April 9, 1946. A. H. HABERSTUMP 2,398,304

RIVET ASSEMBLY AND BUCKING DEVICE

Filed Jan. 4, 1943 2 Sheets-Sheet 1

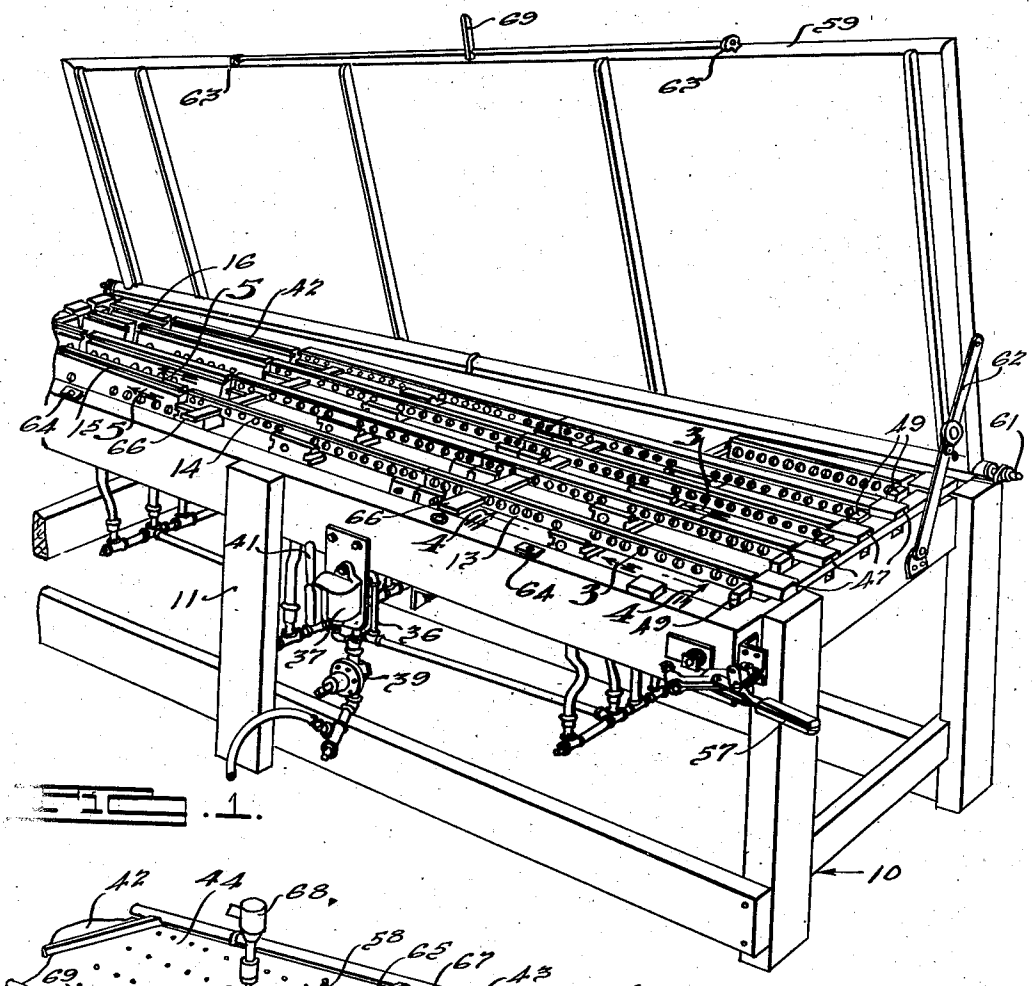


Fig. 1.

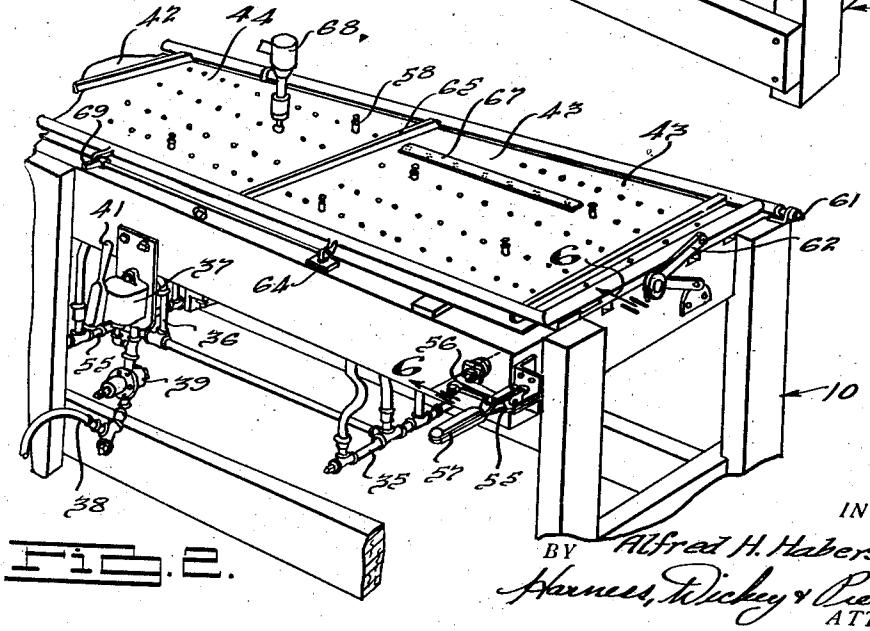


Fig. 2.

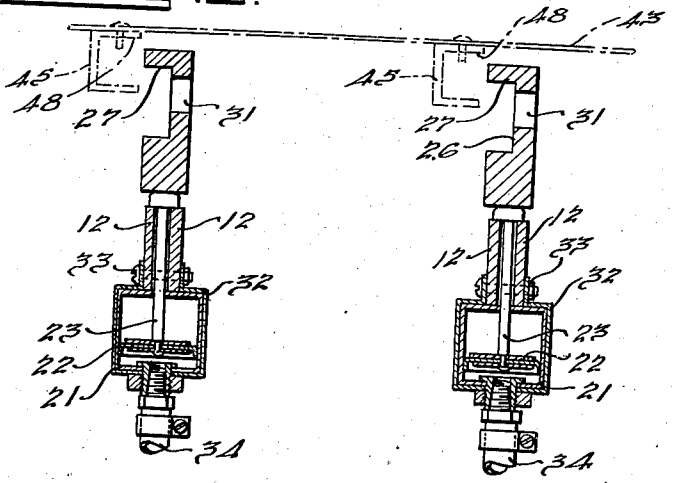
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Fig. 3.



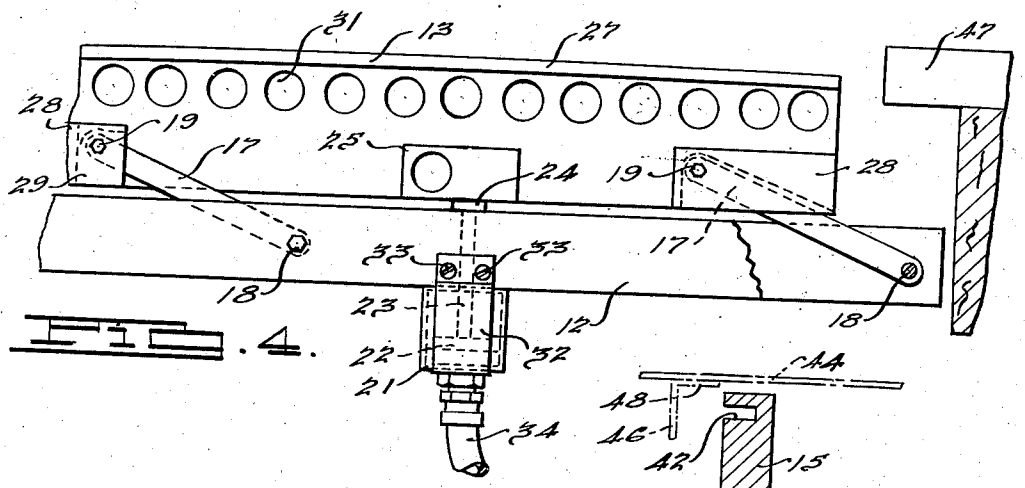


Fig. 4.

Fig. 5.

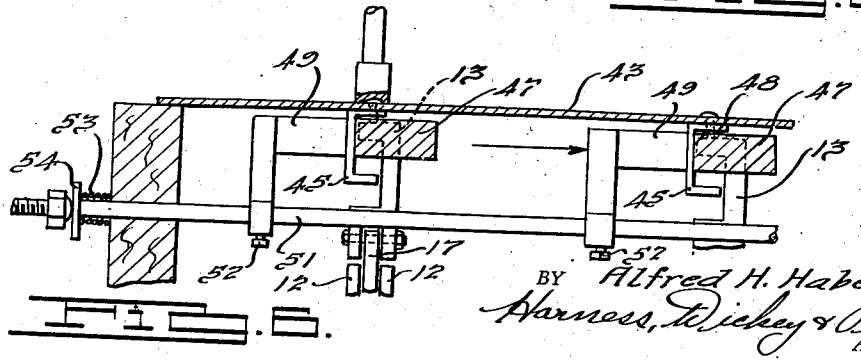


Fig. 6.

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RIVET ASSEMBLY AND BUCKING DEVICE

Alfred H. Haberstump, Detroit, Mich., assignor to The Murray Corporation of America, Detroit, Mich., a corporation of Delaware

Application January 4, 1943, Serial No. 471,235

8 Claims. (Cl. 78—46)

This invention relates to devices for assembling and riveting sheets together, and particularly to a bucking bar and an assembly of a plurality of the bars in a fixture in which sheets are secured together, supplied with rivets, and thereafter riveted together by the operation of a percussion hammer and the associated bucking bars.

In the copending application of A. H. Haberstump, Serial No. 440,837, filed April 28, 1942, and assigned to the assignee of the present invention, bucking bars are illustrated, described, and claimed which are employed for swaging bucktails on rivet ends without the necessity of requiring a bucker to manually support a bucking bar in engagement with each rivet. The bucking bars are of a length to engage a plurality of the rivets which may be swaged seriatim thereon.

When practicing the present invention a plurality of the bucking bars are mounted in a fixture similar to a fixture heretofore employed for supporting and assembling the sheets which were temporarily secured together by fasteners, such as Clico fasteners, commonly employed in the airplane industry. Thereafter, these temporarily assembled sheets were moved as a unit by a plurality of persons to a rivet squeezing machine, where the rivets were swaged as the sheets were moved to have each rivet disposed between the squeezing dies.

The bucking bars are mounted in the fixture in aligned relation and in side by side relation to each other in position to engage spaced rows of rivets through the sheets which are to be swaged. A mechanism is provided for retracting the bars when the sheets are first placed in the fixture and clamped in position by suitable clamping elements and temporarily held together at spaced points by the fastening elements. Thereafter, the mechanism is manipulated to apply a predetermined resilient pressure to all of the bars which are moved into position to buck the rivet ends and form the bucktails as a percussion hammer strikes the rivet heads on the top side of the sheets.

The bucking bars are so constructed as to provide the same reaction to the hammer blows on one as on the other end of the bar and at all points thereinbetween. It is also desirable to have all of the bars balanced, one relative to the other, so that each bar will react in the same manner. By applying a predetermined number of blows to any of the rivets, the same bucktails will be formed on the ends thereof by the reaction of the balanced bar, irrespective of which bar or what point of the bar is operating on the rivet end.

By way of example, a large fixture is illustrated which is employed for riveting channel and annular members on the underside of aluminum sheets which may be of different gage thickness. The assembly forms part of an outer wing surface of an airplane, and all of the rivets are driven while the sheets are secured in the fixture. No more floor area is utilized than that which would be required for the fixture in the first instance. The floor area for the squeezing machine which would otherwise be employed is eliminated, and this area would be greater because of the necessity of having the sheets extend at both sides of the machine.

In view of a portion of the strengthening members being of channel shape, it is necessary to recess the side of the bar to receive the lower flange of the elements as the upper flange rests upon the top of the bar. This provides a further problem, since the bucking surface overhangs the body of the bucking bar and produces a different reaction to the hammer blows than a solid bar. Where the bars are employed on the angle shaped portions of the strengthening elements, no recess is required, but such bars are also slotted at a predetermined point below the top to provide an overhang which produces the same reaction as that of the bars on which overhang is required. The support for the bars produces a parallelogram arrangement between the supporting links and the bar support, so that the reaction of all points of the bar throughout its length is the same when reacting against the rivet ends for producing the swaging operation.

Suitable clamps are employed in the fixture for supporting the channel and angular members relative to the bucking bars, and a hinged frame is utilized for securing the sheets to be riveted onto the strengthening members. Fasteners are then employed for accurately aligning the rivet holes between the strengthening members and the sheets which are then in a position to be riveted. Preferably, rivets are inserted in all of the apertures in the sheets and are retained in position by tape, or other means which may be progressively removed as the rivets are driven or removed thereafter. This is desirable since, when the mechanism is operated to apply a resilient force to the bucking bars, the bars move against the rivets and force them upwardly partially out of the apertures. The strip will retain the rivets in position and prevent them

from being jarred out of the apertures when other rivets are being swaged.

When the rivet is to be driven, the percussion hammer has the riveting head applied to the head of the rivet and forced downwardly to force the head into engagement with the top of the sheet and to deflect the bucking bar. The hammer is then operated and impacts are applied to the head and through the body to the bucking bar, which reacts to swage the rivet end. Preferably, a timing device, such as that illustrated in the application to A. H. Haberstump, Serial No. 439,115, filed April 15, 1942, and assigned to the assignee of the present invention, is employed on the percussion hammer so as to accurately time the duration of its operation. By having all of the bucking bars balanced, the reaction on each rivet is the same when timing the operation of the percussion hammer. This regulates the degree of swaging to the rivet end, so that all of the bucktails which are riveted will be exactly the same and can be brought to standard by regulating the duration of operation of the hammer.

Accordingly, the main objects of the invention are: to provide a fixture in which elements to be riveted together may be assembled and directly riveted; to construct a fixture for assembling elements to be riveted together over bucking bars which are thereafter available for performing the bucking operation on the rivets without removing the assembled sheets therefrom; to construct a fixture in which sheets to be riveted are assembled and secured in predetermined relation to each other over a plurality of bucking bars which are disposed in side-by-side and longitudinal extension of each other and so balanced as to produce the same reaction upon all of the rivets swaged in the fixture; to construct a fixture having a plurality of bucking bars which have slotted sides so that the bucking portion is in overhanging relation on all of the bars, so that the reaction thereof will be the same; to balance a plurality of bucking bars of a fixture so as to obtain the same reaction to the impact on the rivets for producing like bucktails on the ends thereof; to attach supports to a fixture which are aligned with the apertures in elements to be riveted together and mounted on bucking bars on parallel links thereon to produce a parallel movement to the bars, which are similar in weight and overhang so that the reaction at all points of all of the bars will produce like bucktails on the rivets when a predetermined number of blows are applied thereto; and, in general, to construct a fixture in which elements are first assembled and thereafter riveted together, which is simple in construction, positive in operation, and economical of manufacture.

Other objects and features of novelty of this invention will either be specifically pointed out or will become apparent when referring, for a better understanding of the invention, to the following description taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a broken perspective view of a fixture having clamping elements for the members to be riveted together and a plurality of bucking bars supported therein, all of which embodies features of this invention;

Fig. 2 is a broken view of the structure illustrated in Fig. 1, wherein the sheets are assembled in the fixture in position to be operated upon by a riveting hammer;

Fig. 3 is an enlarged sectional view of the structure illustrated in Fig. 1, taken on the line 3—3 thereof;

Fig. 4 is an enlarged broken view of the structure illustrated in Fig. 1, as viewed from line 4—4 thereof;

Fig. 5 is an enlarged sectional view of the structure illustrated in Fig. 1, taken on the line 5—5 thereof; and

Fig. 6 is an enlarged sectional view of the structure illustrated in Fig. 2, taken on the line 6—6 thereof.

The assembling and riveting fixture 10 comprises a base 11 having a plurality of longitudinally extending pairs of supporting bars 12 mounted in slightly angular relation to each other. This angular disposition of the pairs of bars conforms to the angular disposition of the rows of rivets which are to be swaged in the elements which are to be assembled in the fixture. A series of bucking bars 13, 14, and 15 are mounted upon the bars 12 in aligned relation to each other over a pair of parallel links 17. A notch is provided in each of the bars 15 to receive the work supporting elements 16 disposed interjacent of the ends of the bar. One end of the links 17 is pivotally secured to the supporting bars 12 by the pivots 18, while the other ends are secured to the bucking bars by the pivots 19. This parallelogram arrangement between the bucking bars 13, 14, 15, and 16 and the supporting bars 12, produced by the parallel links 17, provides assurance that the same reaction will be obtained at all points throughout the length of the bar which is in engagement with a rivet.

For applying a resilient pressure to the bar, a cylinder 21 is mounted on the supporting bars 12 having a piston 22 therein carrying a piston rod 23. A head 24 is provided on the end of the piston rod 23 disposed in engagement with the undersurface of blocks 25 on each bucking bar. In the construction illustrated in Fig. 4, the bucking bar 13 is cut from solid stock, having a body portion 26, an overhanging bucking portion 27, and end blocks 28 which are slotted at 29 to receive the links 17. The blocks 25, 28, 29, and the overhanging portion 27 may be separate elements which are welded, bolted, or otherwise secured to the body portion 26 of the bucking bars. A plurality of apertures 31 are drilled or otherwise provided through the body portion 26 for the purpose of reducing the weight of the bar and also for balancing the weight of the plurality of bars so that they will be substantially the same.

The cylinder 21 is supported by a strap 32 to the pair of spaced supporting bars 12 by bolts 33. Flexible conductors 34 are connected to the ends of each of the cylinders and to manifolds 35, all of which are connected together and to a supply conduit 36 from an air valve 37 which is connected to a main supply conduit 38 through a regulating valve 39. By operating a handle 41 of the valve, air is delivered to all of the cylinders 21 to apply a predetermined air pressure to the piston which moves upwardly to thereby raise all of the bucking bars 15 against the undersurface of the elements which are to be riveted together. The regulating valve 39 predetermines the amount of pressure applied to the pistons, so that the bars are supported in raised position with the exact pressure required to produce the desired reaction to the bar to perform the swaging operations.

The series of bars 15 at the lefthand end of the fixture is employed for riveting angle elements and, for that reason, would be normally

lighter than the bars in the series 13 and 14. In view of the fact that the angle members are to be riveted thereby, overhanging riveting portion 27 need not be employed on these bars. However, to produce the same reaction to the bars 15, as that of the bars 13 and 14, slots 42 may be cut therein to provide the same thickness of lip to the resulting overhanging portion. The reaction provided by the overhanging portions of the bars 15 during the swaging operation will be the same as that produced by the overhanging portions of the series of bucking bars 13 and 14. It is within the purview of this invention to construct the bars 15 of such weight as to produce the reaction to swage the rivet in the same time as that required of the overhang portions 27 of the bars 13 and 14. The timing of the reaction of the bars is important so that like bucktails will be produced on all of the rivets when struck the same number of blows by the percussion hammer.

The sheets 43 and 44, channel members 45, and angle members 46, which are to be riveted together, are first clamped in the fixture by suitable clamping elements. Blocks 47 are secured to the top of the frame 11 in position to receive the top flange 48 of the channel member 45 and angle member 46. Laterally movable blocks 49 are disposed adjacent to the blocks 47 and are adjustably mounted on the rods 51 by the screws 52. The rods extend through the front portion of the frame 11 at each end and are moved toward the front of the frame by springs 53 operating against plates 54 on the rods. Locking clamps 55, mounted on the front of the frame, have an arm 56 operated by a handle 57 for moving the rods 51 toward the rear of the frame, for moving the blocks 49 against the elements 45 and 46 to clamp them against the blocks 47. The sheets 42 and 43 are then disposed in position on top of the top flanges 48 and are provided with rows of apertures which are accurately aligned with the row of apertures in the flange 48 when secured together at spaced points by fastening elements 58.

The sheets 42 and 43 are retained in position by a frame 59 which is hinged to the back end of the frame on the hinge pins 61. One end of the fixture is provided with a spring balancing device 62 which retains the frame in raised position. A pair of latches 63 engage detents 64 in the frame for securing the frame in lowered position with cross members 65 in engagement with the sheets which are forced against the flanges 48. A plurality of rows of blocks 66 are disposed beneath the cross members 65 against which the sheets are clamped intermediate of the ends of the frame.

Preferably, the rivets are all inserted in the apertures before the riveting operation is performed, and may be retained in position by strips of tape, such as that illustrated at 67, for preventing the rivets from being thrown from the aperture when the bucking bars are raised, or during the operation on adjacent rivets. The tape may be removed from each rivet as the operation progresses, or the rivets may be swaged with the tape in place and the tape removed thereafter. After a group of rivets has been swaged, the fasteners 58 may be removed and the rivets inserted and swaged at these points.

After all of the elements have been secured in the fixture and adjusted to have the apertures thereof disposed in aligned relation with the rivets inserted in the apertures, the handle of the valve 41 is then operated to apply a predetermined pressure of air to the cylinder 21 to move the piston upwardly therein for moving the bars of all of the series 13, 14, and 15 upwardly against the rivet ends. This moves the rivets upwardly in the apertures until the overhanging portions 27 of the bucking bars engage the undersurface of the flange 48. Thereafter a percussion hammer, such as the hammer 68 illustrated in Fig. 2, is employed for pushing a rivet downwardly against the sheets and the pressure of the piston to deflect the bucking bar which is then in position to buck the rivet end. The hammer 68 is then operated to apply a predetermined number of hammer blows to the rivet head which are transmitted through the rivet body to the bucking bar, which reacts to the force of the blows to swage the bucktails on the rivet ends.

The hammer is preferably adjusted to produce a predetermined number of blows, so that stoppage is unnecessary for the immediate inspection of the rivet and the possible requirement of additional application of the hammer to produce a further swaging of the rivet end.

After the time cycle interrupts the operation of the hammer, the operator is free to immediately move the hammer to the next rivet, which is forced down and immediately swaged by the application of the time cycle of operation of the hammer. After all of the rivets have been swaged, the handle 41 is then operated to remove the pressure from the cylinders 21 and the handles 57 of the clamps at both ends of the fixture are then released to release the channel and angle elements 45 and 46 respectively. The latches 63 are then released by the manipulation of the handle 69 and the frame 59 is then raised to permit the assembled sheets and channel and angle members, which have been riveted together, to be removed from the fixture.

It will be noted, in Figs. 3 and 6, that the sheets 43 and 42 are slightly arched, and that a similar slight arc is provided at the tops of the overhanging portions 47 of the bucking bars. In this arrangement, the tops of the bars are disposed in exact right angle relation to the axis of the rivets so that the bucktails will be formed on the rivet axis and not at an angle thereto, which would produce a deformed bucktail. It will also be noted that the bucking bars are slightly arched from one to the other end thereof to conform to the slight arc in the strengthening members and in the assembled sheet from one end to the other thereof. This arching of the bars both laterally and longitudinally of their length provides assurance that the axes of the rivets will be presented normal to the surface of the bar, so that the swaging will occur exactly on the axis, which is necessary to swage bucktails having axes which fall upon the axes of the rivets.

It is to be understood that the thickness of the sheets 42 and 43 and that of the channel and angle strengthening members 45 and 46 may vary throughout the length of the sheets and members, and that this is taken care of by the length of the rivet to be driven, since the height of all of the bucktails produced by the bucking bar beneath the lower surface of the channel and angle members will be the same. In all instances, where the rivet diameters are the same, the same cycle of operation of the percussion hammer will produce like bucktails on the rivet ends.

It is further to be understood that the fixture herein illustrated and described was shown more by the way of example than to be limiting to the particular structure illustrated, since the shape

of the fixture, and the disposition of the bars and the clamping elements all will vary, conforming to the shape and size of the sheets, strengthening members, and other elements which are to be secured together therein. Where portions of the elements require rivets of larger diameter than those at the other, it is within the purview of the invention to employ heavier bucking bars for the larger rivets, and change the cycle of operation of the percussion hammer when operating on the series of rivets of larger diameters. The particular timing device illustrated and described in the above-mentioned copending application has adjusting means which quickly change the cycle of operation to any desired amount.

What is claimed is:

1. In a fixture for assembling and riveting elements together, which includes a frame, a plurality of bucking bars disposed in said frame, means for clamping said elements to be riveted together in said frame in predetermined relation to each other and to the bucking bars, means for applying a resilient pressure to said bars for moving them into bucking position, the weight of said bars being balanced relative to each other for producing the same reaction on the rivet ends being swaged when hammer blows are applied to the rivet heads.

2. In a fixture for assembling and riveting elements together, which includes a frame, a plurality of bucking bars in longitudinally aligned and side by side relation mounted in said frame, means for clamping the elements to be secured together in said frame in predetermined relation to each other, the weight of said bars being balanced relative to each other to have them respond in the same manner to the hammer blows applied to the rivet ends when the heads are struck for producing like swaged ends during a predetermined time cycle of operation.

3. A fixture for assembling and riveting elements together, which includes a frame, a plurality of bucking bars in longitudinally aligned and side by side relation mounted in said frame, means for clamping the elements to be secured together in predetermined relation to each other in said frame, the weight of said bars being balanced relative to each other to have them respond in the same manner to the hammer blows applied to the rivet ends for producing like swaged ends during a predetermined time cycle of operation, the surface of said bucking bars being disposed in such manner as to be maintained in all positions normal to the axes of the rivets so as to apply the reactive force to the hammer blows along the rivet axis.

4. In a fixture, a plurality of bucking bars each having an overhang portion for receiving the flange of channel elements which are to be riveted to other elements, means for supporting said bars in said fixture, additional bars for bucking rivets in plane elements also being provided with an overhang portion to produce similarity in all of the bars to have them respond in the same manner to the hammer blows applied to the heads of the rivets during the riveting operations on the elements, means for supporting said additional bars in said fixture, and resilient means for simultaneously supporting all of said bars in bucking position above the supports therefor.

5. A method of riveting elements together which includes the steps of assembling the elements in predetermined relation to each other in a fixture, of inserting rivets through the apertures in the elements, of applying securing means to the rivets, of simultaneously moving bucking bars into engagement with the rivet ends to move them upwardly within the apertures, and of thereafter moving the rivets downwardly seriatim to deflect the bar and apply hammer blows to perform a swaging operation.

6. A method of riveting elements together which includes the steps of assembling the elements in predetermined relation to each other in a fixture, of inserting rivets through the apertures in the elements, of applying securing means to the rivets, of moving bucking bars that are balanced relative to each other into engagement with the rivet ends to move them upwardly within the apertures, and of thereafter moving the rivets downwardly to deflect the bar and apply hammer blows thereto to perform a swaging operation.

7. A fixture for securing and riveting elements to a sheet of material which includes, a base frame, a plurality of longitudinally aligned bucking bars mounted in said frame in spaced rows, means for clamping the elements and sheets relative to said bucking bars and to each other, some of said bars having an overhang portion required to engage the rivets in certain of said elements, and other of said bars being provided with an overhang portion to react in the same manner as said first bars to produce the same degree of swaging on all of the rivets during a predetermined time cycle of operation.

8. A fixture for securing and riveting elements to a sheet of material, which includes, a base frame, a plurality of longitudinally aligned bucking bars mounted in said frame in spaced rows, means for clamping the elements and sheets relative to said bucking bars and to each other, some of said bars having an overhang portion required to engage the rivets in certain of said elements, other of said bars being provided with an overhang portion to react in the same manner on all of the rivets during a predetermined time cycle of operation, said bars being shaped laterally and longitudinally of their length to have tangents to the surface thereof disposed normal to the axes of the rivets so as to apply the reactive force to the hammer blows during a swaging operation directly along the axes of the rivets.

ALFRED H. HABERSTUMP.