Oct. 16, 1956 J. D. HEIBEL 2,766,510

METHOD AND APPARATUS FOR MAKING CONDENSERS

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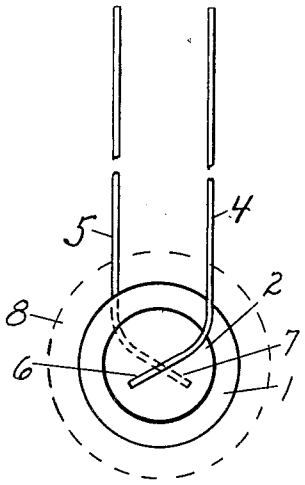

FIG. 1

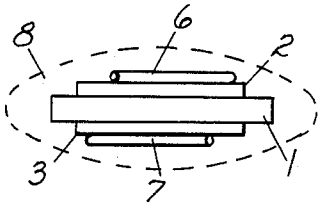

FIG. 2

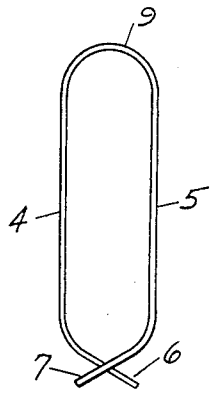

FIG. 3

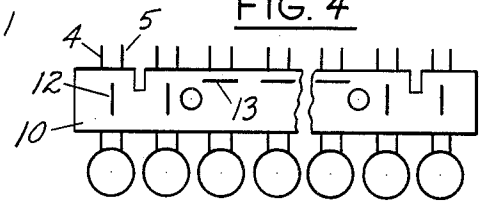

FIG. 4

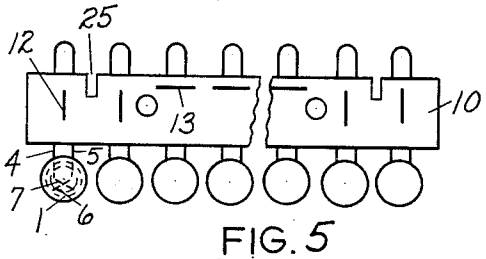

FIG. 5

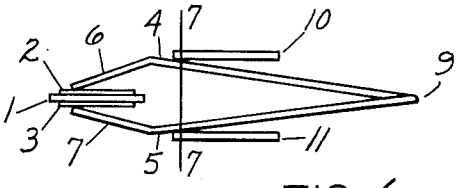

FIG. 6

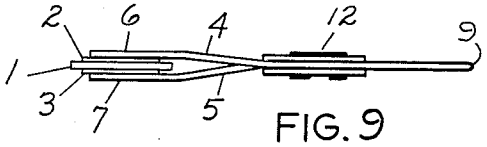

FIG. 9

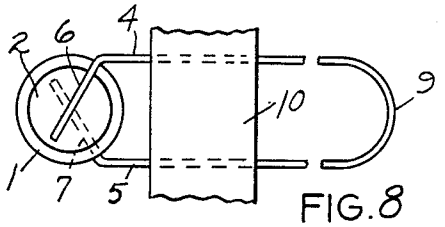

FIG. 8

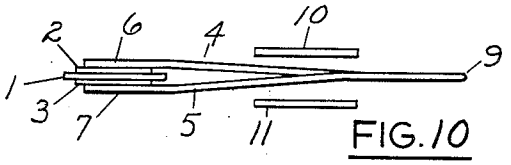

FIG. 10

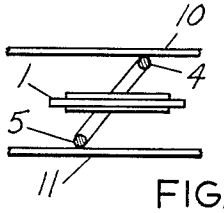

FIG. 7

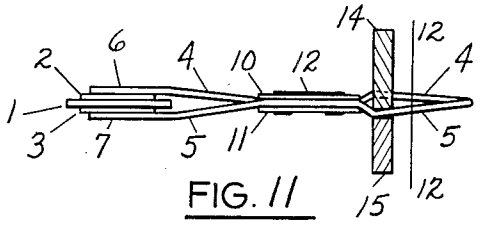

FIG. 11

INVENTOR

Jerome D. Heibel

BY Ralph Hamman

ATTORNEY

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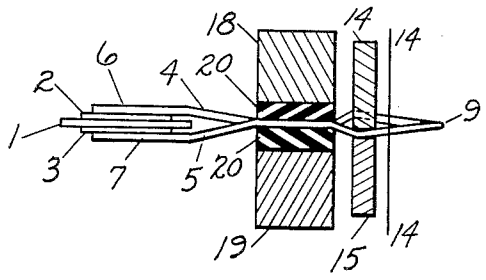


FIG. 13

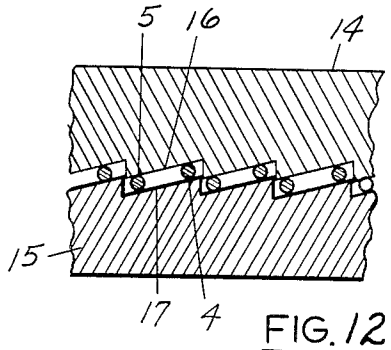
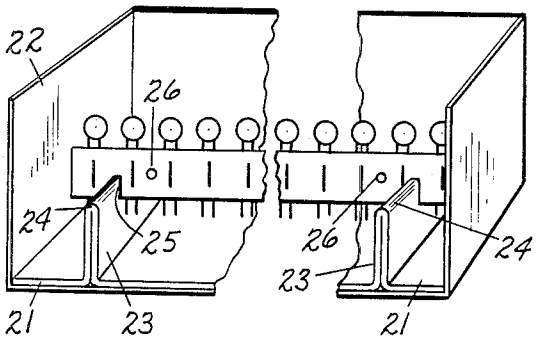


FIG. 12

FIG. 15



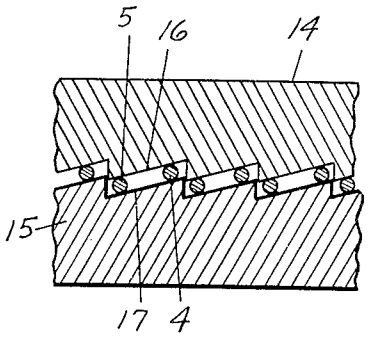


FIG. 14

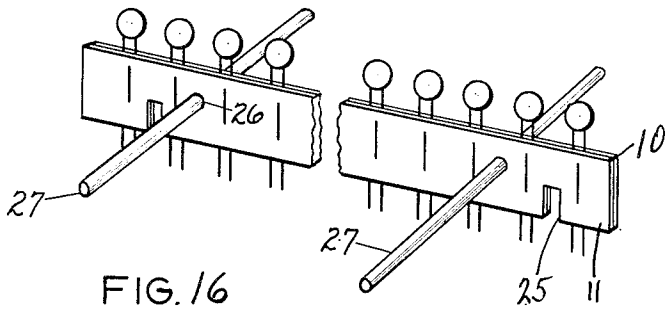


FIG. 16

INVENTOR

Jerome D Heibel

BY Ralph Hammar

ATTORNEY

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METHOD AND APPARATUS FOR MAKING CONDENSERS

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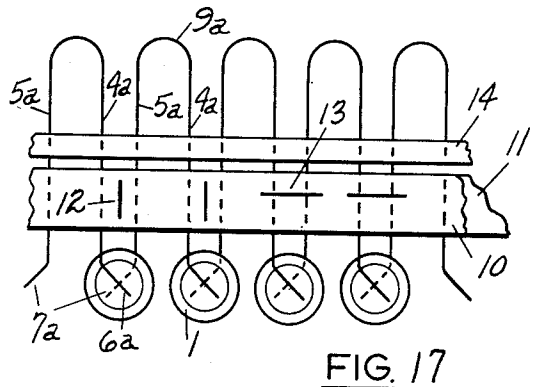

FIG. 17

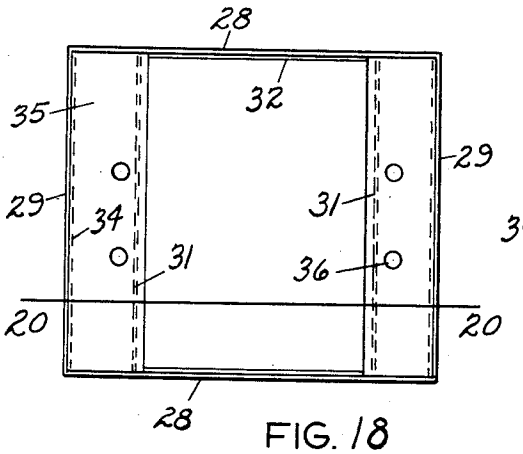

FIG. 18

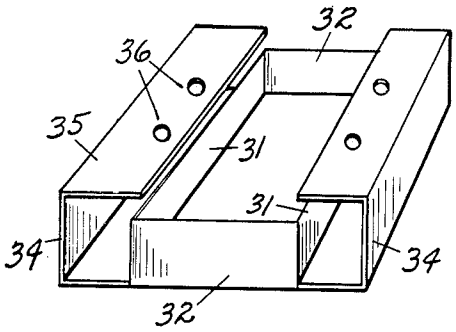

FIG. 19

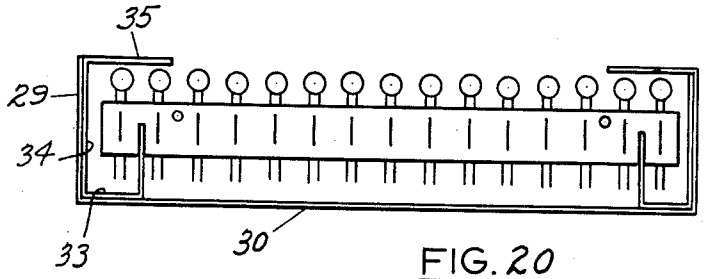

FIG. 20

INVENTOR

Jerome D. Heibel

BY Ralph Hammar

ATTORNEY

United States Patent Office 2,766,510 Patented Oct. 16, 1956

2,766,510

METHOD AND APPARATUS FOR MAKING CONDENSERS

Jerome D. Heibel, Erie, Pa., assignor to Erie Resistor Corporation, Erie, Pa., a corporation of Pennsylvania

Application November 4, 1953, Serial No. 390,115

6 Claims. (Cl. 29—25.42)

This invention is intended to simplify the handling of electrical condensers during manufacture, shipping, and movement up to the point of use. Such condensers commonly comprise an electroded ceramic or other dielectric body with generally parallel soft wire leads which tend to tangle if the condensers are packed in bulk and which are usually cut off to the desired length, straightened and formed at the point of use.

One feature is the twisting of hairpin leads so as to increase the grip of the free ends of the leads on an intervening electroded body. In one form, there is a clamping member at an intermediate portion of the leads with the dielectric body on one side of the clamping member between the free ends of the leads. A twist applied to the leads on the other side of the clamping member materially increases the grip on the dielectric body which is desirable prior to soldering. In a preferred form, the clamping member comprises a pair of elongated cards which are stapled together to clamp the individual hairpin leads between the cards. If the hairpin leads have an initial reverse twist, the clamping of the cards together will overcome the reverse twist and impart the desirable gripping force on the intervening dielectric body. Another expedient is a clamping arrangement with offset gripping surfaces on the side of the gripping member remote from the dielectric bodies which impart the twisting force. When a plurality of condensers are mounted on the stapled cards, the condensers are easily shipped by supporting the cards edgewise on supports which fit in notches in the cards. The mounted condensers are also easily handled in storage and movement up to the point of use. Suitable index holes in the cards facilitate the feeding of the condensers to automatic machines for forming the leads to the desired shape and length for ready connection into a circuit.

In the accompanying drawings, Fig. 1 is a side elevation of a condenser; Fig. 2 is an end view of the condenser; Fig. 3 is a side view of one of the hairpin leads used in the manufacture of the Fig. 1 condenser; Fig. 4 is a side view of a plurality of condensers mounted between cards; Fig. 5 is a similar view of a plurality of condensers mounted between cards at an intermediate stage of manufacture; Fig. 6 is an edge view of one of the condensers showing the hairpin lead in position to be clamped against the electrodes on opposite faces of the condenser dielectric; Fig. 7 is a section on line 7—7 of Fig. 6; Fig. 8 is a top plan view of the Fig. 6 condenser; Fig. 9 is a view similar to Fig. 6 with the cards stapled together to develop the desired clamping pressure between the free ends of the hairpin leads and the electrodes on opposite faces of the condenser dielectric; Fig. 10 is an edge view of a condenser with another form of hairpin lead; Fig. 11 is a view similar to Fig. 10 with the cards stapled together to clamp the free ends of the hairpin lead against electrodes on opposite sides of the condenser dielectric and with a supplemental clamping member imparting a twist to the hairpin leads to increase the gripping pressure on the condenser electrodes; Fig. 12 is a section on line 12—12 of Fig. 11; Fig. 13 is a view similar to Fig. 10 with other clamping members substituted for the cards; Fig. 14 is a section on line 14—14 of Fig. 13; Fig. 15 is a perspective showing the manner of supporting the cards for shipping and storage on supports fitting in notches in the edges of the cards; Fig. 16 is a perspective showing the manner of handling the assembly of condensers on the cards by spaced fingers or rods projecting through holes in the cards; Fig. 17 is a plan view of a strip of condensers using different leads but with the same twisting arrangement for increasing the gripping force on the condensers; Fig. 18 is a top plan of a tray for shipping a plurality of strips of condensers; Fig. 19 is a perspective of the tray; and Fig. 20 is a section on line 20—20 of Fig. 18.

In Figs. 1 and 2 of the drawings is shown a condenser having a disc-shaped dielectric 1 preferably of ceramic with electrodes 2 and 3 on opposite faces thereof. The condenser has generally parallel leads 4 and 5 respectively having angularly offset ends 6 and 7 engaging and soldered to electrodes 2 and 3. The condenser is enclosed in an insulating case 8 usually formed by dipping in a plastic, which serves as a moisture barrier in addition to providing electrical insulation. The leads 4 and 5 which project a considerable distance outside the case are usually longer than is required for many of the uses so that at the point of use the leads are cut to the desired length, if necessary, and are given a preliminary forming operation so that the leads may be easily connected into the circuit. The condenser so far described is or may be of common construction.

For convenience in manufacture, the leads 4 and 5 are usually made in the form of a hairpin as shown in Fig. 3 with the free ends of the hairpin having the angular offsets 6 and 7 and the other ends being connected by an arch 9. While there may appear to be some resemblance between the hairpin lead construction shown in Fig. 3 and a paper-clip, the fact that the leads 4 and 5 must be of soft wire so as to be easily bent in making connections and the length of the leads 4 and 5 makes this construction have very little of the gripping characteristics of a paper-clip. It has been found, however, that if the leads 4 and 5 can be twisted relative to the free ends 6 and 7 sufficient gripping force between the ends 6 and 7 can be developed so that a capacitor can be gripped between the ends 6 and 7 so as to permit dip-soldering to the electrodes 2 and 3. Figs. 6 to 13, inclusive, show various arrangements for producing the twisting action which provides the necessary additional gripping force between the ends 6 and 7 so that a condenser can be supported therebetween until the permanent connection is made by dip-soldering.

Fig. 6 shows the condenser dielectric 1 gripped between the ends 6 and 7 of a hairpin lead. This operation can be done manually or automatically. Instead of having the arms 4 and 5 of the hairpin lead in substantially the same plane as is conventional, the arms have been given an initial twist so that when the condenser dielectric in inserted between the ends 6 and 7, the arms 4 and 5 are offset on each side of the plane of the disc 1 as indicated in Figs. 6 and 7. The portion of the hairpin leads intermediate the ends 6 and 7 and the arch 9 is placed between flexible strips 10, 11 of cardboard which are stapled together either by staples 12 between the arms 4 and 5 or by staples 13 which straddle the arms 4 and 5. As the flexible card strips 10, 11 are stapled together, the arms 4 and 5 of the leads are brought into substantially the plane of the dielectric disc 1 thereby overcoming the initial reverse twist imparted to the arms 4 and 5 and increasing the clamping pressure between the ends 6 and 7 to such a value that when the stapled cards 10, 11 are supported in a horizontal position with the condensers 1 depending therefrom, the condensers will not slip out from between the ends 6 and 7 and a permanent soldered connection can easily be made by dipping the condenser into a molten solder pot.

Of course, after the permanent soldered connection is made to the ends 6 and 7, other operations necessary to bring the condensers to the finished state can be carried out using the stapled cards 10, 11 as a carrier. At the

end of the manufacturing steps, the condensers will still be carried between stapled cards **10**, **11** as shown in Fig. 4 and the arched section **9** of the hairpin leads can be cut off leaving only the arms **4** and **5** which are of lengths adequate to make any desired electrical connections to the condenser.

In Figs. 10, 11, and 12 is shown an arrangement for imparting a twist to the hairpin leads so as to increase the gripping pressure between the free ends **6** and **7** without imparting an initial reverse twist to the hairpin leads. When the hairpin leads do not have an initial reverse twist, the arms **4** and **5** lie substantially in the same plane when the condenser dielectric **1** is inserted between the free ends **6** and **7**. Due to the fact that the hairpin leads are made out of soft wire and the arms **4** and **5** leading back to the arch **9** are quite long, the inherent resilience of the arms **4** and **5** cannot be relied upon to provide adequate gripping pressure between the free ends **6** and **7** even after the elongated cards **10**, **11** are stapled together by the staples **12** or **13**. The additional gripping force between the ends **6** and **7** is obtained by elongated clamping members **14** and **15** arranged adjacent the edge of the cards **10**, **11** remote from the free ends **6** and **7**. The clamping members **14** and **15** have inclined gripping surfaces **16** and **17** which lift the arm **4** above the plane of the disc **1** and depress the arm **5** below the plane of the disc **1**. This rocks the arms **4** and **5** about the cards **10**, **11** as a fulcrum depressing the free end **6** into tighter engagement with the electrode **2** and raising the free end **7** into tighter engagement with the electrode **3** so that the condenser will be firmly gripped beween the free ends **6** and **7** and can be inverted and immersed in a solder pot for dip-soldering. The inclined gripping surfaces **16** and **17** have the advantage over the Figs. 6–9 construction in that the twist is easily controlled by the inclination of the gripping surfaces and does not depend upon the accuracy with which a reverse twist is put into the hairpin leads.

Figs. 13 and 14 show an arrangement in which the hairpin leads are not clamped between the stapled cards **10**, **11**, but instead are clamped between clamping members **18** and **19**, each of which has a resilient face of rubber or like material **20** which makes the gripping contact with the arms **4** and **5** of the hairpin leads. The clamping members **18** and **19** in conjunction with the clamping members **14** and **15**, which provide the twisting action increasing the gripping pressure, function in the same manner as the Figs. 10–12 arrangement holding the condensers throughout the manufacturing operations starting with the dip-soldering and including other operations such as dipping the condensers in plastic to provide the insulating case, curing the plastic, cutting off the arched sections **9** of the hairpin leads, stamping the capacity values on the insulating case, and wax impregnating or coating.

The clamping members could be located on the side of the clamping members **10**, **11** or **18**, **19** nearest the condensers in which case the twisting force would be applied in the opposite direction, i. e. the arm **4** would be depressed and the arm **5** would be lifted, thereby depressing the free end **6** into tighter engagement with the electrode **2** and lifting the free end **7** into tighter engagement with the electrode **3**.

In any arrangement, the arch **9** should be uncut when the twisting force is applied to the leads. The arch **9** resists turning of the arms **4** and **5** about their axes by the torque or torsional forces set up in the arms **4** and **5** by the forces on the free ends **6** and **7**. Because these torsional forces are in opposite directions, the center of the arch remains in fixed position independent of the torsional forces. The arch **9** could be replaced by clamping arrangements or other means for resisting turning of the arms **4** and **5**, but the connected arch **9** is perhaps the simplest arrangement.

Throughout all these manufacturing operations, the condensers will be held in fixed relation to the gripping members **18** and **19** just as the condensers are held in fixed relation to the cards **10** and **11** so that the gripping members serve as the carrier which is adapted to mechanized operations since the position of the carrier always has a fixed relation to the positions of the condensers. For example, when the carrier is lowered, either for dip-soldering or for the dip application of the insulating case, all of the condensers can be simultaneously dipped. The same is true of other operations such as the stamping of capacity values on the insulated case and the cutting of the arched sections **9** off the hairpin leads at the end of the manufacture. The gripping members **18** and **19** do have the disadvantage that they must be removed at the end of the manufacturing operations and the condensers will then have to be handled in bulk with the possibility that the leads of individual condensers will become tangled with each other. Throughout the manufacture, however, the gripping members **18** and **19** function in the same manner as the stapled cards **10**, **11**.

When the condensers are held between the stapled cards **10**, **11**, as shown in Figs. 4 to 12, inclusive, it is convenient to keep the condensers stapled to the cards during shipment and movement up to the point of use. Upon reaching the point of use, the cards can be fed into a machine which will automatically cut the leads to the length desired for a particular application and form the leads so that the soldered connections can be most easily made. Having the condensers held in fixed relation to the cards, makes the automatic feeding of the condensers to a lead trimming and forming machine much easier than as though the condensers were shipped in bulk and had to be untangled by a sorting mechanism.

Having the condensers held between the stapled cards **10**, **11** facilitates the shipment as shown in Fig. 15. One way of shipping the condensers is to mount a cardboard filler piece **21** in the bottom of a shipping container **22**. The cardboard filler piece has folds **23** which provide upstanding supports **24** fitting in notches **25** in the cards **10**, **11**. A plurality of cards can be stacked side by side in the shipping container **22** on the supports **24** thereby providing an orderly fill for the shipping container in which the total number of condensers can be readily ascertained. This is advantageous not only in shipping, but in subsequent stockroom storage prior to the movement of the condensers up to the point of use.

For convenience in automatic handling of the condensers at the point of use, the cards **10**, **11** are provided with holes **26** for receiving rods **27**. By threading the rods **27** through the holes **26**, the entire contents of a shipping container can be lifted out of the container at one step and each of the cards with the condensers thereon will thereafter be held in fixed relation to the rods **27**. As the condensers are used, the cards can be successively slid off the ends of the rods one card at a time and fed to the usual machinery for straightening and forming the condenser leads.

In the method, a wire is formed in the general shape of a hairpin with the free ends offset so as to be in opposed relation, a condenser dielectric with electrodes on opposite faces is inserted between the free ends of the hairpin lead, a plurality of condensers are arranged side by side in a row and the intermediate portions of the hairpin leads are clamped to a holder (which may be by stapling to cardboard strips or by clamping between reusable elongated clamping members), and the holder then manipulated to perform the operations of dip-soldering, dip application of the insulating case, curing, stamping, cutting of the leads, and packing for shipment. All of these operations can easily be carried out by machinery, because the individual condensers are in fixed relation to a holder. Furthermore, upon arrival at the point of use, the cards to which the rows of condensers are fastened continue the advantages of ease of handling in the lead forming and trimming operation which adapts

the condensers for ready connection into a particular circuit.

In the previously described construction using hairpin leads, the free ends **6** and **7** have converged toward each other so as to be in overlapping relation with respect to the intervening dielectric disc **1**. In Fig. **17** is shown a somewhat different arrangement in which the free ends **6***a* and **7***a* of the individual hairpin leads diverge so that the overlapping ends **6***a* and **7***a* between adjacent hairpin leads are in overlapping relation with respect to the intervening dielectric disc **1**. In this arrangement, the individual leads **4***a* and **5***a* for the finished condenser are not part of the same hairpin lead, but are a part of adjacent hairpin leads. In other respects, the operation is the same. Turning of the arms **4***a* and **5***a* on their axes is prevented by the connecting arches **9***a* of the hairpin leads. The hairpin leads are arranged in rows crosswise of a clamping member such as the cardboard strips **10**, **11** with the free ends **6***a*, **7***a* of adjacent hairpin leads in overlapping relation to clamp an intervening dielectric disc **1**. Because the wire of the hairpin leads is soft, adequate clamping pressure is not obtained by stapling the cards **10**, **11** together by the staples **12** or **13**. The additional clamping pressure is obtained by the twisting force applied by the clamping members **14**, **15**. At each end of the row, one of the arms of the hairpin lead will have to be thrown away, for example, the arm **5***a* at the extreme left in Fig. 17, but this is not an important disadvantage due to the large number of condensers arranged in the row.

Figs. 18, 19, and 20 show an improved pack for supporting a large number of the strips of condensers side by side. In this arrangement, there is an open-topped generally rectangular tray having side walls **28**, end walls **29**, and a bottom wall **30**. Telescoped within the open-topped container is a rack having at its center a support comprising spaced upstanding walls **31** spaced inward from the end walls **29** and being connected at their ends by upstanding walls **32** adjacent the side walls **28**. The notches **25** of the strips **10**, **11** fit over the upper edge of the upstanding walls **31**, as shown more clearly in Fig. 20, thereby supporting the condensers with their leads slightly above the bottom wall **30** and the condensers slightly below the upper edges of the walls **28**, **29**. A large number of the strips **10**, **11** with the condensers fixed thereto can be supported side by side on the supporting walls **31**. Integral with the bottom edge of each of the walls **31** is a flap having a section **33** extending along the bottom wall **30** to the end wall **29**, a section **34** extending up along the inside of the wall **29** and an inwardly extending section **35** extending in spaced relation over the top of the ends of the strips of condensers. As shown in Fig. 18, hand holes **36** permit the rack to be lifted out of the open-topped container. After the strips of condensers have been loaded side by side on the rack, the rack with the condensers thereon can be wax impregnated thereby coating all the exposed surfaces of the condensers and leads with a film of wax. There is some loss of wax absorbed by the rack and by the card supports **10**, **11**, but this is not material.

Upon arriving at the point of use, the rack can easily be lifted out of the open-topped container by gripping the flaps **35** through the finger holes **6** and when the rack is outside the container, the holes **26** will be above the upper edges of the upstanding walls **31**, **32** so that fingers or rods **27** can be run through the holes **26** and the entire load of condensers lifted off the rack at once. This is convenient if the strips of condensers are to be fed to a machine which will automatically remove the condensers from the strip and cut and form the leads.

What is claimed as new is:

1. Apparatus for the manufacture of disc shaped devices having electrodes on opposite faces to be connected to leads, comprising clamping means for clamping the intermediate portions of the arms of hair pin leads having free ends offset toward each other in overlapping relation along one edge of the clamping means and adapted to receive a disc therebetween, and another clamping means imparting a twist to the arms of the lead relative to the first clamping means in the direction to increase the gripping force between the free ends of the leads.

2. Apparatus for the manufacture of disc shaped devices having electrodes on opposite faces to be connected to leads, comprising clamping means for clamping the intermediate portions of the arms of hair pin leads having free ends offset toward each other in overlapping relation along one edge of the clamping means and adapted to receive a disc therebetween, said clamping means having clamping faces in the plane of the discs, and another clamping means on the side of the first clamping means remote from the disc having clamping faces engaging one of the leads above the plane of the disc and engaging the other of the leads below the plane of the disc and imparting a twist to the leads relative to the first clamping means in the direction to increase the gripping force on the disc.

3. The method of making condensers from dielectric discs having electrodes on opposite faces, which comprises arranging spaced hairpin leads crosswise between strips with pairs of free ends of the leads offset toward each other in overlapping relation and spaced apart along one edge of the strips and the connecting arches of each lead spaced apart along the other edge of the strip, inserting discs between each pair of free ends of the leads with the electrodes in contact therewith and fastening the strips together to fasten and clamp the leads therebetween, applying a twisting force to the leads in the direction to increase the gripping force of the pairs of free ends of the leads on the intervening discs, and using the strips as a carrier dipping the discs in solder to solder the electrodes to the free ends of the leads.

4. The combination of claim 1 in which the first clamping means comprises a pair of flexible strips fastened together with the hairpin lead extending crosswise of the strip and projecting beyond each edge thereof.

5. The method of making condensers from dielectric discs having electrodes on opposite faces, which comprises forming wire into hairpin leads with free ends offset toward each other and in overlapping relation, inserting individual discs between the free ends of individual leads and fastening and clamping the individual leads to a strip with the discs spaced along one edge of the strip and the arched ends of the hairpin leads spaced along the opposite edge of the strip, applying a twisting force to the leads in the direction to increase the gripping force of the pairs of free ends of the leads on the intervening discs, and using the strip as a carrier dipping the discs in solder to solder the electrodes to the free ends of the leads.

6. The method of making condensers from dielectric discs having electrodes on opposite faces, which comprises arranging spaced leads crosswise of a clamping strip with pairs of free ends of the leads offset toward each other in overlapping relation and spaced apart along one edge of the strip, inserting discs between each pair of free ends of the leads with the electrodes in contact therewith and clamping the leads against the strip, applying a twisting force to the leads relative to the strip in the direction to increase the gripping force of the pairs of free ends of the leads on the intervening discs, and using the strip as a carrier dipping the discs in solder to solder the electrodes to the free ends of the leads.

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