

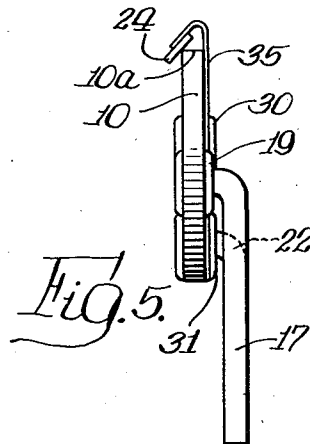
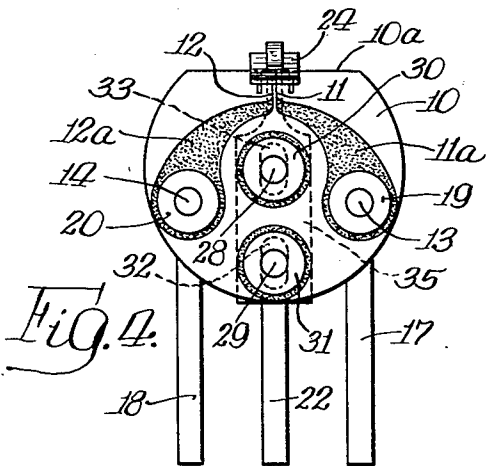
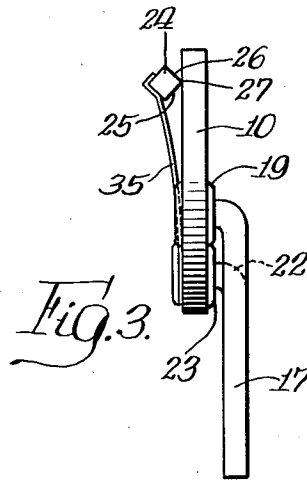
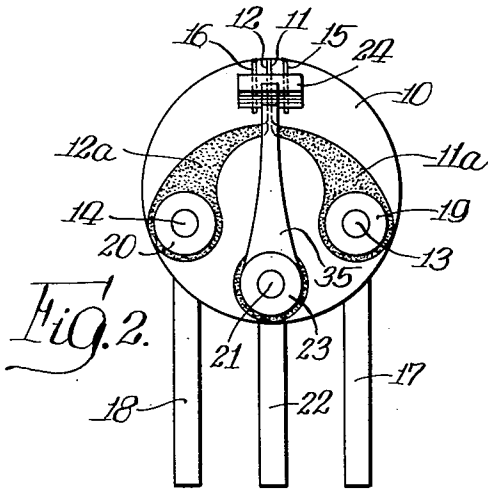
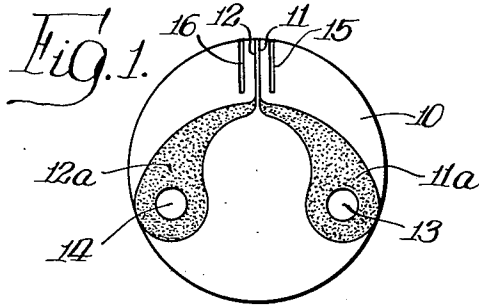
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2,795,745

TRANSISTOR UNIT

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2,795,745

TRANSISTOR UNIT

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7 Claims. (Cl. 317—235)

The present invention relates to semi-conductor circuit elements, and more particularly to an improved 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 transistor includes a pair of electrodes known respectively as the emitter and collector which are in point contact with one surface of the crystal. A metal block or tab is also provided and affixed to another surface of the crystal to constitute what is termed a base electrode for the assembly. The emitter and collector electrodes in the prior art point contact transistor usually take the form of a pair of fine wires or thin metallic ribbons. These wires are supported by the transistor casing to extend perpendicularly to the surface of the crystal with pointed ends in point contact with that surface. The wires have a diameter of the order of .002" and their points are spaced about .002" on the face of a crystal having cubical dimensions of the order of .032" on a side. Such electrodes require a high degree of manual dexterity in their assembly to mount and achieve proper placement thereof due to their microscopic size and spacing. Since these prior art assemblies require visual adjustment and a high degree of manual efficiency, their construction is complicated and expensive and it is difficult to maintain uniformity in the product when the units are fabricated on a mass production basis.

It is an object of the present invention to provide an improved point contact type transistor assembly in which the collector, emitter and base electrodes are fabricated and supported in a simplified manner for accurate dimensioning and positioning of the electrodes.

A further object of the invention is to provide such an improved transistor unit that may be produced on a mass production basis and which is constructed so that units so produced have uniform characteristics and are not subject to variations from one unit to the next.

Another object of the invention is to provide such an improved transistor unit that may be produced at a low cost and yet in which the various components are precisely positioned and have a high degree of mechanical stability.

A feature of the invention is the provision of a circuit element in the form of a transistor unit in which the emitter and collector electrodes are thin, elongated, precisely spaced metallic coatings on an insulating disc, and in which the various electrodes of the unit are secured to the disc in a convenient manner to constitute a compact assembly with the desired electrical and mechanical characteristics.

A further feature of the invention is the provision of a transistor unit which incorporates an insulating base having emitter and collector electrodes formed on one surface thereof by thin, mutually parallel, metallic

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coatings; and which has a resilient metallic strip secured to the base with a free end extending across the base and resiliently holding a crystal against the emitter and collector electrodes.

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:

Figure 1 shows a component of the transistor of the present invention;

Figures 2 and 3 respectively show front and side views of one embodiment of the invention; and

Figures 4 and 5 respectively show front and side views of a second embodiment of the invention.

The improved transistor unit of the present invention comprises an insulating member with a pair of thin elongated metallic coatings formed on one of its surfaces in mutually spaced parallel relation and insulated one from the other. An elongated resilient metallic member is secured at at least one selected point to a surface of the insulating member and the metallic member has a free end which extends from the selected point across the surface of the insulating member. A semi-conductor crystal is interposed between the free end of the metallic member and the pair of metallic coatings, the crystal being in electrical contact with the conductive member and biased thereby into electrical contact with the pair of metallic coatings.

Figure 1 of the drawing shows an insulating disc 10 having a pair of thin elongated mutually spaced and parallel conductive coatings 11, 12 formed thereon. The elongated coatings 11 and 12 have respective portions 11a and 12a of enlarged area extending the elongated coatings to points 13 and 14 on the disc 10. Insulated disc 10 also has a pair of elongated spaced parallel coatings 15 and 16 disposed on either side of the coatings 11 and 12, and the coatings 15 and 16 function as pads to assure that the transistor crystal is precisely maintained in electrical contact with the elongated coatings 11 and 12.

In the embodiment of Figure 2, leads 17 and 18 are secured respectively to points 13 and 14 of disc 10 through appropriate metallic connecting eyelets 19 and 20. The leads are electrically connected by the eyelets to the portions 11a and 12a so as to establish electrical connection from the leads to the elongated metal coatings 11 and 12.

A resilient metallic strip 35 is supported on the same surface of disc 10 as the metallic coatings at a selected point 21 on the disc, and the strip has a free end extending across the surface of the disc from that selected point. A lead 22 is connected to metallic strip 35 through an appropriate metallic eyelet 23 extending through disc 10 at point 21.

A semi-conductive element 24 such as a germanium crystal is secured, by soldering or welding, to the extremity of the free end of metallic strip 35 and is resiliently held thereby against the surface of disc 10. Crystal 24 may be in the form of a rectangular block and has a pair of inclined faces 25, 26 defining a line of juncture 27 therebetween. The crystal is held by metallic strip 35 so that the line of juncture 27 extends across metallic coatings 11 and 12 and these coatings contact the crystal at two closely adjacent points precisely spaced along the line of juncture.

The extremity of metallic strip 35 functions as a base electrode for the transistor, and the metallic strip forms an electrical connection between the base electrode and

lead 22. Elongated coatings 11 and 12 respectively form the emitter and collector electrodes for the unit and electrical connection is established thereto from eyelets 19, 20 and leads 17, 18 by the respective portions 11a and 12a.

The elongated coatings 15 and 16 assure that crystal 24 is supported with the line of juncture 27 extending across and in electrical connection with both the coatings 11, 12. This precludes any possibility for the crystal to be supported in a tilted position with the connection to one or the other of coatings 15 and 16 being broken.

The conductive coatings 11, 12, 11a, 12a, 15 and 16 may be formed on the insulating disc 10 by any suitable printing or plating process. Due to the minute size of the disc, it is preferable that a photo-engraving process be used such as that disclosed and claimed in copending application, Serial No. 358,241, filed May 29, 1953, in the name of Gerald C. Rich, entitled "Semi-Conductor Unit," and assigned to the present assignee. As described in detail in that application, it is possible with such a process to form the elongated conductive coatings 11 and 12 with precise dimensions and spacing and to achieve this rapidly and on a mass production basis, thus eliminating any necessity for extreme manual skill in the final assembly of the unit.

The transistor of the present invention may be constructed in an extremely simple manner, it being merely necessary to affix the crystal 24 to the extremity of member 35 to secure member 35 to point 21 on disc 10 by eyelet 23 so that the extremity of member 35 supports crystal 24 across the prelocated elongated coatings 11 and 12 in the aforescribed manner. It can be seen that there are no critical dimensions or tolerances that must be adhered to in the final assembly of the unit.

Leads 17, 18 and 22 are preferably bent over in the illustrated manner so that the completed unit is formed into a compact and neat package. The resiliency of strip 35 is such that the crystal 24 is firmly held with its line of juncture 27 traversing the coatings 11 and 12 so that the unit exhibits rugged mechanical and electrical characteristics.

The following dimensions are given merely by way of example and are not intended to limit the invention in any way:

	Inches
Diameter of disc 10.....	.250
Thickness of disc 10.....	.065
Width of coatings 11, 12.....	.0005
Separation of coatings 11, 12.....	.001
Length of metallic coatings 11, 12.....	.100

In the modification of Figures 4 and 5, the insulating disc 10 is provided with a flat edge 10a and the elongated coatings 11 and 12 extend to this edge. In this embodiment, metallic strip 35 is secured to the opposite surface of disc 10 from coatings 11, 12; the strip being supported on that surface at a pair of points 28 and 29 by suitable eyelets 30 and 31. Strip 35, in the latter embodiment, has a pair of longitudinal slots 32 and 33 through which the respective eyelets 30 and 31 extend. The extremity of the free end of strip 35 in the latter embodiment is looped around the flat edge 10a of disc 10 and supports crystal 24 in an inclined position across that edge so that a flat surface of the crystal is in point contact with the extremities of the elongated coatings 11 and 12. The provision of slots 32, 33 allows strip 35 to be moved longitudinally until a desired contact pressure is established between the crystal and the ends of coatings 11, 12.

In the latter embodiment, the coatings 11 and 12 establish a point contact connection to two precisely spaced points on the surface of crystal 24 and, as before, these coatings function as the emitter and collector electrodes respectively for the crystal. The extremity of strip 35 in the latter embodiment also forms the base electrode for

the crystal and electrical connection is made to the base electrode from lead 22 through the strip.

The invention provides, therefore, a transistor unit that is compact and rugged mechanically and which exhibits the desired electrical characteristics to function efficiently as a commercial transistor. The unit of the present invention may be constructed simply and with a minimum of manual skill since all the critical tolerances are established by mechanical means prior to the final assembly of the unit.

While particular embodiments of the invention have 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 transistor unit including in combination, an insulating member having a flat surface, at least one electrically conductive coating formed on said flat surface of said insulating member, an elongated resilient electrically conductive member secured at at least one selected point to said flat surface of said insulating member and having a free end extending from said selected point across at least a portion of said flat surface and essentially parallel thereto, and a semi-conductive crystal supported by said free end of said conductive member and interposed between said free end of said conductive member and said electrically conductive coating, said crystal being in electrical contact with said conductive member and biased thereby into electrical contact with said electrically conductive coating.

2. A transistor unit including in combination, an insulating member having a flat surface, a pair of thin elongated metallic coatings formed on said flat surface of said insulating member in mutually spaced parallel relation and insulated one from the other, an elongated resilient electrically conductive member secured at at least one selected point to said flat surface of said insulating member and having a free end extending from said selected point across such surface of said insulating member essentially parallel thereto, and a semi-conductive crystal supported by said free end of said conductive member and interposed between said free end of said conductive member and said pair of metallic coatings, said crystal being in electrical contact with said conductive member and biased thereby into electrical contact with said pair of metallic coatings.

3. A transistor unit including in combination, an insulating member having at least one flat surface, a pair of thin elongated metallic coatings formed on said flat surface of said insulating member in mutually spaced parallel relation and insulated one from the other, an elongated resilient electrically conductive member secured at at least one selected point to said flat surface and having a free end extending from said selected point across said surface essentially parallel thereto and biased toward the plane of said surface, and a semi-conductive crystal supported by said free end of said conductive member and interposed between said free end of said conductive member and said pair of metallic coatings, said crystal being in electrical contact with said conductive member and biased thereby into electrical contact with said pair of metallic coatings.

4. A transistor unit including in combination, a flat disc-like insulating member having a pair of opposite flat surfaces, a pair of thin elongated metallic coatings formed on one of said flat surfaces of said insulating member in mutually spaced parallel relation and insulated one from the other, a pair of terminals extending through said insulating member and connected respectively to said metallic coatings, an elongated resilient electrically conductive member secured at at least one selected point to said one of said flat surfaces and having a free end extending from said selected point across such surface along

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an axis intermediate and parallel to said pair of metallic coatings and essentially parallel to the plane of such surface, a semi-conductive crystal supported by said free end of said conductive member and interposed between said free end of said conductive member and said pair of metallic coatings, said crystal being affixed to said free end in electrical contact therewith and being biased by said free end into electrical contact with said pair of metallic coatings, and a further terminal extending through said insulating member and electrically connected to said electrically conductive member.

5. A transistor unit including in combination, a flat disc-like insulating member, a pair of thin elongated metallic coatings formed on a surface of said insulating member in mutually spaced parallel relation and insulated one from the other, a pair of terminals extending through said insulating member and connected respectively to said metallic coatings, an elongated resilient metallic member secured at a selected point to said surface of said insulating member and having a free end extending from said selected point across said surface along an axis intermediate and parallel to said pair of metallic coatings and essentially parallel to the plane of said surface, a semi-conductive crystal supported by said free end of said conductive member and interposed between said free end of said conductive member and said pair of metallic coatings, said crystal being affixed to said free end in electrical contact therewith and having a pair of inclined faces forming a line of juncture therebetween, and said crystal being biased by said free end into electrical contact with said pair of metallic coatings with said line of juncture traversing said metallic coatings, and a further terminal extending through said insulating member and electrically connected to said metallic member.

6. A transistor unit including in combination, a flat disc-like insulating member having a pair of opposite flat surfaces, a pair of thin elongated metallic coatings formed on one of said flat surfaces of said insulating member in mutually spaced parallel relation and insulated one from the other, said coatings extending along said surface to an edge of said insulating member, a pair of terminals extending through said insulating member and connected respectively to said metallic coatings, an elongated resilient metallic member secured at a selected point to the other of said flat surfaces of said insulating member and having a free end extending from said selected point across such surface along an axis intermediate and parallel to said pair of metallic coatings, said

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free end extending to the aforesaid edge of said insulating member and having a bent-over extremity extending around said edge, a semi-conductive crystal interposed between said extremity and said pair of metallic coatings, said crystal being affixed to said free end in electrical contact therewith and biased by said extremity in an inclined position against said edge of said insulating member in contact with said metallic coatings, and a further terminal extending through said insulating member and electrically connected to said metallic member.

7. A transistor unit including in combination, a flat disc-like insulating member having a pair of opposite flat surfaces, a pair of thin elongated metallic coatings formed on one of said flat surfaces of said insulating member in mutually spaced parallel relation and insulated one from the other, said coatings extending along said surface to an edge of said insulating member, a pair of terminals extending through said insulating member and connected respectively to said metallic coatings, an elongated resilient metallic member having a pair of longitudinal slots formed therein at spaced positions therealong, a pair of terminals extending through said insulating member and through respective ones of said slots for securing said metallic member to the other of said flat surfaces of said insulating member, said metallic member having a free end extending across said last mentioned flat surface of said insulating member intermediate and parallel to said pair of metallic coatings, said free end extending to the aforesaid edge of said insulating member and having a bent-over extremity extending around said edge, a semi-conductive crystal interposed between said extremity and said pair of metallic coatings, and said crystal being affixed to said free end in electrical contact therewith and biased by said extremity in an inclined position against said edge of said insulating member in contact with said metallic coatings.

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