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TRANSISTOR UNIT

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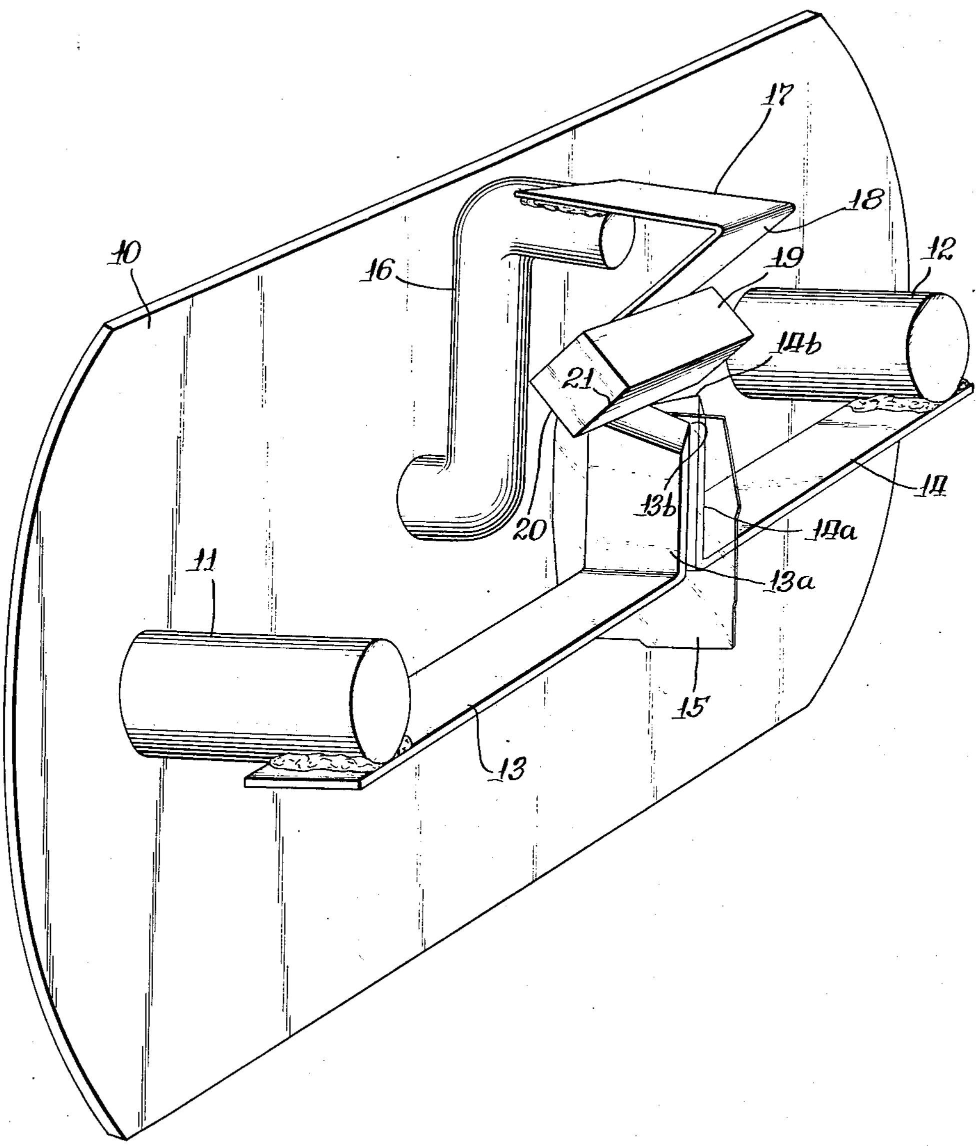

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TRANSISTOR UNIT

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The present invention relates to semi-conductor transistor units and more particularly to an improved and simplified transistor unit of the point contact type.

The point contact type of transistor usually comprises a crystal of semi-conductive material, such as germanium or silicon, that has been treated with impurities of the donor or acceptor types to form an "N" or "P" type semi-conductor.

The point contact type of transistor usually includes a pair of electrodes known respectively as emitter and collector which extend perpendicularly to a surface of the crystal and having pointed extremities in contact with that surface. A third electrode, which is usually in the form of a metal block or tab, is also provided and affixed to another surface of the crystal to constitute a base electrode for the unit.

The emitter and collector electrodes of prior art transistor units usually take the form of a pair of pointed fine wires or thin metallic ribbons supported to extend in spaced parallel relation perpendicular to one face of the crystal. These electrodes usually have a diameter of the order of .002" with a spacing between their points of .002". Moreover, the crystal is usually a cube with a .032" side. Therefore, the transistor unit is an extremely small device and the fine wire emitter and collector electrodes are of microscopic dimensions and spacing. This renders the manufacture of this type of transistor extremely difficult when prior art practices are followed since it entails critical manual spacing and assembling operations of the fine wire electrodes. In addition, due to the requirements for precise manual mounting and spacing of such electrodes, it is difficult, if not impossible, to achieve any degree of uniformity between individual ones of a plurality of transistor units constructed in this manner. Moreover, the use of fine wires for the collector and emitter electrodes in point contact transistor units usually results in a device that is extremely delicate and which has a relatively low mechanical stability.

It is an object of the present invention to provide an improved point contact transistor unit that may be manufactured easily and with a minimum of mechanical skill, and which is so constructed that uniform characteristics may be attained between individual ones of a quantity of transistor units manufactured in accordance with the invention.

Another object of the invention is to provide such an improved point contact transistor unit that is rugged in its construction and which possesses a high degree of mechanical stability.

A feature of the invention is the provision of a pair of resilient metallic strips supported in a unique manner on an insulating base and having bent-over ends which extend parallel to one another with edges at their extremities constituting the emitter and collector electrodes for the unit. A semi-conductive crystal is resiliently supported against the bent-over ends by a base electrode with an edge of the crystal traversing the edges of the bent-over ends and in electrical contact therewith.

Another feature of the invention is the provision of such an improved transistor unit in which the edges of the bent-over ends of the resilient metallic strips mentioned above are each sharpened to a knife edge and are inclined in opposite directions, the crystal being resiliently supported by the base electrode so that an edge thereof contacts the knife edges of the bent-over ends at the apex formed thereby. This construction allows the crystal to be resiliently supported and accurately positioned against the knife edges, and eliminates any tendency for the crystal to shift laterally along the knife edges.

Yet another feature of the invention is the provision of a thin sheet of insulating material interposed between the bent-over ends of the resilient metallic strips to insulate and separate these ends and eliminate the need for accurate microscopic spacing between the ends during the fabrication of the unit.

The above and other features of the invention which are believed to be new are set forth with particularity in the appended claims. The invention itself, however, together with further objects and advantages thereof, may best be understood by reference to the following description when taken in conjunction with the accompanying drawing in which the single figure shows a preferred embodiment of the invention.

The transistor unit of the present invention comprises a flat insulating base with a pair of rigid spaced parallel metallic leads extending perpendicularly through the base at the respective ends thereof. A pair of resilient metallic strips are secured respectively at one end to the leads and extend toward one another in a plane essentially perpendicular to the plane of the base. The metallic strips each have a turned-up end, and these turned-up ends are in spaced parallel relation and have respective edges at the extremities thereof. A third rigid metallic lead extends through the base perpendicularly thereto and intermediate the first mentioned pair of leads. A semi-conductive crystal is provided which has a pair of inclined faces having an edge formed by the line of juncture between such faces. Finally, a resilient metallic strip is secured to the third metallic lead at one end and has its other end soldered to another face of the crystal. The last mentioned end of the metallic strip constitutes a base electrode for the crystal, and the metallic strip supports the crystal against the turned-up ends of the pair of strips with the edge of the crystal contacting the edges of the turned-up ends in transverse relation thereto.

The transistor unit of the invention includes a flat insulating base **10** having a pair of rigid metallic leads **11** and **12** extending perpendicularly therethrough at opposite ends thereof. A pair of resilient metallic strips **13**, **14** composed, for example, of Phosphor bronze are respectively welded at one end to leads **11** and **12**. The metallic strips **13** and **14** extend inwardly from leads **11** and **12** in a plane essentially perpendicular to the plane of insulating base **10** and have a pair of 90° bent-over ends **13*a*** and **14*a*** which extend parallel to one another. The ends **13*a*** and **14*a*** have respective edges **13*b*** and **14*b*** which are sharpened to a knife edge and which are oppositely inclined to form an apex therebetween.

The bent-over ends **13*a*** and **14*a*** are separated and insulated by a sheet or film **15** of insulating material which is interposed between these ends and which, for example, may have a thickness of 1 mil. Insulating material **15** can be composed, for example, of a material marketed under the trade-mark of "Teflon."

A third rigid metallic lead **16** extends perpendicularly through base **10** intermediate leads **11** and **12** and has an S shape. A resilient metallic strip **17**, which also may be composed of Phosphor bronze, is welded to the upper side of lead **16** and has a bent-over end **18** which is soldered to a parallelopiped semi-conductive crystal block **19**, the end **18** of strip **17** forming a base electrode for the crystal. Crystal **19** has a pair of inclined faces **20**, **21** with the line of juncture therebetween forming an edge of the crystal. Resilient strip **17** supports the crystal with its edges transversing the edges **13*b*** and **14*b*** of bent-over ends **13*a*** and **14*a*** in electrical contact therewith.

With the construction described above, the end **18** of strip **17** forms a base electrode for the crystal **19** and electrical connection is made to the base through lead **16** and strip **17**. The edges **13*b*** and **14*b*** of the bent-over end of strips **13** and **14** constitute respectively the emitter and collector electrodes for the crystal and each make a point contact with the edge of the crystal at spaced points along that edge. Electrical connection is made to the emitter electrode through lead **11** and portion **13**; whereas electrical connection may be made to the collector electrode through lead **12** and portion **14**.

The crystal is resiliently suspended, by the construction described above, between base electrode **18** and knife edges **13*b*** and **14*b***, and is held firmly against lateral shifting along the knife edges due to the inclined configuration of these edges.

The improved transistor unit of the present invention may be constructed in a relatively simple manner and no accurate and delicate spacing of the various electrodes thereof is required during the manufacturing process. In the construction of the unit, strip **13** may first be welded to lead **11** and film **15** adhered to the bent-over portion of that strip. The bent-over portion **14*a*** of strip **14** is then brought against the other face of the insulating film and strip **14** is welded to lead **12**. Alternately, the unit may be assembled with the bent-over portions in contact with one another and the insulating film then slipped between them. The metallic strip **17** may then be welded to lead **14** and soldered to the crystal, the edge of the crystal being accurately brought to the desired point of contact between it and the edges **13*b*** and **14*b*** by the inclined configuration of these edges.

The resulting assembly is relatively rugged since, instead of fine and delicate wire electrodes, the electrodes are formed by metallic strips which are supported in an improved manner to maintain the crystal in proper position therebetween. Moreover, there is no need for minute spacing adjustments during the manufacturing process since the emitter and collector electrodes are accurately spaced and insulated by the film **15**. In addition, there is no requirement for manual locating of these electrodes on the crystal edge, since the proper location is obtained automatically due to the inclination of edges **13*b*** and **14*b***. With this construction the units may be assembled rapidly and with a minimum of rejects, and individual units of a plurality so assembled exhibit uniform characteristics since a standardized spacing and location of the electrodes may be achieved.

While a particular embodiment of the invention has been shown and described, modifications may be made and it is intended in the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

I claim:

1. A circuit element including in combination, a flat insulating base, a pair of rigid spaced parallel metallic leads extending perpendicularly through said base, a pair of resilient metallic strips respectively secured to said leads and extending toward one another in a plane essentially perpendicular to the plane of said base, said metallic strips each having a turned-up end, and the turned-up ends of said strips being in spaced parallel relation and having respective edges at the extremities thereof, a third rigid metallic lead extending through said base, a semi-conductive device having a pair of inclined faces with an edge formed by the line of juncture between said faces, and a resilient metallic strip secured to said third metallic lead and to said semi-conductive device for supporting said device against said turned-up ends of said metallic strips with said edge of said device contacting said edges of said turned-up ends in transverse relation thereto.

2. A circuit element including in combination, a base portion, a pair of rigid electrically conductive supporting leads extending through said base and spaced one from the other, a pair of resilient electrically conductive supporting members respectively secured to said leads and extending toward one another, said resilient members each having a turned-up end, and the turned-up ends of said resilient members being in spaced parallel relation and having respective edges at the extremities thereof, a third rigid electrically conductive supporting lead extending through said base, a semi-conductive device having a pair of inclined faces with an edge formed by the line of juncture between said faces, and a resilient electrically conductive member secured to said third lead and to said semi-conductive device for supporting said device against said turned-up ends of said first mentioned resilient supporting members with said edge of said device contacting said edges of said turned-up ends in transverse relation thereto.

3. A circuit element including in combination, a flat insulating base, a pair of spaced parallel rigid metallic leads extending perpendicularly through said base at the respective ends thereof, a pair of resilient metallic strips each having one end secured to and in electrical contact with a respective one of said leads, said strips extending toward one another in a plane essentially perpendicular to the plane of said base and having ninety degree bent-over parallel adjacent ends, said bent-over ends forming electrodes and having oppositely inclined knife edges at the extremities thereof forming an apex therebetween, a sheet of insulating material interposed between said bent-over ends to separate and insulate said bent-over ends from one another, a third rigid metallic lead extending through said base intermediate said pair of leads, a semi-conductive crystal having a pair of inclined faces with an edge formed by the line of juncture between said faces, and a resilient metallic strip secured to said third metallic lead at one end and secured to another face of said crystal at its other end, said last mentioned end forming an electrode for said crystal and said last mentioned strip supporting said crystal against said bent-over ends of said pair of metallic strips with said edge of said crystal contacting said knife edges of said bent-over ends in transverse relation thereto at the apex formed thereby.

4. A circuit element including in combination, a flat insulating base, a pair of spaced parallel rigid metallic leads extending perpendicularly through said base, a pair of resilient metallic strips respectively secured to said leads and extending toward one another in a plane essentially perpendicular to the plane of said base, said metallic strips each having a turned-up end, and the turned-up ends of said strips being parallel one to the other and having respective oppositely inclined knife edges at the extremities thereof forming an apex therebetween, a sheet of insulating material interposed between said turned-up ends to separate and insulate said turned-up ends from one another, a third rigid metallic lead extending through said base, a semi-conductive device having a pair of inclined faces with an edge formed by the line of juncture between said faces, and a resilient metallic strip secured to said third metallic lead and to said semi-conductive device for supporting said device against said turned-up ends of said pair of metallic strips with said edge of said device contacting said knife edges of said turned-up ends in transverse relation thereto at the apex formed thereby.

5. A circuit element including in combination, a flat insulating base, a pair of spaced parallel rigid metallic leads extending perpendicularly through said base at the respective ends thereof, a pair of resilient metallic strips each having one end secured to and in electrical contact with a respective one of said leads, said strips extending toward one another in a plane essentially perpendicular to the plane of said base and having turned-up ends in mutually spaced parallel relation, said turned-up ends forming electrodes and having respective knife edges at the extremities thereof, a third rigid metallic lead extending through said base, a semi-conductive crystal having a pair of inclined faces with an edge formed by the line of juncture between said faces, and a resilient metallic strip secured to said third metallic lead at one end and secured to a further face of said semi-conductive crystal at its other end, said last-mentioned end forming an electrode for said semi-conductive crystal, and said last mentioned strip supporting said crystal against said turned-up ends of said pair of metallic strips with said edge of said crystal contacting said knife edges of said turned-up ends in transverse relation thereto.

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