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M. CONRAD

2,718,616

SEMI-CONDUCTIVE DEVICE

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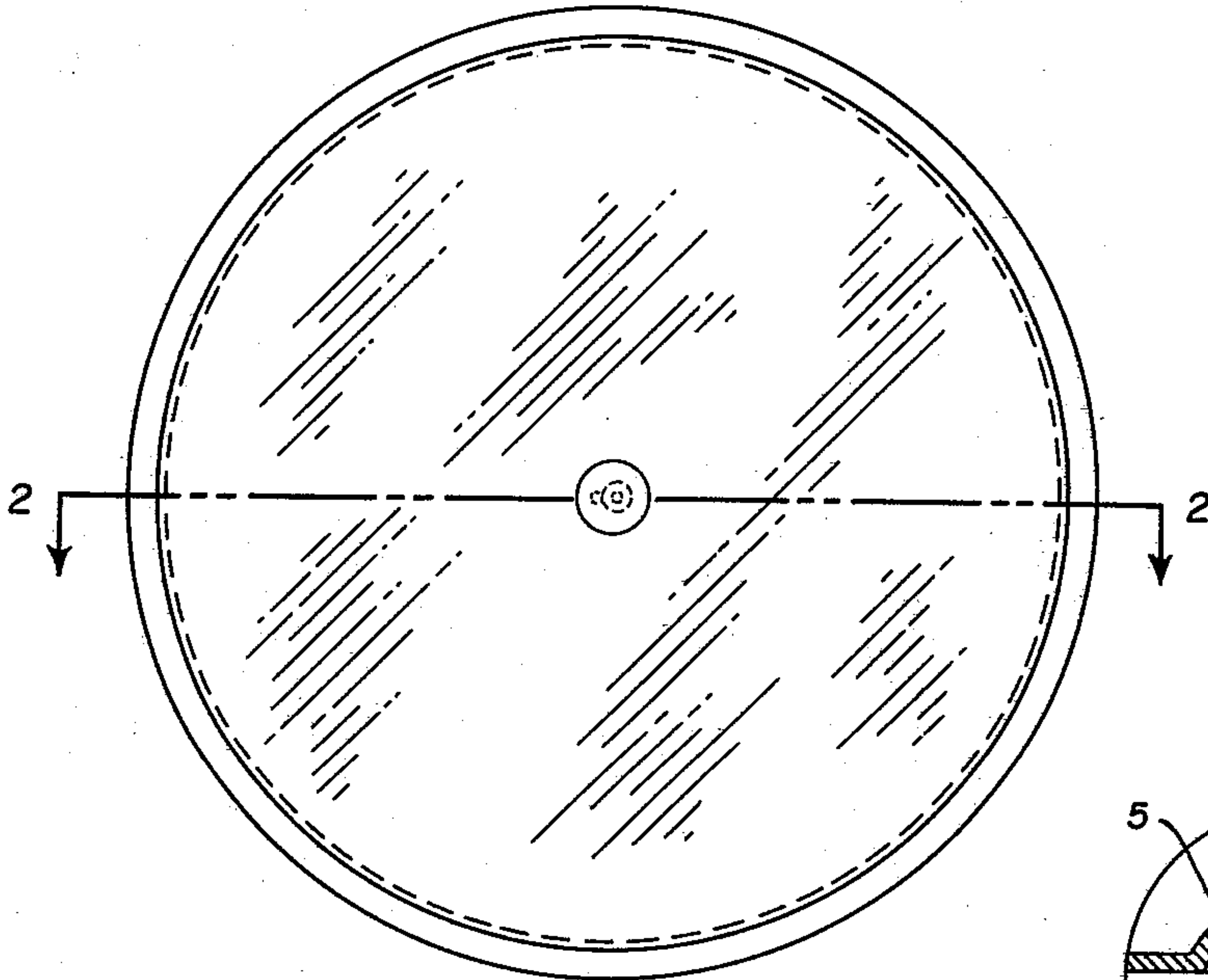


FIG. 1

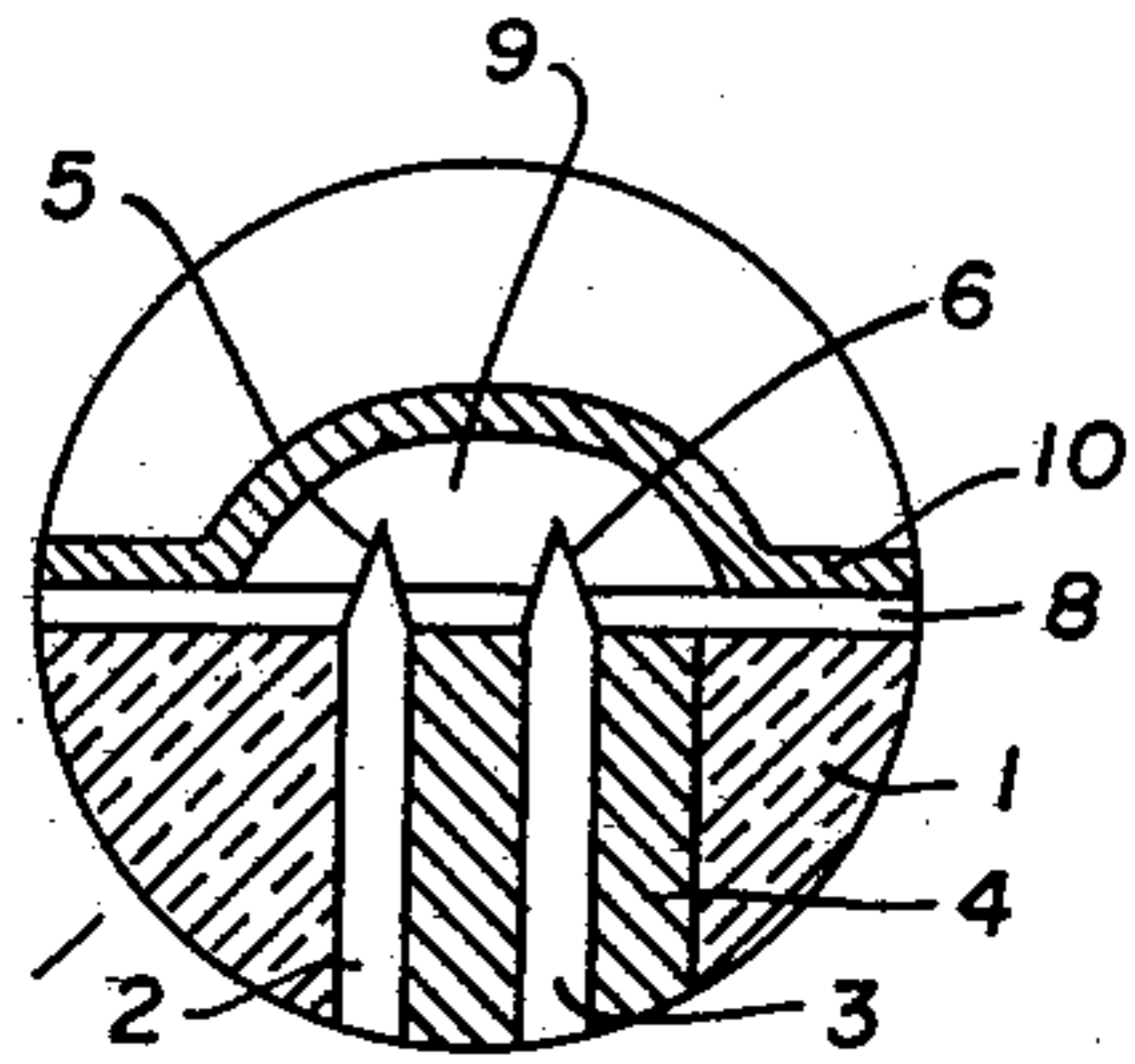


FIG. 3

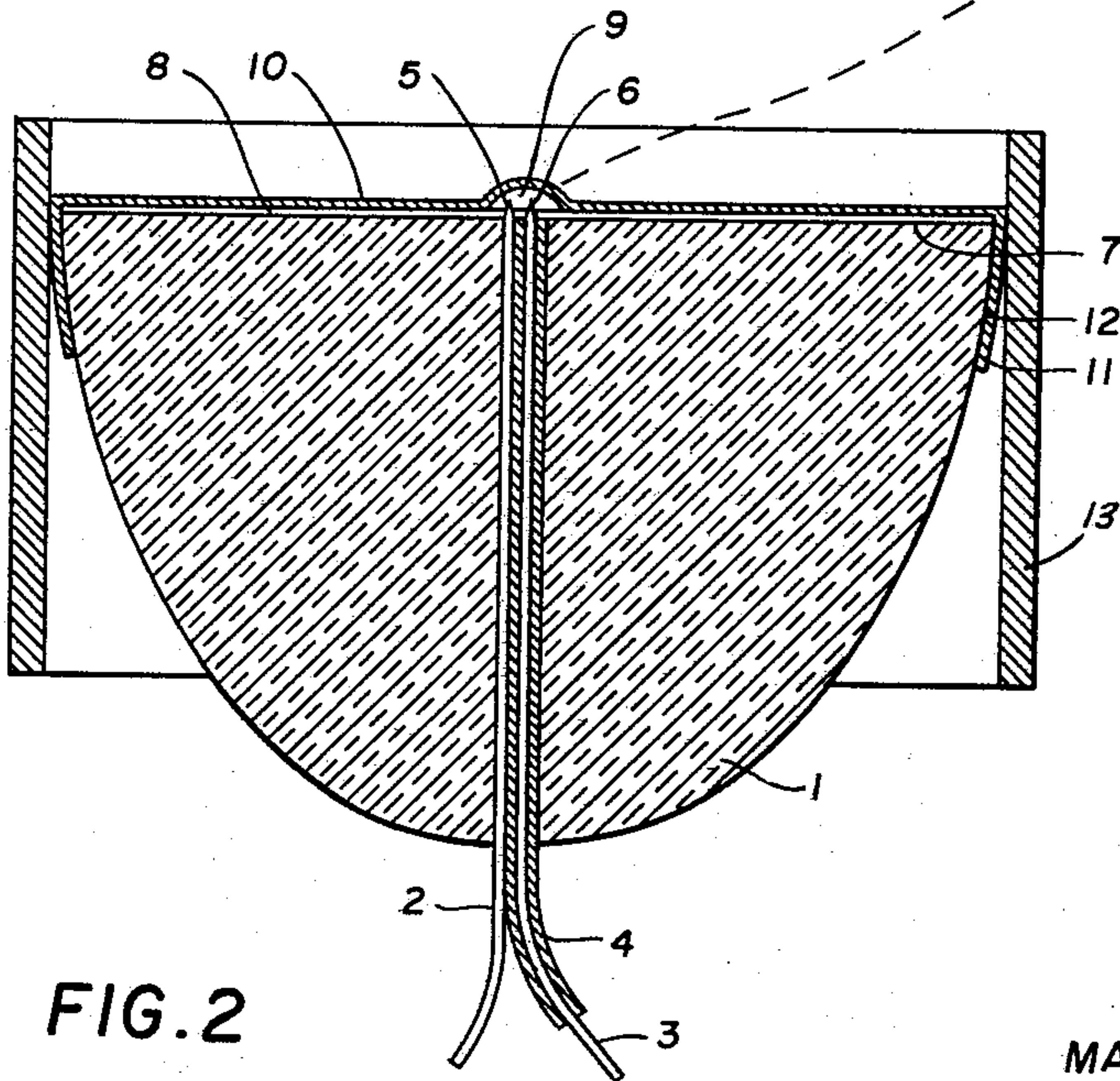


FIG. 2

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SEMI-CONDUCTIVE DEVICE

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4 Claims. (Cl. 317-235)

My invention relates to semi-conductive devices, and more particularly to semi-conductive devices of the point-contact type.

Point-contact semi-conductive devices known before my invention have in general been fragile and expensive to make by reason of the costly jigs and fixtures required for their assembly. Furthermore, devices of this type have been expensive to manufacture because it has been necessary to saw minute wafers from crystallized blocks of semi-conductive material. The resulting wafer is difficult to handle, and the sawing process results in an appreciable waste of semi-conductive material which is washed away in the coolant.

It is accordingly an object of my invention to provide a relatively inexpensive point-contact semi-conductive device.

It is another object of my invention to provide a semi-conductive device in which the amount of semi-conductive material is reduced, wastage is virtually eliminated and the composition of the semi-conductive material can be more easily controlled.

It is another object of my invention to provide a semi-conductive device of the point-contact type in which the semi-conductive material is applied to the points instead of the points being pressed onto the semi-conductive material, as has conventionally been done heretofore.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawing in which:

Fig. 1 is a top view of a preferred embodiment of my invention;

Fig. 2 is a section along line 2-2 of the embodiment of the Fig. 1; and

Fig. 3 is an enlarged portion of the view shown in Fig. 2.

As shown in the accompanying drawing, a preferred embodiment of my invention comprises a bead 1 of insulating material, such as glass, in which are embedded conductive elements, or wires, 2 and 3. These conductors are preferably made of platinum, and are insulated from each other by a tube 4 of insulating material having suitable characteristics. Wires 2 and 3 have accessible ends 5 and 6, respectively, which project through a surface 7 of bead 1. Ends 5 and 6 are preferably pointed, and surface 7 preferably has a substantially plane portion, at least in the vicinity of ends 5 and 6. However, this is not a necessary requirement for the practice of my invention. The arrangement so far described forms the basis of copending application Serial Number 323,087 of Carl F. Miller, filed November 28, 1952, the invention being assigned to the assignee of the present application.

Atop surface 7 of bead 1 is a layer 8 of semi-conductive material. This layer may be only 0.0001 to 0.0005 of an inch in thickness, while the ends 5 and 6 may be

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spaced apart by 0.002 inch. The semi-conductive material may be, for example, a thin layer of germanium.

In the area of the semi-conductive layer over and about ends 5 and 6, there is an adherent electrical insulating means 9 which may be made, for example of polymethyl methacrylate. A layer 10 of conductive material, such as gold, extends over the remaining exposed portion of semi-conductive layer 8, and may also extend over insulating means 9 as shown, depending upon the manner of applying conductive layer 10. Conductive layer 10 has a portion 11 which extends down the side 12 of bead 1. Portion 11 extends peripherally around bead 1, and thus enables a tubular contact member 13 to establish contact with conductive layer 10. Connection may be made in turn to contact member 13 by any convenient means. The latter will readily occur to those skilled in the art.

In making the above-described semi-conductive device, bead 1, together with wires 2 and 3 and insulating tube 4, may be prepared as described in the above-identified application of Miller. Next, semi-conductive layer 8 is applied to surface 7 of bead 1, preferably by evaporation of germanium in a vacuum.

Next, insulating means 9 is applied. This may be done by dissolving polymethyl methacrylate in ethylene dichloride (a mixture referred to in the trade as Lucite cement) and applying a drop of the mixture to the exposed surface of the evaporated germanium layer in the area over and about ends 5 and 6. The assembly may then be set aside until the drop has dried through evaporation of the ethylene dichloride, which is a volatile solvent for polymethyl methacrylate. It is to be understood that other materials, or other combinations of insulating materials and solvents, may be employed for insulating means 9 without departing from the scope of my invention.

After insulating means 9 has dried or has otherwise stabilized, layer 10 of conductive material may be applied. I prefer to apply this layer by vacuum evaporation of gold onto the remaining exposed surface of the bead. Portion 11 is also deposited directly on bead surface 12, in the case of the illustrated embodiment of my invention, but this last portion may be omitted if another means for making contact with this conductive layer is employed which directly contacts the upper surface of layer 10. Instead of vacuum evaporation of the gold layer, I may prefer to use instead the process known as carbonyl gas-plating.

In making the embodiment of my invention here shown, the final step is to place bead 1 in contact with tubular member 13. This is preferably done by means of a force fit.

While I have shown and described my invention as applied to a specific embodiment thereof, other modifications will readily occur to those skilled in the art. I do not, therefore, desire my invention to be limited to the specific arrangement shown and described, and I intend in the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim is:

1. In a semi-conductor device, the combination of a plurality of conductive elements, each of said elements having an accessible end; means providing an insulating surface; means for insulatingly supporting said elements relative to each other such that said accessible ends project through said insulating surface; semi-conductive means extending over said surface and into contact with at least a portion of said ends; means for insulating the surface of said semi-conductive means in the area over and about said ends; and means for establishing an electrical contact with the exposed portion of said semi-

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conductive means independently of said conductive elements.

2. In a semi-conductor device, the combination of a plurality of conductive elements, each of said elements having an accessible end; means providing an insulating surface; means for insulatingly supporting said elements relative to each other such that said accessible ends project through said insulating surface; semi-conductive means extending over said surface and into contact with at least a portion of said ends; means for insulating the surface of said semi-conductive means in the area over and about said ends, said last-named means being sufficiently thick to cover said ends; and means for establishing electrical contact with the remaining exposed portion of said semi-conductive means independently of said conductive elements.

3. In a semi-conductor device, the combination of a plurality of conductive elements, each of said elements having an accessible end; means providing an insulating plane; means for insulatingly supporting said elements relative to each other such that said ends project substantially equally through said plane; semi-conductive means extending over said plane and into contact with at least a portion of said ends; means for insulating the surface of said semi-conductive means in the area over and about said ends, said last-named means being sufficiently thick to cover said ends; and means for estab-

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lishing electrical contact with the remaining exposed portion of said semi-conductive means independently of said conductive elements.

4. In a semi-conductive device, the combination of a mass of insulating material having at least one substantially plane surface; a plurality of conductors embedded in said mass of insulating material, each said conductor having one substantially pointed end and being insulated from the remaining said plurality of conductors, said pointed ends being positioned to project beyond said plane surface; a layer of semi-conductive material extending over said plane surface and into contact with at least a portion of said ends; means for electrically insulating the exposed surface of said semi-conductive material in the area thereof lying over and about said pointed ends; electrically conductive means extending over the combined surfaces presented by said electrical insulating means and the uncovered portion of said semi-conductive material; and means for making contact to said electrically conductive means independently of said conductors.

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