March 11, 1952 R. S. COLLEY 2,588,907

METHOD OF INSTALLING TUBULAR RIVETS

Filed Dec. 1, 1949

Fig-1

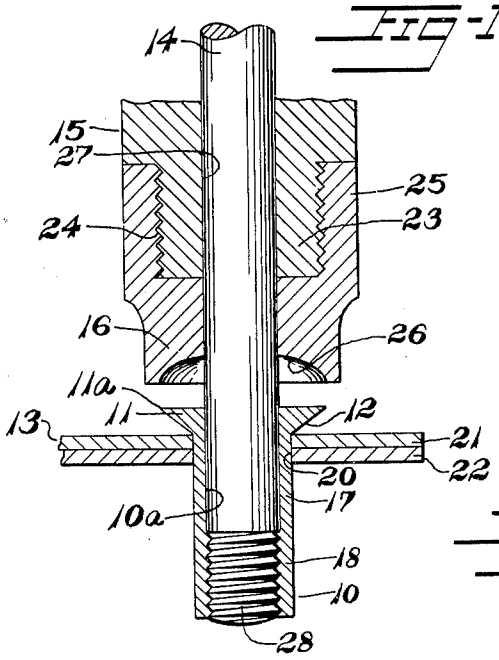


Fig-2

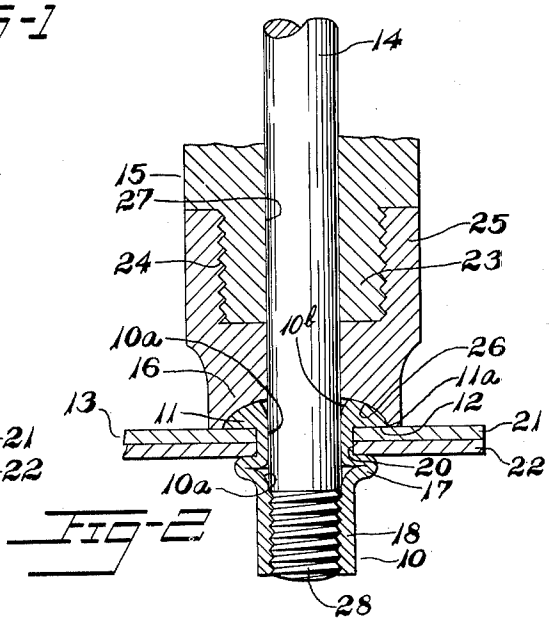


Fig-3

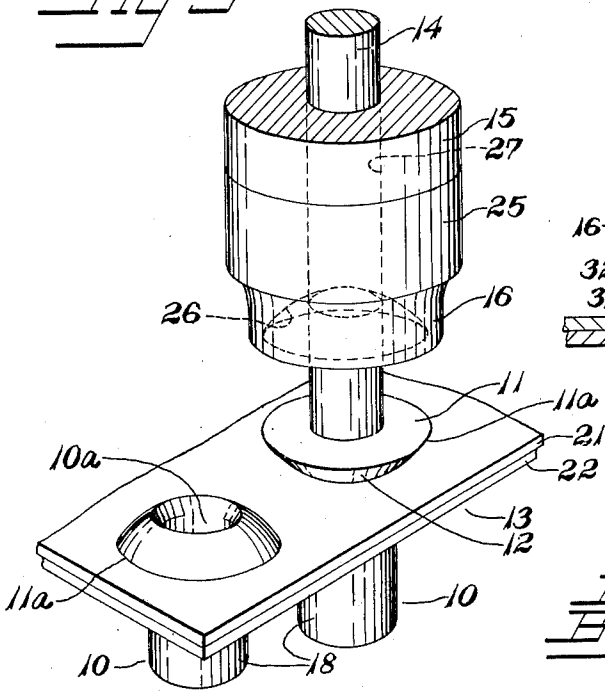
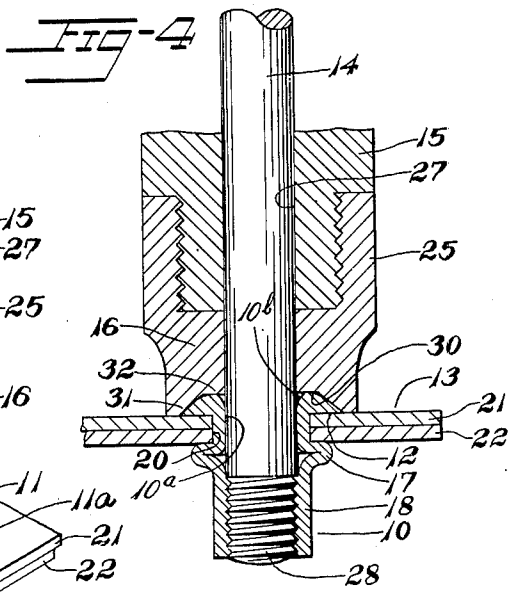


Fig-4



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METHOD OF INSTALLING TUBULAR RIVETS

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2 Claims. (Cl. 218—29)

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The invention relates to the installing and upsetting of headed tubular rivets.

Heretofore, internally threaded, tubular rivets provided with pre-formed flat, round, countersunk, or other suitably shaped heads have been used for riveted attachments as for joining parts of an airplane wing or other structure. A type of head designed for a particular use has not been suitable for work necessitating other types of heads. This has resulted in the stocking and use of a wide variety of rivets having different shapes of heads, each best suited for a particular use. Also, this has resulted in objectionable manufacturing complications and even in objectionable shortages at times of a particular size and kind of headed rivet.

An object of the invention is to provide for overcoming the foregoing difficulties and other disadvantages of the prior rivets and their attachments to the work.

Other objects are to provide an improved method of installing a hollow or headed tubular rivet while forming a head thereon in conformance to the work and to provide an improved apparatus including forming means for accomplishing the same; to provide a headed rivet that is standard for a number of applications and at the same time is formable during the upsetting operation for changing the head to one of a number of other standard type heads; to provide for changing the lower or seating surface of the head such that it conforms to the work while the head is being shaped during the upsetting; to provide for maintaining the lateral extent of the head while changing both the upper and the lower surfaces of the rivet head to a different configuration during the upsetting; to provide for simplicity of construction of the apparatus; to provide for a reduction in the number of kinds of pre-formed rivet heads; and to provide for convenience of manufacture and installation, and for effectiveness of operation.

These and other objects and advantages of the invention will be apparent from the following description.

In the accompanying drawings which form a part of this specification and in which like numerals are employed to designate like parts throughout the same,

Fig. 1 is a sectional view in elevation of a tool and a headed tubular rivet in assembled relation on the apertured work before the upsetting operation, and constructed in accordance with and embodying the invention, parts being broken away,

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Fig. 2 is a view like Fig. 1 but showing the tool and the rivet in their respective conditions after the upsetting operation,

Fig. 3 is a perspective view from above showing the tool and rivet of Fig. 1 and a second rivet in upset condition, and

Fig. 4 is a view like Fig. 2 but showing a modification of the tool and a different shape of the rivet head resulting therefrom.

The illustrative embodiment of the invention shown in the drawings includes a tubular rivet comprising a shank 10 having a seating portion or pre-formed head 11 which is shaped as shown in Fig. 1, with a seating surface 12 which does not conform to the work 13, and includes an installing or upsetting tool 15 having an axially movable draw rod 14 and forming means or anvil 16.

The rivet shown has the countersunk type of head 11 and can be used without modification in work with countersunk apertures. In the embodiment of Figs. 1 and 2, however, it is desired to adapt the countersunk type of head to conformation with the flat work, shown as apertured parts 21, 22, during the upsetting operation in order that the countersunk type of head will be suited for a wide variety of applications and not only in cases of countersunk work.

The rivet to be upset is first engaged detachably with the draw rod, then inserted in the work, as shown in Fig. 1, and next axial compressive force is applied by the tool to the rivet to upset it in the work while the head 11 is re-formed by the reactionary force applied through the forming means 16 to the head, thereby causing bending of the material of the head and preferably also cold-working thereof in a manner such as to seat the seating surface 12 conformingly against the work, and to shape the head to the desired form, as shown in Fig. 2, after which the tool and draw rod are removed from the installed or upset rivet.

The tubular rivet has an outwardly collapsible or expansible wall portion 17 adjacent the countersunk type of head for engaging the work and an internally threaded end portion 18 for engaging the draw rod, and is of ductile material such, for example, as aluminum, brass, and steel.

The forming means or anvil, which may be internally threaded at 24 for engagement with an externally threaded body 23 of the tool, has an end portion 25 presenting a forming face or surface 26 of hardened steel or other suitable material harder than that of the rivet, for abutting and re-forming the head to a different shape and

conforming it to the work. The forming surface 26 is of a shape and size such that the desired configuration of the head and the desired conformance of the seating surface are produced by the forming means re-forming the head conformingly against the work and causing bending of the material of the head axially toward the work and cold-working and strain-hardening of the material of the head thus increasing the inherent strength and holding power of the head.

To change the countersunk type of head to one having, for example, a final rounded shape with the seating surface 12 conformingly against the work, the forming surface 26 is of generally concave shape so that it is, preferably, circumferentially continuous and inwardly and continuously curved or arcuate relative to said end, and is of a diameter at its outer peripheral edge not less than that of the countersunk head to maintain the lateral extent of the head substantially uniform. The radius of curvature of the forming surface at its outer peripheral region may be less than that of the curvature at the inner or central region of such surface to provide greater sharpness of curvature at the outer peripheral region than at the central region, which arrangement is advantageous to facilitate the desired re-forming of the head, especially progressively, from the outer margin or peripheral edge 11*a* of the head inwardly thereof and terminating at the bore 10*a* of the rivet.

The tool has the draw rod 14 disposed in an axial bore 27 extending centrally through the body 23 and anvil 16, which draw rod is connected to any suitable means in the body for providing relative axial movement of the draw rod and body 23 to upset the rivet. The draw rod projects beyond the forming surface 26 and terminates in an externally threaded end portion 28 for engaging the internal threads of the end portion 18 of the rivet.

In installing the rivet in the work, the rivet to be upset is threadedly engaged at its end portion 18 with the threaded end part of the draw rod, the countersunk type of head being nearest the forming surface 26 for abutment with the same, and then the rivet is inserted into the hole 20 of the work until the head contacts the work at a part of the head inwardly of its outer margin or edge 11*a* while the margin 11*a* is spaced from the work, as shown in Fig. 1. The next step is to operate the tool including the draw rod in a manner such that compressive force is exerted in an axial direction on the rivet to outwardly collapse or expand the wall portion 17 so as to increase its diameter beyond the diameter of the rivet hole 20 and to form an annular and bulged flange to clamp the work between the head and the flange.

The reactionary force in the opposite axial direction of the rivet is exerted on the countersunk head by the forming means including the forming surface 26 and produces bending and also cold-working of the material of the head, thereby re-forming the head to a different work-conforming shape. By virtue of its shape and size, the forming surface exerts the reactionary force from the outer peripheral edge 11*a* inwardly thereof and terminating at the bore 10*a*, whereby the head is re-formed conformingly against the work and the outer peripheral edge 11*a* is depressed against the work with the material of the head inwardly of the edge 11*a* raised with respect to the edge 11*a*, the lateral extent of the head being maintained substantially uniform while the uppermost region at 10*b* of the bore in the top of the head is countersunk and flared outwardly, as shown especially in Figs. 2 and 3. The re-forming of the head against the inwardly curved forming surface results in changing the seating surface so that it seats conformingly against the work and changing the countersunk type of head to one of the round type of head, as shown in Fig. 2, for the upset condition of the rivet.

The draw rod is then disengaged from the internally threaded end portion 18 and removed from the rivet. The tool 15 is then ready for subsequent use.

The modification shown especially in Fig. 4 is like that of Figs. 1, 2 and 3, except that the shape of the dished forming surface 30 of the anvil differs from that of the forming surface 26 in that the outer peripheral region at 31 of the surface 30 tapers inwardly relative to the end of the forming means 16 and the central region at 32 of the surface 30 is flat providing a sectional shape of a truncated cone for receiving the head of the rivet. When the rivet is upset, the forming surface 30 bends the material of the head such that the re-formed head has a final shape of a truncated cone with the seating surface 12 constituting the base of the cone and conforming to the work.

The practice described hereinabove makes feasible the utilization of the same type of pre-headed rivet for work requiring the same or different shapes of the head, and it provides for the conformance of the seating surface of the head to the work, and the working of the head to the desired final shape. This permits advantageously a reduction in the number of kinds of pre-headed rivets to be stocked and manufactured.

Variations may be made without departing from the scope of the invention as it is defined in the following claims.

I claim:

1. The method of attaching in distortion-resisting work a rivet having a shank terminating in a head having an outwardly and upwardly flared underface not conforming to said work and a top face not conforming to a head-contacting surface of a tool so that contact of said top face with the head-contacting surface starts along a peripheral line at the outer margin of the head, with a bore extending through said head into the shank of the rivet to an engaging portion therein and including an expansible shank portion intermediate the engaging portion and the head, which method comprises the steps of inserting the rivet in an aperture in the work with said expansible shank portion projecting beyond the back of the work and with the entire outer margin of the head initially spaced substantially from the front of the work while the material of the head at the innermost part of said underface is initially against the front of the work with the remainder of said underface initially projecting angularly away from the front of the work, applying pulling force to the rivet in the axial direction thereof toward the head by a drawing element of the tool inserted through said head and engaging said engaging portion so as to bulb outwardly said expansible shank portion against the back of the work, and at the same time altering the original shape of the head and conforming said underface of the head to the front of the work by applying a reacting force through the head-contacting surface of the tool to the head initially at said outer

margin only and progressively additively inwardly thereof so as to bend and depress said outer margin and flex said remainder of the underface about said innermost part thereof conformingly against the front of the work while continuously pressing said innermost part of said underface against the front of the work and continuing application of the forces until the work is tightly clamped between the head and the bulb.

2. The method of attaching in distortion-resisting work a rivet having a shank terminating in a head having an outwardly and upwardly tapered underface not conforming to said work and a top face not conforming to a head-contacting surface of a tool so that contact of said top face with the head-contacting surface starts along a peripheral line at the outer margin of the head, with a bore extending through said head into the shank of the rivet to an internally threaded portion therein spaced from the head and including an expansible shank portion intermediate the threaded portion and the head, which method comprises the steps of inserting the rivet in an aperture in the work with said expansible shank portion projecting beyond the back of the work and with the entire outer margin of the head initially spaced substantially from the front of the work while the material of said head at the innermost part of said underface is initially against the front of the work with the remainder of said underface initially projecting angularly away from the front of the work, applying pulling force to the rivet in the axial direction thereof toward the head through a threaded drawing member of the tool inserted

through said head into threaded engagement with said threaded portion so as to bulb outwardly said expansible shank portion against the back of the work, and at the same time altering the original shape of the head and conforming said underface of the head to the front of the work by applying a reacting force through the head-contacting surface of the tool to the head initially at and peripherally continuously about said outer margin only and progressively additively inwardly and peripherally thereof so as to bend and depress said outer margin and flex said remainder of the underface about said innermost part thereof conformingly against the front of the work while continuously pressing said innermost part of said underface against the front of the work and continuing application of the forces until the work is tightly clamped between the head and the bulb.

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