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METHOD AND APPARATUS FOR USE IN THE MANUFACTURE OF TRANSISTORS

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FIG. 1

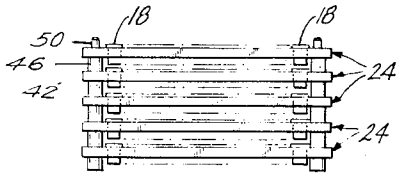


FIG. 2

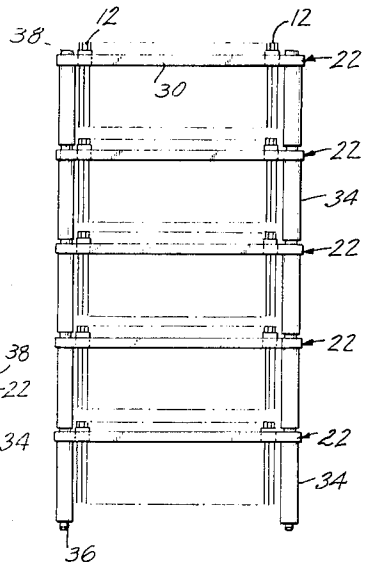
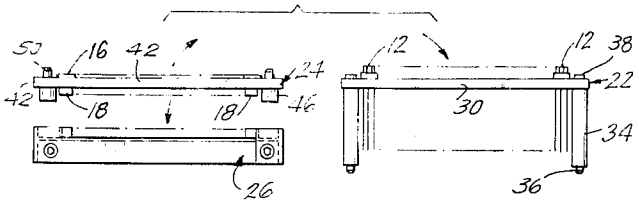


FIG. 3



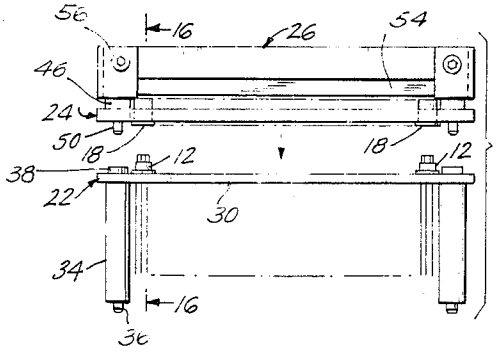
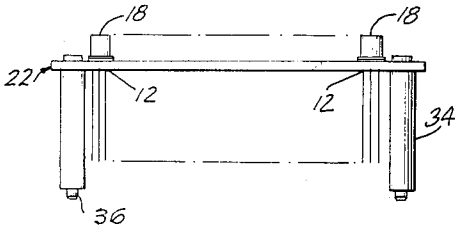


FIG. 4

FIG. 6



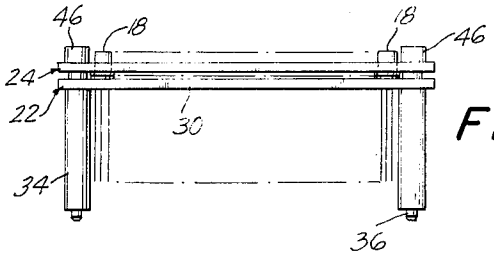


FIG. 5

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FIG. 7

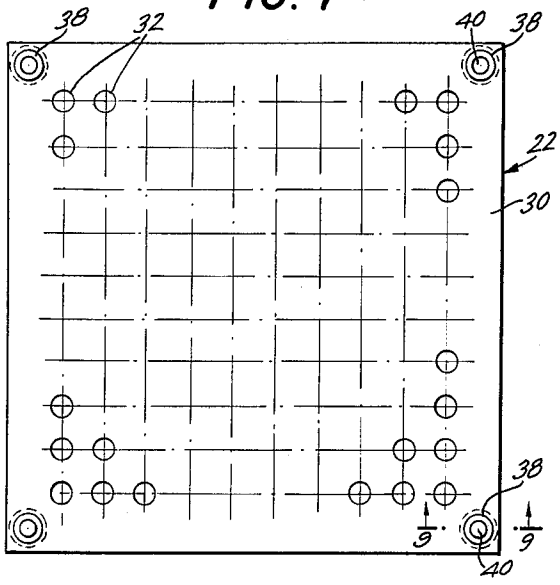
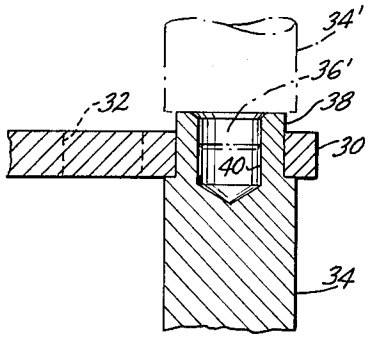


FIG. 9



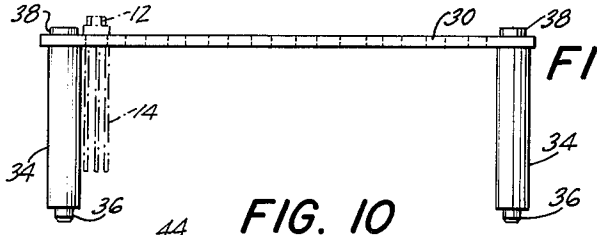


FIG. 8

FIG. 10

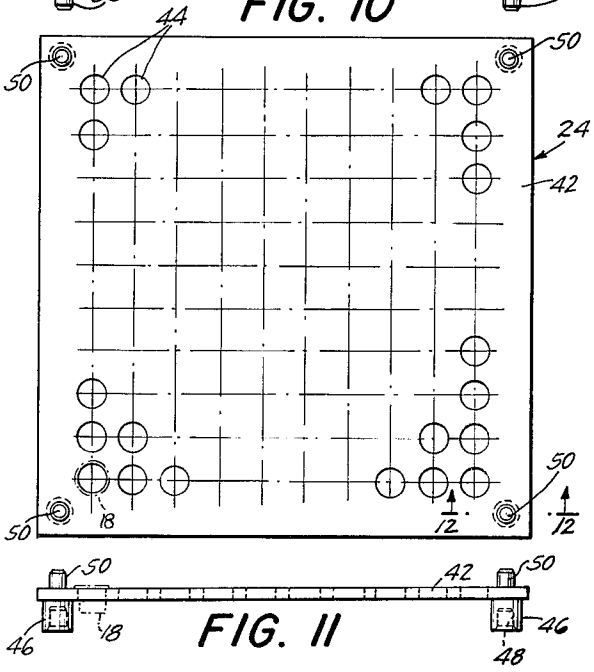


FIG. 12

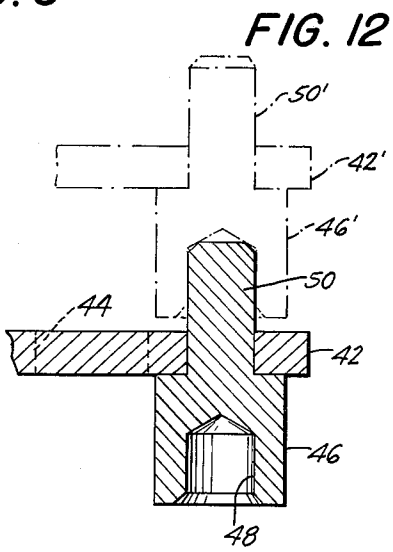


FIG. 11

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FIG. 13

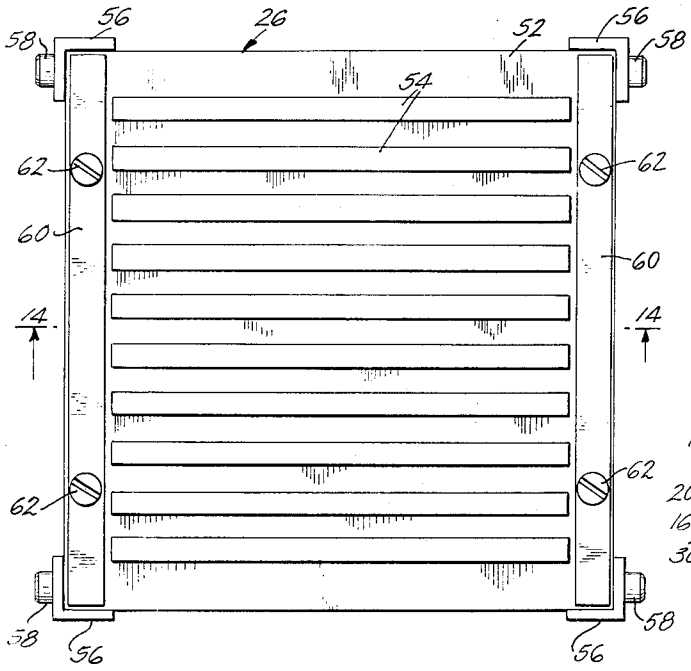


FIG. 16

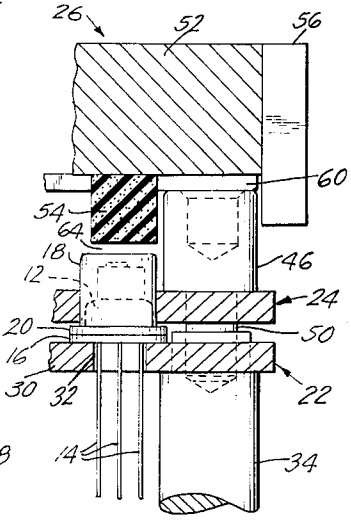


FIG. 14

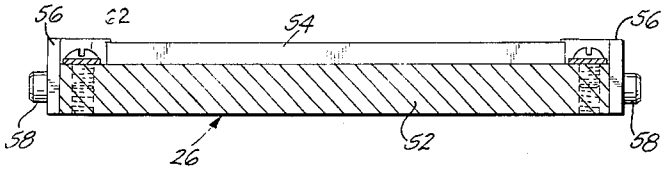


FIG. 17

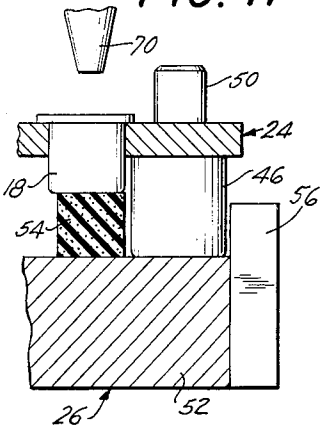
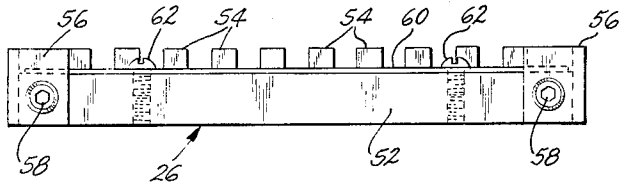


FIG. 15



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United States Patent Office 3,221,394
Patented Dec. 7, 1965

3,221,394

METHOD AND APPARATUS FOR USE IN THE MANUFACTURE OF TRANSISTORS

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Filed Oct. 26, 1962, Ser. No. 233,332
14 Claims. (Cl. 29—155.5)

This invention relates to the manufacture of electronic components, and more particularly transistors.

A typical transistor comprises a header carrying the transistor elements, and having lead wires depending therefrom. The transistor elements are protectively enclosed in a metal envelope or so-called "can," the latter having a flange at its open end which is welded to the header.

The cans and headers are preliminarily baked in an oven disposed at one end of a dry box, following which they are transferred directly into the dry box in which the welding machine is housed. An operator inverts a can over a header and welds the assembly by means of the welding machine in the dry box.

The primary object of the present invention is to generally improve the manufacture of transistors. A more particular object is to handle a large number, say one hundred parts at once, so that one hundred headers may be simultaneously capped with one hundred cans in a single capping operation. Stacks of carriers or jigs, each with hundreds of units, may be baked in the oven and transferred to the dry box. The number one hundred is used as an example, and not in limitation of the invention.

The cans may be preliminarily filled with a soft potting material, typically a silicone grease. In accordance with a further feature and object of my invention, the same devices that are used for the capping operation may be employed during the operation of loading the cans with the silicone grease.

To accomplish the foregoing general objects, and other more specific objects which will hereinafter appear, my invention resides in the apparatus elements, and their relation one to another as well as the use of the same, as are more particularly described in the following specification. The specification is accompanied by drawings in which:

FIG. 1 is an elevation of a part of a stack of can jigs;

FIG. 2 is an elevation of a stack of header carriers;

FIG. 3 shows how a can jig may be placed over a magnetic chuck preparatory to inverting the assembly over a header carrier;

FIG. 4 shows the assembly inverted and being placed on a header carrier;

FIG. 5 shows the same with the magnetic chuck removed;

FIG. 6 shows the same with the can jig removed, leaving the cans on the headers;

FIG. 7 is a plan view of a header carrier;

FIG. 8 is an elevation of the same;

FIG. 9 is a fragmentary section, drawn to enlarged scale, and taken in the plane of the line 9—9 of FIG. 7;

FIG. 10 is a plan view of a can jig;

FIG. 11 is an elevation of the same;

FIG. 12 is a fragmentary section, drawn to enlarged scale, and taken approximately in the plane of the line 12—12 of FIG. 10;

FIG. 13 is a plan view of a magnetic chuck embodying features of the invention;

FIG. 14 is a transverse section taken approximately in the plane of the line 14—14 of FIG. 13;

FIG. 15 is an elevation, looking toward the right side of FIG. 13;

FIG. 16 is a fragmentary view, drawn to enlarged scale, through one corner of the assembled parts, somewhat as

though taken in the plane of the line 16—16 of FIG. 4; and

FIG. 17 is a somewhat similar fragmentary section taken through a jig and chuck used earlier for loading, prior to stacking and baking.

Referring to the drawing, and more particularly to FIG. 16, a typical transistor comprises a header 12 carrying the transistor elements (emitter, collector, and base), and having lead wires 14 depending from the header. The header includes a circular metal flange 16. The transistor elements are protectively housed within a cylindrical metal envelope or so-called can 18, which is closed at the top, and which has a flange 20 at its open lower end. The flanges 16 and 20 are welded together to house the transistor elements.

Referring now to FIG. 3, in accordance with the present invention, a large number, say one hundred of the headers 12 are placed in a carrier 22. A similar large number of cans 18 are placed in a jig 24. The jig is placed over a magnetic chuck 26 in order to hold the cans in the jig. As shown in FIG. 4, the assembly of jig 24 and chuck 26 then is inverted over carrier 22. In this way all of the headers 12 may be simultaneously capped with the cans 18.

The magnetic chuck 26 then may be removed, as shown in FIG. 5, leaving the jig 24 on the carrier 22. At this time the cans 18 are restrained against movement with the magnetic chuck because of the flanges of the cans 18, which are held beneath the jig 24. The jig then may be removed, as shown in FIG. 6, leaving the carrier 22 loaded with headers 12 capped by cans 18. When, as in the present case, there are ten rows of headers having ten each, one hundred headers are capped by one hundred cans in a single capping operation.

The illustrated parts have additional utility and advantage. Pilot means are provided for proper registration, and the parts are so arrange that the same pilot means serve also for stacking of jigs and carriers. FIG. 1 shows five jigs 24, each loaded with one hundred cans, stacked one above the other, preparatory to baking in an oven. In practice about two dozen such jigs may be stacked in a single stack for the baking operation.

FIG. 2 shows five carriers 22, each loaded with one hundred headers, the carriers being stacked for convenience in handling, and for the baking operation.

As is explained later, the magnetic chuck may be used in combination with a jig 24 during loading of the jig with cans, and during filling of the cans with silicone grease.

Considering the parts in greater detail, a carrier is shown in FIGS. 7, 8 and 9. It comprises a square plate 30, preferably made of a nonmagnetic material such as aluminum. It has a large number of holes 32 dimensioned to receive the headers. In the particular case here shown there are ten rows, each with ten holes, making one hundred holes in all. The holes are large enough to receive the depending lead wires which pass through the holes. If desired the holes might be recessed to receive the circular rim or flange 16 (FIG. 16) of the header, but I have found that this refinement is not needed, and that the headers are sufficiently accurately located or centered by the three lead wires alone.

The carrier has legs 34 which are longer than the lead wires 14. In the present case there are four corner legs 34, and the lower ends are necked at 36 to act as pilots. The upper ends 38 are shouldered and pass through the plate 30 (FIG. 9) and are fixedly secured in position, as by means of a force fit, shrink fit, brazing or other desired expedient. The upper ends of the legs are hollowed or counterbored to form pilot holes 40. These are dimensioned to receive the pilots 36 of additional carriers when stacking the carriers, as shown in FIG. 2, or for cooperation with a jig when capping the headers, as shown in

FIG. 5. Stacking is also suggested in FIG. 9, in which the broken line parts 34', 36', are received by the solid line parts 38, 40 of leg 34.

A preferred form of jig is shown in FIGS. 10, 11 and 12, referring to which there is a main plate 42, which in the present case is square, and made of a nonmagnetic material, specifically aluminum. It has ten rows of ten holes each, indicated at 44. The centers of the holes have the same pitch or spacing as the holes in the carrier of FIGS. 7. However, in the present case the holes are dimensioned to receive the cylindrical can bodies, the holes being smaller than the flanges of the cans. Thus the cans may be loaded into the jig with their open ends on top, and are held against falling through by the flanges.

The jig has pilot means to register it with the carrier. In the example here shown the jig has four corner feet 46 which are dimensioned to act as spacers. These are hollowed at their lower ends to provide pilot holes 48. The feet are necked at their upper ends and passed through and beyond the corners of the plate 42 to provide pilots 50. The attachment may be by force fit, or solder, etc. The pilots 50 are dimensioned for cooperation with additional jigs when stacking the jigs as shown in FIG. 1, or for cooperation with a carrier when capping the headers as shown in FIG. 5. The stacking of jig on jig is further suggested in FIG. 12, in which the parts 42', 46', and 50', shown in broken lines, are superposed on the corresponding parts shown in solid lines.

The magnetic chuck 26 is shown in FIGS. 13, 14 and 15. It comprises a plate 52, here made of aluminum. This carries ten bar magnets 54, the magnets being properly spaced for registration with ten rows of cans carried by the jig. In the present case the bar magnets are rubberized magnets, and more specifically are magnets sold under the name "Plastiform" by Leyman Corporation of Cincinnati, Ohio. The direction of magnetization is perpendicular to the plate 52, that is, vertical when the chuck is in the working position shown in FIG. 15. The magnets are most simply secured to the plate by the use of a suitable adhesive or epoxy cement.

The magnetic chuck has pilot means for cooperation with the jig. In the present case there are angle pieces 56 which are secured to the corners of the plate, as by means of screws 58. These angle pieces fit rather closely around the four cylindrical feet 46 (FIGS. 11 and 12) of the jig, and thus locate the jig with the cans in registration with the magnets. This relation is shown in FIGS. 4, 16 and 17.

The particular magnetic chuck here shown further comprises optionally usable spacer means for modifying the spacing between the magnets and the cans. For this purpose there are flat strips 60 of nonmagnetic material, held in place by any desired means, in this case screws 62, the screws being located well in from the corners so as not to interfere with the feet of the jig. Referring now to FIG. 16, the foot 46 of jig 24 bears at its upper end against spacer strip 60, the thickness of which provides a corresponding air gap at 64 between the magnet 54 and the top of can 18. This is desired in order to weaken the flow of magnetic flux through the cans to the headers, which if too strong, may cause the headers to lift somewhat from the carrier as the cans are being placed over the headers as shown in FIG. 4 of the drawing. What is wanted is enough magnetic attraction to safely hold the cans, but without excess attraction which arises when the magnets are in direct contact with the cans. The spacing also makes it easier to remove the chuck for the step shown in FIG. 5.

At another stage in manufacture the increased magnetic attraction is desirable. I refer here to the initial loading of cans into the jig and/or the filling of cans with silicone grease. For this purpose the same jig is employed, and substantially the same magnetic chuck, but the magnetic chuck used at the loading station is preferably devoid of the spacer strips 60 just described. The relative positioning of the parts then is as shown in FIG. 17, in which jig 24 has been placed over magnetic chuck 26, with the feet 46 located within the angle pieces 56, and resting at their lower ends directly in the plate 26. In that case the magnets 54 are substantially in contact with the cans 18, and strongly hold the cans in position.

To load a jig with cans the jig first may be placed over the chuck, as shown in FIG. 17, and cans brushed back and forth over the jig until the holes are all filled. The assembly then may be placed in a machine which repeatedly and rythmically discharges measured quantities of silicone grease through a nozzle, schematically suggested at 70 in FIG. 17. By relatively moving the assembly and nozzle in proper rythm, the cans are filled, one after another, with no danger of a can lifting from its hole in the jig. If desired the filling machine may be provided with multiple nozzles to speed the filling operation. The jigs with filled cans then are stacked as shown in FIG. 1 (except that many more, say 24 jigs may be stacked) preparatory to transfer to the baking oven, to be followed by transfer directly into the dry box for the multiple capping operation previously described, and illustrated in FIGS. 3 through 6 of the drawing.

It is believed that my improvement in the manufacture of electronic components, and particularly transistors, as well as the apparatus and method of using the same, and the advantages thereof, will be apparent from the foregoing detailed description. It will also be apparent that while I have shown and described my invention in a preferred form, changes may be made without departing from the scope of the invention as sought to be defined in the following claims.

I claim:

1. For use in the manufacture of electronic components having a header capped by a flanged can, in combination, a header carrier, a can jig, and a magnetic chuck, said carrier and said jig each comprising a plate with a large equal number of holes, said carrier holes being dimensioned to receive and locate the headers, said jig holes being dimensioned to receive the flanged cans, said chuck having permanent magnets disposed for registration with the cans, the arrangement being such that a large number of cans may be held in said jig by placing the jig over the chuck, and the assembly then inverted over the carrier to simultaneously cap all of the headers, following which the chuck may be removed, and then the jig removed to leave the cans on the headers.

2. For use in the manufacture of electronic components having a header capped by a flanged can, in combination, a header carrier, a can jig, and a magnetic chuck, said carrier and said jig each comprising a plate with a large equal number of holes, said carrier holes being dimensioned to receive and locate the headers, said jig holes being dimensioned to receive the flanged cans, said jig having pilot means to register the jig with the carrier, said chuck having pilot means for cooperation with the jig and having permanent magnets disposed for registration with the cans, the arrangement being such that a large number of cans may be held in said jig by placing the jig over the chuck, and the assembly then inverted over the carrier to simultaneously cap all of the headers, following which the chuck may be removed, and then the jig removed to leave the cans on the headers.

3. For use in the manufacture of transistors each having a header capped by a flanged can, in combination, a header carrier, a can jig, and a magnetic chuck, said carrier and said jig each comprising a plate with a large equal number of holes, said carrier holes being dimensioned to receive and locate the headers, said carrier having legs longer than the lead wires of the headers, said jig holes being dimensioned to receive the flanged cans, said jig having pilot means to register the jig with

the carrier, said chuck having pilot means for cooperation with the jig and having permanent magnets disposed for registration with the cans, the arrangement being such that a large number of cans may be held in said jig by placing the jig over the chuck, and the assembly then inverted over the carrier to simultaneously cap all of the headers, following which the chuck may be removed, and then the jig removed to leave the cans on the headers.

4. For use in the manufacture of electronic components each having a header capped by a flanged can, in combination, a header carrier, a can jig, and a magnetic chuck, said carrier and said jig each comprising a non-magnetic plate with a large equal number of holes, said carrier holes being dimensioned to receive and support the headers, said carrier having legs, the lower ends of said legs being shaped to act as pilots, the upper ends being shaped to act as mating pilots for cooperation with additional carriers for stacking or for cooperation with a jig for capping, said jig holes being dimensioned to receive the cans, said jig having feet dimensioned to act as spacers, said feet being shaped at their lower ends to act as pilots and being shaped at their upper ends to act as mating pilots for cooperation with additional jigs for stacking or for cooperation with a carrier for capping, said chuck having pilot means for cooperation with the jig and having permanent magnets disposed for registration with the cans in a jig, the arrangement being such that cans may be held in the jig by placing the jig over the chuck, and the assembly then inverted over the carrier to simultaneously cap the headers, following which the chuck may be removed, and then the jig removed to leave the cans on the headers.

5. For use in the manufacture of transistors each having a header capped by a flanged can, in combination, a header carrier, a can jig, and a magnetic chuck, said carrier and said jig each comprising a nonmagnetic plate with a large equal number of holes in multiple rows of multiple holes, said carrier holes being dimensioned to receive and support the headers, said carrier having legs which are longer than the lead wires, the lower ends of said legs being necked to act as pilots, the upper ends being hollowed to act as pilot holes for cooperation with additional carriers for stacking or for cooperation with a jig for capping, said jig holes being dimensioned to receive the cans, said jig having feet dimensioned to act as spacers, said feet being hollowed at their lower ends to act as pilot holes and being necked at their upper ends to act as pilots for cooperation with additional jigs for stacking or for cooperation with a carrier for capping, said chuck having pilot means for cooperation with the jig and having permanent magnets in bar form disposed for registration over the rows of cans in a jig, the arrangement being such than cans may be held in the jig by placing the jig over the chuck, and the assembly then inverted over the carrier to simultaneously cap the headers, following which the chuck may be removed, and then the jig removed to leave the cans on the headers.

6. For use in the manufacture of transistors each having a header capped by a flanged can, in combination, a header carrier, a can jig, and a magnetic chuck, said carrier and said jig each comprising a nonmagnetic aluminum plate with ten rows of ten holes each, said carrier holes being dimensioned to receive the lead wires of headers, said carrier having four corner legs which are longer than the lead wires, the lower ends of said legs being necked to act as pilots, the upper ends being hollowed to act as pilot holes for cooperation with additional carriers for stacking or for cooperation with a jig for capping, said jig holes being dimensioned to receive the cans, said jig having four corner feet dimensioned to act as spacers, said feet being hollowed at their lower ends to act as pilot holes and being necked at their upper ends to act as pilots for cooperation with additional jigs for stacking or for cooperation with a carrier for capping, said chuck having pilot means for cooperation with the jig and having ten permanent magnets in bar form disposed for registration over the ten rows of cans in a jig, the arrangement being such that one hundred cans may be held in the jig by placing the jig over the chuck, and the assembly then inverted over the carrier to simultaneously cap one hundred headers, following which the chuck may be removed, and then the jig removed to leave the cans on the headers.

7. In the manufacture of electronic components each having a header capped by a flanged can, the method which includes placing a large number of headers in a carrier, placing a large number of cans in a jig, placing the jig over a magnetic chuck to hold the cans in the jig, inverting the assembly of jig and chuch over the carrier to simultaneously cap all of the headers with cans, removing the chuck while restraining the cans by means of the jig, and then removing the jig to leave the cans on the headers.

8. In the manufacture of transistors having a header capped by a flanged can, the method which includes placing a jig over a magnetic chuck, placing a large number of cans in the jig, loading the cans with a desired potting material, removing the jig from the chuck, stacking the jigs for treatment, placing a large number of headers in a carrier, stacking the carriers for treatment, placing a treated jig over a magnetic chuck to hold the cans in the jig, inverting the assembly of jig and chuck over a treated carrier to simultaneously cap all of the headers with cans, removing the chuck while restraining the cans by means of the jig, and then removing the jig to leave the cans on the headers.

9. For use in the manufacture of transistors each having a header capped by a flanged can, in combination, a header carrier, a can jig, and a chuck, said carrier and said jig each comprising a plate with a large equal number of holes, said carrier holes being dimensioned to receive and locate the headers, said jig holes being dimensioned to receive the flanged cans, said chuck having means for holding the cans, the arrangement being such that a large number of cans may be held in said jig by placing the jig over the chuck, and the assembly then inverted over the carrier to simultaneously cap all of the headers, following which the chuck may be removed, and then the jig removed to leave the cans on the headers.

10. For use in the manufacture of transistors each having a header capped by a flanged can, in combination, a header carrier, a can jig, and a chuck, said carrier and said jig each comprising a plate with a large equal number of holes, said carrier holes being dimensioned to receive and locate the headers, said carrier having legs longer than the lead wires of the headers, said jig holes being dimensioned to receive the flanged cans, said jig having pilot means to register the jig with the carrier, said chuck having pilot means for cooperation with the jig and having means for holding the cans, the arrangement being such that a large number of cans may be held in said jig by placing the jig over the chuck, and the assembly then inverted over the carrier to simultaneously cap all of the headers, following which the chuck may be removed, and then the jig removed to leave the cans on the headers.

11. For use in the manufacture of transistors each having a header capped by a flanged can, in combination, a can jig, and a magnetic chuck, said jig comprising a plate with a large number of holes, said holes being dimensioned to receive the flanged cans, said chuck having pilot means for cooperation with the jig and having permanent magnets disposed for registration with the cans, the arrangement being such that a large number of cans may be held in said jig by placing the jig over the chuck, and the assembly then inverted over an array of headers to simultaneously cap all of the headers, following which the chuck may be removed, and then the jig removed to leave the cans on the headers.

12. For use in the manufacture of transistors each having a header capped by a flanged can, in combination, a header carrier, and a can jig, said carrier and said jig each comprising a plate with a large equal number of holes, said carrier holes being dimensioned to receive and locate the headers, said carrier having legs longer than the lead wires of the headers, said jig holes being dimensioned to receive the flanged cans, and said jig having pilot means to register the jig with the carrier, the arrangement being such that a large number of cans may be held in said jig and the jig then inverted over the carrier to simultaneously cap all of the headers, following which the jig may be removed to leave the cans on the headers.

13. For use in the manufacture of transistors each having a header capped by a flanged can, in combination, a header carrier, and a can jig, said carrier and said jig each comprising a plate with a large equal number of holes, said carrier holes being dimensioned to receive and support the headers, said carrier having legs which are longer than the lead wires, the lower ends of said legs being necked to act as pilots, the upper ends being hollowed to act as pilot holes for cooperation with additional carriers for stacking or for cooperation with a jig for capping, said jig holes being dimensioned to receive the cans, said jig having feet dimensioned to act as spacers, said feet being hollowed at their lower ends to act as pilot holes and being necked at their upper ends to act as pilots for cooperation with additional jigs

for stacking or for cooperation with a carrier for capping, the arrangement being such that cans may be held in the jig and the jig then inverted over the carrier to simultaneously cap the headers, following which the jig may be removed to leave the cans on the headers.

14. For use in the manufacture of transistors each having a header capped by a flanged can, in combination, a can jig, and a magnetic chuck, said jig comprising a nonmagnetic plate with a large number of holes, said jig holes being dimensioned to receive the cans, said jig having feet dimensioned to act as spacers, said feet being hollowed at their lower ends to act as pilot holes and being necked at their upper ends to act as pilots for cooperation with additional jigs for stacking, said chuck having pilot means for cooperation with the jig and having permanent magnets disposed for registration over the cans in a jig, the arrangement being such that cans may be held in the jig by placing the jig over the chuck and the assembly then inverted over an array of headers, following which the chuck may be removed, and then the jig removed to leave the cans on the headers.

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WHITMORE A. WILTZ, *Primary Examiner.*