March 31, 1942. L. E. MITCHELL ET AL 2,277,871

HERMETIC SEAL

Filed Nov. 30, 1940

Fig. 1

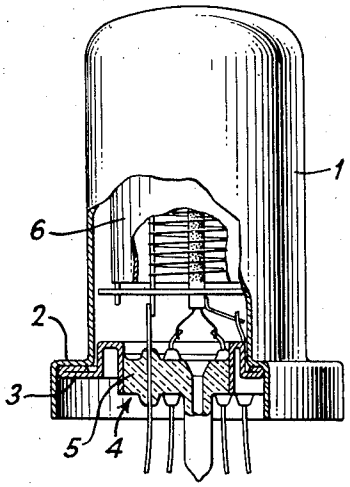


Fig. 2

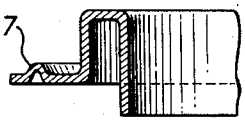


Fig. 3

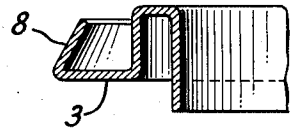


Fig. 4

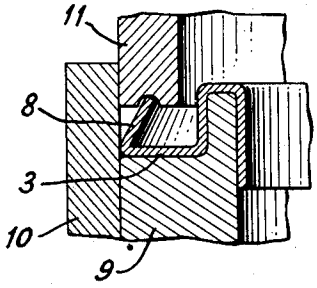


Fig. 5

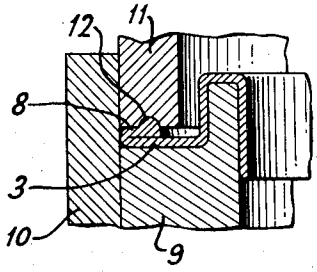


Fig. 6

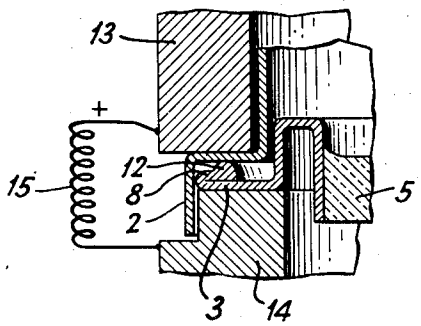
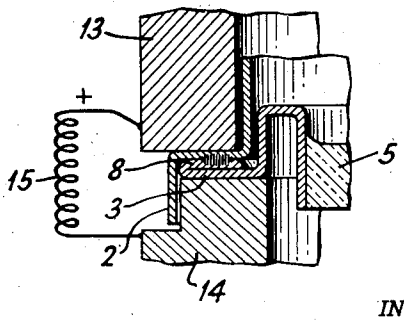


Fig. 7



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HERMETIC SEAL

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4 Claims. (Cl. 219—10)

Our invention relates to welding, particularly to electrically welded hermetic seals in metal envelopes such as envelopes for radio tubes.

The metal shell of a radio tube is usually closed by a header having a flat metal ring welded to the flanged rim of the shell. The shell flange is pressed with considerable pressure against the header ring and welding current passed transversely through the annular surface of contact between the flange and ring. Although an embossed annular bead in one of the welded pieces increases the contact resistance between the two pieces it has been found in factory practice that many imperfect welds are made, apparently because of uneven distribution of current along the long line of contact. There may, for example, be total lack of fusion at one point of the weld, while at another the metal parts may be burned and splashed away.

An object of our invention is a welded hermetic seal along an extended line of contact between two sheet metal members.

Another object of our invention is an improved shell-to-header weld for metal envelope radio tubes.

The characteristic features of our invention are defined in the appended claims and the preferred embodiment thereof is described in the following specification and shown in the accompanying drawing in which—

Figure 1 shows a metal envelope partly in section made according to our invention;

Figure 2 is a sectional detail view of a header made according to the prior art;

Figures 3, 4 and 5 show in succession the steps of our novel method of preparing a sheet metal member preparatory to welding;

Figure 6 shows the sheet metal member, prepared according to our invention, and the member to which it is to be welded in position for welding; and

Figure 7 shows in sectioned detail a hermetically tight welded joint according to our invention.

The radio tube shown in Figure 1, chosen for illustrating one application of our invention, comprises the usual metal shell 1 with an outwardly extending radial flange 2 welded to the flat metal ring 3 of the header 4. The metal ring 3 is hermetically joined to a glass button 5 in which is sealed the lead-in conductor for the electrodes 6 of the tube, and preferably the ring is joined to the glass button through an integral metal annulus, U-shaped in cross section, to isolate the glass-to-metal seal from the thermal and mechanical shock caused by welding the shell flange and header ring. The usual header ring is embossed, as shown in Figure 2, with an annular bead 7 midway between the peripheries of the ring and concentric with the ring. The bead is pressed into the ring by embossing tools which draw the metal upward from the face of the ring. The thickness of the metal in the bead is thinned by the drawing operation and it is probable the metal of the bead is considerably weakened so that pressure applied to the bead by welding electrodes collapses the bead, reduces the contact welding resistance and produces imperfect welds.

The header made according to our invention is provided with a flat ring larger in diameter than the conventional ring and the outer edge of the ring is folded inwardly and back upon the ring, and a thickened bead is formed along the inner edge of the folded portion. As shown in detail in Figures 3, 4 and 5 the outer portion 8 of the ring 3 is bent upwardly, first to an upstanding position and then to an inwardly inclined position about as shown in Figure 3. While the ring is held in the backing die 9 and marginal die 10, annular beading tool 11 with an annular groove in its face descends upon the upper edge of the folded portion 8 and presses the folded portion against the upper face of the ring. The upset metal of the folded portion readily flows and fills the recess in the beading tool and forms a solid embossed bead 12, of the coin type, on the ring.

The header ring with our novel bead is then placed between the annular welding electrodes 13 and 14 which press the shell flange against the bead with considerable force and welding current from source 15 is passed through the shell flange and header ring to melt the bead and weld the header and shell together. Good results have been obtained in making uniform hermetic header-to-shell welds in radio tubes having a shell diameter of about one inch and a shell and header wall thickness of .016 to .020 inch, the welding being made with an electrode pressure of more than 1400 pounds and a welding current of about 60,000 amperes flowing for two to three cycles of a commercial power source of 60 cycles per second alternating current.

It is our belief that the uniform hermetic welds may be attributed to the solid bead 12. The high amplitude short-time welding current and high mechanical pressure, necessary to fuse and weld the parts before oxidation of the parts sets in, require a bead that will not collapse at the beginning of the heating and hence permit short

circuiting of the welding electrodes, but will support the electrodes and permit gradual heating and welding. Many of the failures with the conventional type bead of Figure 2 were apparently caused by premature liquefaction of the hollow and relatively light bead, and arcing between the relatively cool shell flange and pool of molten metal at the bead. This result is manifested by excessive splashing of molten metal from the welded junction and imperfect hermetic seals.

We believe, further, the better welds are made according to our invention because of improved electrical and heating conditions of the weld region. The length of the current path through the welded pieces is increased. The current flows from the bead around the bend in the header ring and to the other electrode with negligible current flowing in straight lines between the electrodes because of the metal oxides and other insulating impurities between the surfaces of the header ring and its folded bead. The increase in the resistance of the current path through the header decreases the proportional value of the contact resistance between the bead and the shell flange, thus minimizing the effect of variable contact resistance caused by random scale and oxides on the bead. Further, heat loss caused by conduction from the heated region at the bead during welding to the lower electrode is substantially reduced by the additional layer of metal in the ring and by heat insulating oxide layers between the ring and its beaded fold. The thermal isolation of the weld region and the substantial increase in the weld resistance appears to account for the material improvement in welded seams.

Our improved shell-to-header weld is less expensive in manufacture because of the simple dies used in forming the bead. A solid bead is made with relatively low die pressures compared to the die pressures necessary for raising a bead from solid metal by the conventional coin embossing method. Our invention provides inexpensive hermetic seals along an extended line of contact between two sheet metal parts.

We claim:

1. A radio tube envelope comprising a sheet metal shell with an outwardly extending flat radial flange at the rim of the shell, means for closing the end of the shell comprising a header with a sheet metal flat ring coextensive with said flange, the peripheral portion of the ring being folded back upon itself and the edge of said peripheral portion being formed into a bead substantially thicker than the sheet metal, said bead being resistance welded to said flange.

2. The method of fabricating a metal envelope having a shell flanged at its rim and a header ring hermetically joined to the flange comprising folding the outer edge portion of the ring inwardly and back upon the ring, forming a thickened bead along the inner edge of the folded portion, and, while pressing the bead against the shell flange, passing welding current between the bead and flange.

3. The method of joining two sheet metal members along an extended line of contact comprising bending an upstanding flange in the edge of one member, upsetting said flange against the side of said one member to form a bead, pressing said bead against the side of the other of said members and passing welding current between said bead and the other of said members.

4. The method of joining two sheet metal pieces along an extended line of contact comprising folding the edge portion of one piece back upon itself, forming a bead in the folded portion substantially thicker than the sheet metal of said one piece, pressing said bead against the other piece and passing welding current between the two pieces through said bead.

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