprising a housing enclosing said discs and friction rings, at least one of said other discs being nonrotatably but axially movably connected to said housing, at least one other of said other discs being nonrotatably but axially mov-

5

ably connected to said sleeve, said housing having a bottom wall on the side of the disc on the end of said sleeve opposite the other said discs, and balls supporting the disc on the end of the sleeve on said bottom wall of the housing.

8. A power screw driver according to claim 7 in which the end of said driver shank adjacent the sleeve and said bottom wall of said housing form cooperating elements of a clutch device operable upon movement of the driver shank toward the said bottom wall of the housing to effect

5

10

6

driving connection between the driver shank and the clutch housing and also operable in response to movement of said driver shank away from said bottom wall of the housing to interrupt said driving connection.

No references cited.

WILLIAM W. DYER, JR., *Primary Examiner*.

R. J. ZLOTNIK, *Assistant Examiner*.