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DIMPLING MANDREL

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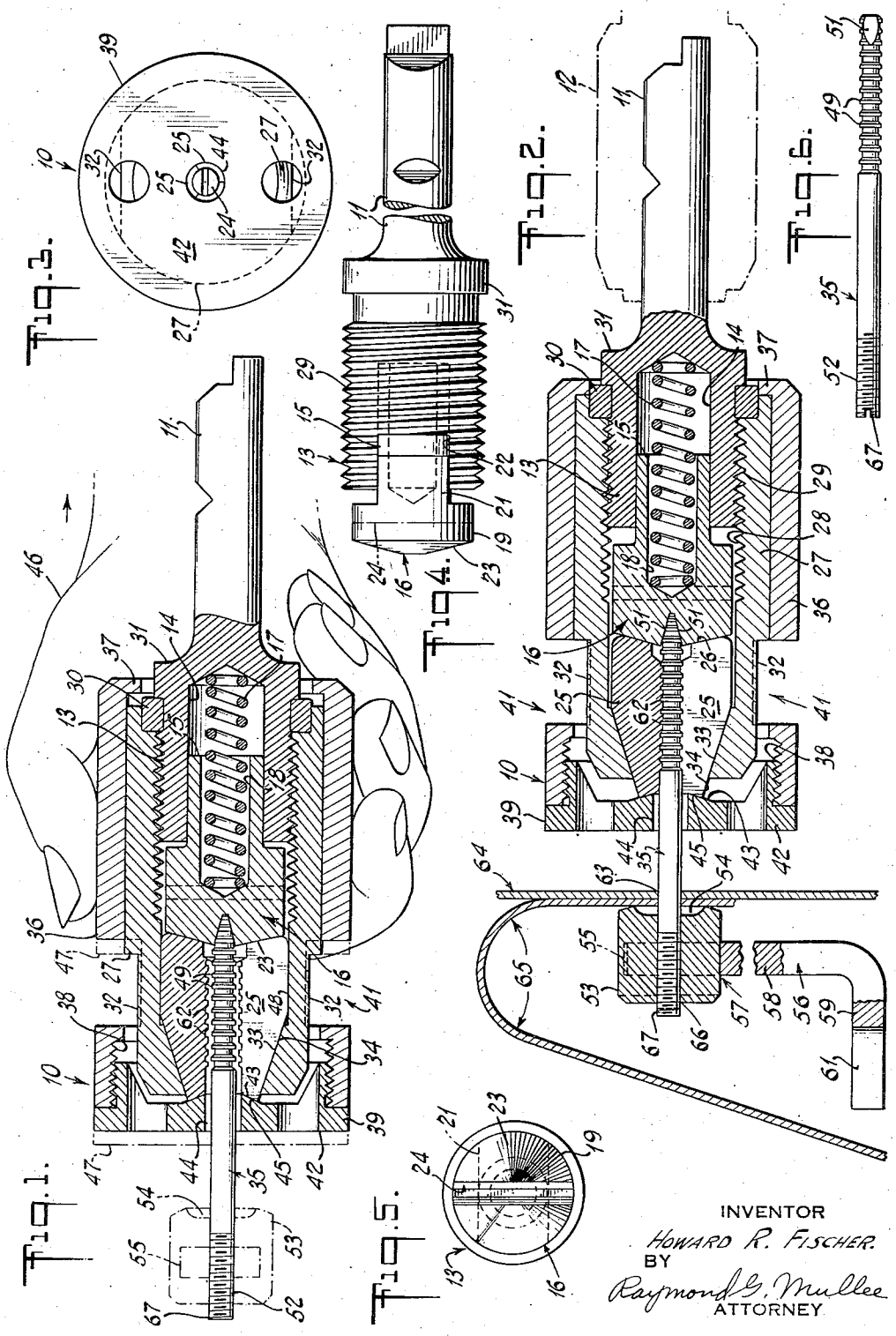

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## DIMPLING MANDREL

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6 Claims. (Cl. 153—21)

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This invention relates to the dimpling of metal sheets around rivet holes therein in order to adapt the latter for receiving a countersunk or flush type rivet by utilizing a draw pin or mandrel when connected to a powered dimpling tool for drawing a pair of dimpling dies together upon said sheets to dimple them. The invention refers particularly to a rotatable mandrel to be used with means for speedily inserting the mandrel into one of the two dimpling dies preparatory to dimpling the metal sheets by said dimpling tool and also for quickly removing said mandrel following the dimpling operation and reinserting the mandrel in the die through another rivet hole.

Flush rivets are used extensively in aircraft construction on the exposed surfaces of the metal skin which forms a cover for the fuselage, wing sections and other structural elements. The metal sheets, usually made of aluminum alloy, are mounted in place and the overlapping portions thereof are provided with registering perforations formed by drilling or punching. The sheets are dimpled around the holes to provide recesses for receiving the heads of the rivets. The resulting structure has the advantages of increased strength of the rivet joint and decreased wind resistance.

According to one method of dimpling, which is considered to be the most effective for certain types of work, a draw pin is inserted from one side of the sheets through the rivet hole and the projecting end on the other side is grasped with a power tool which applies pressure to opposed dimpling dies through the application of tensile force to the draw pin. As soon as the dimple is formed, the draw pin or mandrel is withdrawn and moved to the next hole. The cycle of operation must necessarily be repeated in rapid succession because of the thousands of holes required to be dimpled in a single airplane.

Thus it is a main object of this invention to provide facilities for speeding up the dimpling cycle as a whole by facilitating speedy initial insertion of the mandrel into the one dimpling die and also final withdrawal of said mandrel from the latter in such efficient manner as to save time during each cycle of the operation.

It is also an object to minimize any loss of time resulting from occasional breakage of the mandrel and to allow rapid removal of the broken mandrel parts from the die and replacement by a new mandrel.

A special feature of the invention is the use of a screw type mandrel with a corresponding screw type dimpling die and a handle to allow insertion of the mandrel with simultaneous placing of the

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die preparatory to subsequent dimpling of metal sheets in very close quarters where but narrow working space is available.

Other objects and features of the invention will appear more fully in detail from the following description, due reference being had to the accompanying drawing forming part hereof, in which:

Fig. 1 is a side elevation, largely in longitudinal section, of a rotatable mandrel together with a driving tool in condition to receive the mandrel;

Fig. 2 is a similar view of the tool with the mandrel in place and fully inserted into a dimpling die by means of said tool;

Fig. 3 is an end elevation of the tool of Figs. 1 and 2 as seen from the left or chuck end;

Fig. 4 is a side elevation of the shank a threaded portion, integral therewith and an associated plunger, the view showing the parts turned 90 degrees about the longitudinal axis of the shank from the position of said parts in Figs. 1 to 3;

Fig. 5 is an end elevation of the same parts shown in Fig. 4 as seen from the left end in the latter view; and

Fig. 6 is a side elevation of the mandrel alone of Figs. 1 and 2 when turned or rotated 90 degrees about its longitudinal axis from the position of said views.

When the mandrel is to be inserted into a rivet hole in one or more metal sheets to be dimpled, it is usually first screwed into a holder and then passed through a dimpling die, etc., as disclosed in the Patent No. 2,333,418, granted to the present applicant November 2, 1943, and thereafter individually into each of a plurality of such holes in the sheets and each time engaged by a power operated dimpling tool provided with a second dimpling die to effect dimpling about each hole. During such operation the mandrel remains in the holder which is used to shift said mandrel from one hole to the next, being a convenient means for handling the mandrel and facilitating dimpling the sheets at high efficiency.

However, frequently certain narrow spaces are encountered in or between the metal sheets in which no adequate room is found for placing the mentioned holder, and in which not even the full length of the mandrel alone can be accommodated, so that the latter must obviously be inserted into the rivet holes from the working side, that is, from the same side upon which the dimpling tool operates. As the dimpling tool forms no part of this invention, it is superfluous to describe for the above mentioned patent discloses it in detail, but in any case, the mandrel has a series of serrations upon one end portion adapted to be engaged

by said dimpling tool and a thread upon the other end.

With the foregoing objects in view and in order to make it feasible to dimple metal sheets rapidly, even in narrow portions of structures including them, it is proposed to insert the mandrel through the metal sheets from the dimpling side directly into a dimpling die by screwing it into the latter when it is located on the other side of said sheets, while using a holder or handle to shift said die from one rivet hole to the next and render the entire operation speedy and practical, as will now be specifically set forth.

Referring again to the drawings, a mandrel inserting tool, generally indicated at 10 has a shank 11 adapted for insertion into the chuck 12 of a hand drill or preferably of a "Yankee" type screw driver by which to rotate the tool under control and at will. The shank 11 is integral with the threaded portion or member 13 which is of greater diameter than that of the shank and which has an internal bore 14 into which a hollow shank portion 15 of a mandrel driving plunger 16 extends. An interior expansion spring 17 occupies the bore 14 in member 13 and also a bore 18 in said plunger and actively tends to urge said plunger out of said bore 14. The driving plunger 16 has a cylindrical head 19 with opposite depending portions or elongations 21, Fig. 5, on two sides extending into the open slots 22 in the threaded member 13 which virtually forms a chuck core or base, in order to prevent relative rotation of the plunger with respect to the rest of the tool and especially to the shank 11, while allowing free axial movement of said plunger into and out of member 13 by the action of spring 17.

The front end 23 of the plunger head is of conical form and diametrically across the same is cut a wedge shaped slot 24 adapted to receive one end of the mandrel, to be described, said end engaging against a group of chuck jaws 25 whose rear ends 26 are correspondingly inclined to fit against the conical end 23 of said head. The jaws are retained in mutual association by means of a chuck casing 27, internally threaded at 28 and screwed in upon the threads 29 of member 13 against the ring 30 seated against the rear flange 31 on said core member 13, the casing 27 having a pair of opposite flat portions 32 adapting the casing for engagement by a wrench to screw the same on said member 13. The chuck casing at the forward end has a forwardly tapered internal wall 33 engaging against inclined portions 34 upon the exterior forward ends of the chuck jaws in order to bring the latter together by means of the driving plunger 16 under the forward bias or impulse of the jaw closing spring 17 when the latter is allowed to act freely upon said jaws through said plunger.

In order to open the chuck jaws and allow insertion into the chuck of a draw pin or mandrel, generally indicated at 35, a manually shiftable sleeve 36 is slidably mounted externally on the chuck casing and rearwardly provided with an inwardly turned flange 37 serving as a forward stop against the rear end of the chuck casing 27 to limit forward movement of said sleeve. The latter has an internal thread 38 within the forward end into which the chuck cap 39 is screwed, while being preferably knurled upon the exterior thereof to improve the grip thereon (not shown) and provided with a pair of side gaps or openings 41 to allow access to the flat sides 32 of the chuck casing for gripping the latter by a wrench when



assembling or disassembling the tool. The cap 39, while having a substantially flat outer face 42 is provided with a rearwardly directed frusto-conical portion 43 occupying the center area of the interior of said cap around a central aperture 44 in the latter and abutting the outer ends 45 of the chuck jaws which are inclined toward the chuck casing to correspond to the inclination of said frusto-conical portion.

Obviously, if the sleeve 36 is seized by the hand of the operator as indicated at 46 in Fig. 1 and drawn rearwardly while the tool is held against rearward movement (the shank 11 being clamped in the chuck 12 of the screw driver or the like), the sleeve will be caused to occupy the retracted position shown in said Fig. 1 in contrast with the normal position indicated at 47 in broken lines, and the interior central portion 43 will force the jaws 25 rearwardly, and thereby the driving plunger 16 rearwardly against spring 17. Due to the simultaneous release of the jaws from intimate contact with the converging internal wall 33 of the chuck casing consequent upon the separating or wedging action of the conical portion 43 against the inclined forward ends 45 of the jaws in cooperation with the simultaneous separating or wedging action of the conical face or end 23 of the plunger against the correspondingly inclined rear ends 26 of these jaws, the latter will be separated to a maximum limit position wherein they engage against the interior cylindrical wall 48 of the casing, which provides adequate spacing apart of the jaws for release or insertion of a mandrel.

The mentioned mandrel is provided at one end with a regularly spaced series of circumferential serrations 49 (Fig. 6) adapting said end to be effectively gripped and pulled strongly by a power operated dimpling tool, the extreme end having two inclined side portions 51 converging sufficiently to form a wedge shaped end adapted to fit into the transverse slot 24 in the end of the plunger head so that rotation of the tool as a whole by means of the screw driver or hand drill connected to the shank 11 will also cause positive rotation of the mandrel. The other end of the mandrel is provided with a thread 52 adapting the latter to be screwed into a dimpling die 53 having a concave portion 54 into which the metal will be projected during dimpling, while the sides of said die have opposite flat portions or slots 55 cut therein to adapt the die for engagement by a bifurcated holder or handle 56 having an open slot 57 upon the end of its longer limb 58 while the shorter limb 59 on said handle has a similar slot 61. The handle may thus be fitted to the die at either end, the die fitting into the slot in the end concerned so that it may be shifted from hole to hole as the dimpling proceeds and the mandrel is released therefrom.

The chuck jaws are provided with rows of teeth 62 corresponding to the serrations 49 upon the mandrel. When the latter is inserted by first retracting the outer sleeve upon the tool as shown in Fig. 1, with the end of the mandrel wedged into the slot 24 of the plunger in separated condition of the chuck jaws, releasing the outer sleeve allows the spring 17 to force the plunger forward which thereby also forces the jaws forward and together upon the serrations of the mandrel, with the result that the latter is firmly gripped in the tool ready for positive rotation therewith upon rotation of the tool itself by means of the screw driver or drill to which it is attached.

If then the metal about the rivet hole **63** in a sheet metal structure **64** is to be dimpled, the latter having a rather restricted or narrow space **65**, the die **53** may be introduced into said space and supported by holder **56** with a threaded hole **66** in said die registering with the hole **63** in the sheet metal, when the mandrel inserting tool above described and with the mandrel projecting therefrom may be placed opposite the rivet hole with the threaded end **52** of said mandrel initially inserted into said hole. When the screw driver or hand drill is operated to rotate the chuck and consequently the mandrel, the threaded end **52** of said mandrel will engage in the hole **66** in said die and be quickly screwed into the latter until the slotted end **67** of the mandrel projects beyond the die. If at this stage the outer sleeve **36** is manually withdrawn again as indicated in Fig. 1, opening the chuck, the tool may be withdrawn while the mandrel remains in place in the rivet hole with the die supported thereby on the other side of the sheet metal within space **65**. If a power operated dimpling tool (not shown) having a concave or frusto-conical dimpling die complementary to the die **53** is then thrust in upon the mandrel and caused to engage the same and the dimpling tool operated to dimple the sheets, the latter tool may then be released and the tool embodying the present invention again engaged upon the mandrel for removal thereof from the dimpled rivet hole and the die within. In order to effect this result, the screw driver or hand drill etc., is of course operated to rotate in the opposite direction from that first used to insert the mandrel into the die, and with the mandrel thus released from the die but yet held in said tool, the die is shifted within space **65** to the next hole and the mandrel again caused to engage in the die by means of the present manually rotated tool which is then again released for the dimpling operation by the power operated tool.

Upon occasional breakage of the mandrel, which is likely to occur somewhere along the threaded end **52** thereof, the slotted end **67** is readily engaged by a common screw driver and the broken part removed by unscrewing the same from the die which is obiviously then immediately ready for receiving a new mandrel.

As it is well known among those skilled in the art that a mechanical screw driver of the "Yankee" type can instantly be adjusted for righthand rotation when the handle thereof is depressed toward the work and as easily adjusted for rotation in the opposite direction under the same conditions, the adjustment for the right hand rotation will obviously be used during the screwing of the mandrel into the dimpling die before each dimpling cycle and the adjustment for the opposite direction when unscrewing said mandrel therefrom after each dimpling operation is completed.

While the mandrel inserting tool has thus far been described as a device or attachment to be inserted into the chuck of a hand drill or a mechanical screw driver to replace the screw driver bit of the latter, it is self-evident that the tool can readily be combined with, and be built in as part of, the mechanism of said mechanical screw driver, if so desired. It is equally evident that the tool may be made wholly or in part of steel, bronze or of any other materials as conditions may suggest.

In a divisional application, filed March 15, 1945, Serial No. 582,955, there are claims to a mandrel inserting tool for screwing and unscrewing a threaded mandrel into a correspondingly threaded dimpling die as illustrated and described in this parent application.



What is claimed is:

1. In combination, a mandrel having a shank, a threaded end portion, and a serrated end portion including a series of annular flanges, the outside diameter of the shank, of the crests of the threads, and of the annular flanges being substantially equal so that the mandrel may be passed through an aperture of substantially such diameter in a work sheet, and a die having a threaded bore to receive the threaded end of the mandrel, said die being slotted for the reception of a handle to hold the die in position for the threading of the mandrel thereinto.

2. In combination, a mandrel having a shank and a threaded end portion, the outside diameter of the crests of whose threads is no greater than the outside diameter of the shank, a die having a slot and a threaded bore, the bore being adapted to threadably receive the threaded end portion of the mandrel, and a holder insertable into the die slot to hold the die on one side of a sheet for threadably receiving the mandrel upon insertion of the latter from the other side of the sheet through a perforation in such sheet.

3. A combination, according to claim 2, in which the holder has an extension handle adapted to move the die through a space substantially equal to that dimension of the die which is in the direction in which the mandrel is inserted and to hold said die in position for threadably receiving the mandrel upon the insertion of the latter through a perforation in a work sheet.

4. A combination, according to claim 3, in which the mandrel is formed with a portion including a series of annular flanges adapted to be gripped by a pulling tool.

5. In dimpling apparatus for sheet metal, a mandrel for holding a threaded dimpling die in operative position against a work sheet, said mandrel comprising a shank portion, a threaded end portion having a kerf at the extremity thereof, a serrated end portion including a series of annular flanges, and a tapered extension to the serrated end portion adapted to transmit to the mandrel rotary motion imparted by a slotted tool for the screwing of the threaded end portion of the mandrel into the threaded dimpling die, said threaded portion, shank portion and serrated portion all having equal diameters, said serrated portion being adapted to cooperate with a correspondingly serrated tool to pull the die member into position for dimpling after the mandrel has been threadably connected thereto.

6. In dimpling apparatus for sheet metal, a threaded dimpling die; and a mandrel for holding said die in operative position against a work sheet, said mandrel comprising a shank portion, a threaded end portion having a kerf at the extremity thereof, a serrated end portion including a series of annular flanges, and a tapered extension to the serrated end portion adapted to transmit to the mandrel rotary motion imparted by a slotted tool for the screwing of the threaded end portion of the mandrel into the threaded dimpling die, said threaded portion, shank portion and serrated portion all having equal diameters, said serrated portion being adapted to cooperate with a correspondingly serrated tool to pull the die member into position for dimpling after the mandrel has been threadably connected thereto; said dimpling die having means associated therewith for the positioning of said die for

dimpling operations in work regions which afford minimium clearance.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| Re. 3,966 | Regan | May 10, 1870 |
| 533,759 | Ulrich | Feb. 5, 1895 |
| 668,286 | Freese | Feb. 19, 1901 |
| 2,251,491 | Lozen | Aug. 5, 1941 |
| 2,257,089 | Caminez | Sept. 30, 1941 |
| 2,333,418 | Fischer | Nov. 2, 1943 |
| 2,337,342 | Nordgren | Dec. 21, 1943 |
| 2,344,944 | Hurst | Mar. 28, 1944 |
| 2,365,918 | Tuttle | Dec. 26, 1944 |
| 2,423,951 | Amtsberg | July 15, 1947 |

FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 550,230 | Great Britain | June 26, 1941 |