

May 3, 1955

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2,707,319

SEMI-CONDUCTING DEVICE

Filed Dec. 31, 1952

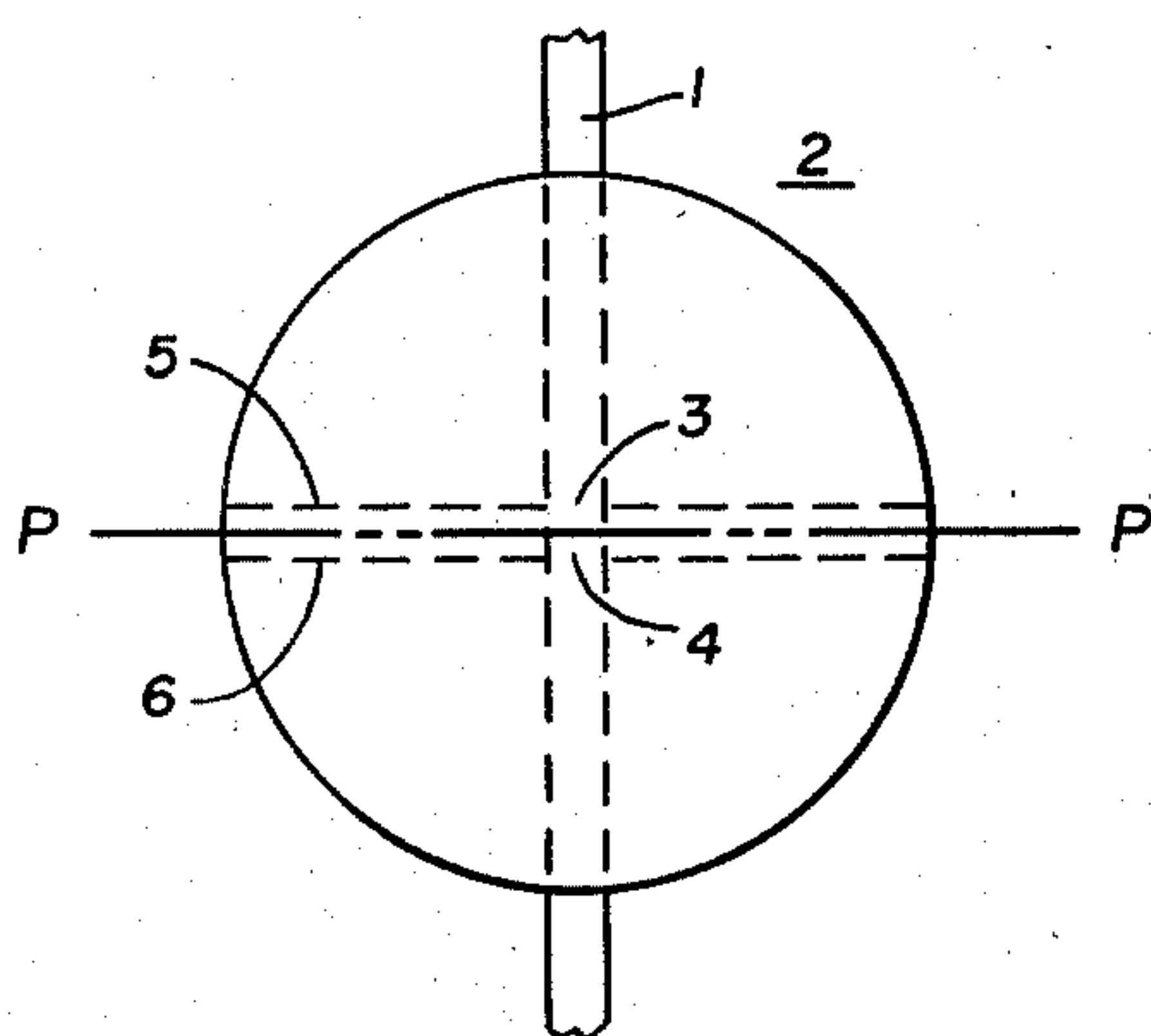


FIG. 1

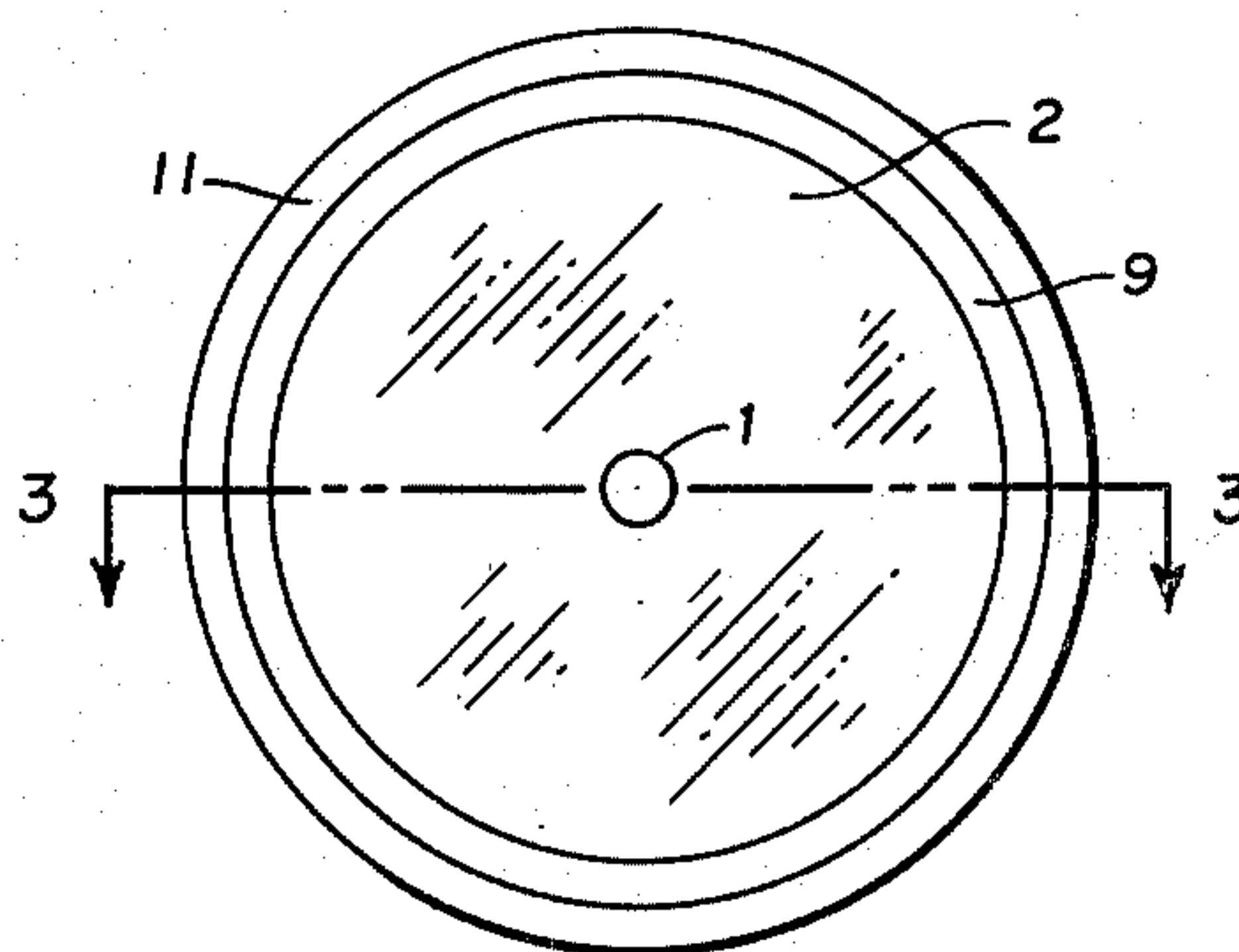


FIG. 2

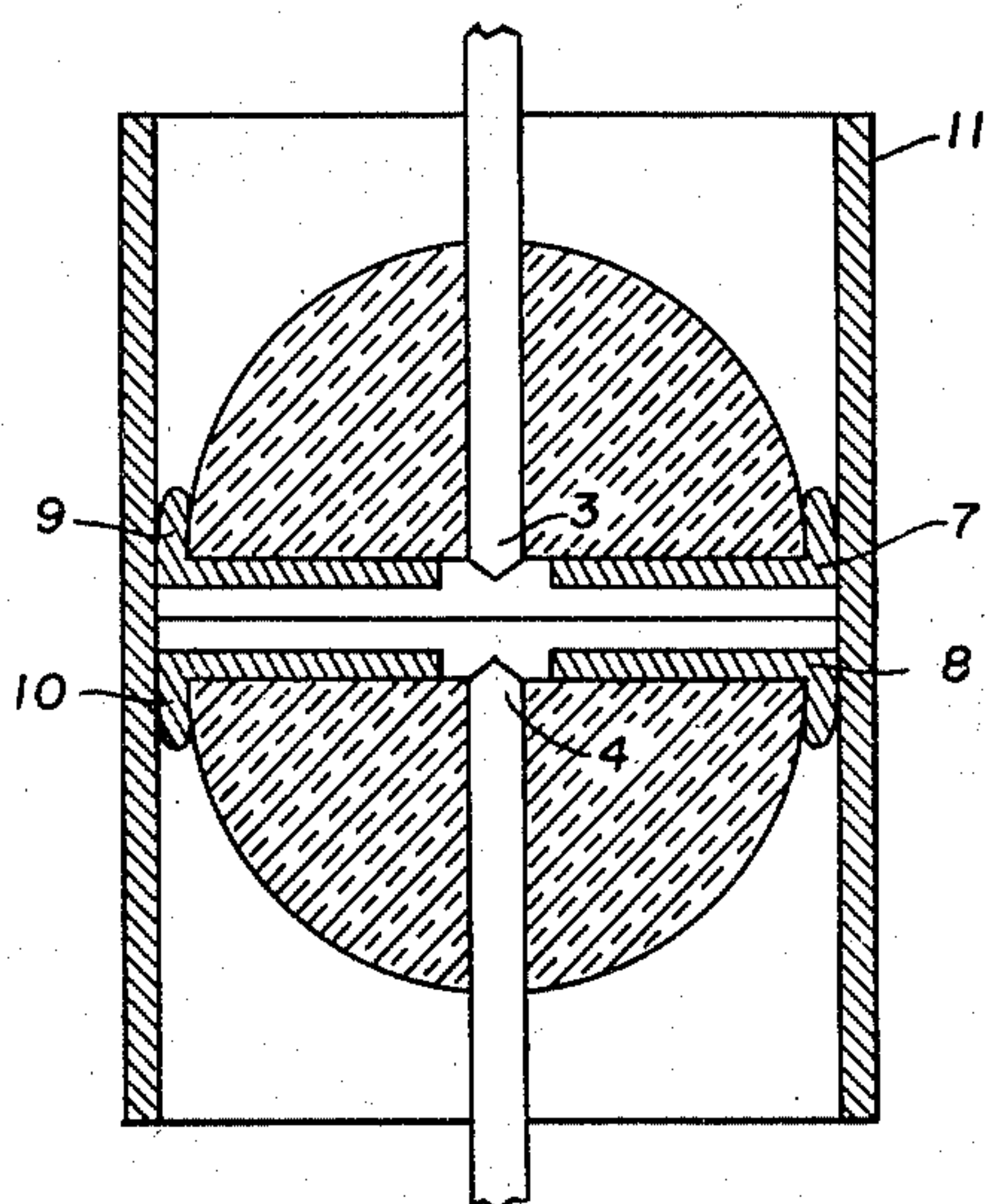


FIG. 3

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Application December 31, 1952, Serial No. 329,025

4 Claims. (Cl. 29—25.3)

My invention relates to a method of making semi-conducting devices of the point-contact type, and more particularly to point-contact semi-conductive devices of the coaxial class.

Coaxial semi-conducting devices known heretofore have been made by cutting a thin wafer of semi-conductive material, placing it in a tube, and bringing a point contact, or cat whisker, into contact with each side of the semi-conducting wafer. This method has been costly because considerable semi-conductive material has been lost in the cutting process, and expensive jigs and fixtures are required to set the points in the proper place. In addition, the wafer method of construction produces variations from unit to unit because of difficulty in holding dimensions and because of the difficulty in controlling the exact composition of the semi-conductive material.

It is therefore an object of my invention to provide a method of making semi-conductive devices which is relatively inexpensive, due to savings in material costs and improved accuracy in contact setting.

It is another object of my invention to provide a semi-conductive device having more uniform characteristics which may be controlled through closer control of dimensions, particularly thickness, and through control of the composition of the semi-conductive material.

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 useful in explaining a step in the method I have invented;

Fig. 2 is a top view of a semi-conductive device produced by the preferred version of the method I have invented; and

Fig. 3 is a section, taken along line 3—3, of the semi-conductive device shown in Fig. 2.

In practicing my invention, I prefer to embed an elongated conductor, such as a wire 1, in a mass, or bead, of insulating material 2. The latter is preferably composed of a refractory material, such as glass. Furthermore, I prefer that wire 1 be made of platinum.

The next step in my invention is to cleave the assembly formed by wire 1 and bead 2 into two portions along a plane perpendicular to the longitudinal direction of wire 1. I have indicated this plane in Fig. 1 by symbols P—P.

Next I cause the cleaved surface of each portion of bead 2 to be depressed below the respective cleaved ends of wire 1. I prefer to do this by selectively etching away the cleaved surface of bead 2 without affecting wire 1. As a result, wire ends 3 and 4 project beyond the etched surfaces which are indicated by dashed lines 5 and 6, respectively.

I prefer that ends 3 and 4 now be given a substantial degree of pointedness, preferably by selectively etching

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them with an etchant which does not attack the material of bead 2.

After each portion has been prepared, a conductive film, such as gold, may be applied to each etched surface of the insulating material. This conductive film may be, for example, gold, and is applied according to my invention in insulated relationship with the projecting ends 3 and 4. The conductive films are indicated in Fig. 3 by reference numerals 7 and 8. I prefer that these films be applied by vacuum evaporation, although those skilled in the art can readily understand that other methods may be used. I prefer that layers 7 and 8 have portions 9 and 10 extending around at least a portion of the outer periphery of the bead material as shown in Fig. 3.

To prevent the conducting film from being deposited on ends 3 or 4 of the conductor, I may prefer that a drop of insulating material be placed over the end before the vacuum evaporation or similar process is accomplished. After application of the conductive film, the insulating material may be removed. For example, the insulating material may be polymethyl methacrylate dissolved in ethylene dichloride. After deposition, the metal deposited on the polymethyl methacrylate may be sufficiently removed to allow the application of ethylene dichloride, which then dissolves the remaining material and so exposes the end of the conductor.

Next a film of semi-conductive material is deposited over the resulting exposed surface of the conductive film and of the conductor end in the case of each portion. I prefer that the semi-conductive material be germanium, and that it be deposited by vacuum evaporation, carbonyl gas-plating, or an equivalent suitable process. I have found that a layer of germanium from 0.0001 to 0.0005 inch in thickness may be so produced. It is to be noted that the deposition processes mentioned enable the purity of the semi-conductive film to be controlled much more readily than is the case with germanium crystallization processes employed heretofore. The slight impurities in the germanium necessary for proper semi-conductor device operation tend to be non-homogeneously located in the latter case, whereas in the film-deposition step contemplated by my invention, the percentage of these impurities present may be readily controlled along with the amount of germanium.

When both portions of the original assembly have been coated with conductive and then semi-conductive films, they are ready for assembly. I prefer that this assembly be accomplished by pressing both portions into a conductive tube 11. It will be noted that conductive tube 11, which may be of brass, provides means for securing both portions in a position where the semi-conductive films of both portions are in intimate contact with each other, while simultaneously making contact with conductive films 7 and 8 at circumferential bands 9 and 10. Those skilled in the art can readily appreciate that any conventional means for making contact to the conductors having ends 3 and 4 and to tube 11 may be employed.

While I have shown and described my invention as applied to a specific version 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 method illustrated 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. The method of producing a semi-conductor device which comprises the steps of embedding a longitudinal conductor in a mass of insulating material to form an assembly; cleaving said assembly into two portions along a plane perpendicular to the longitudinal direction of

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said conductor; selectively etching the cleaved surface of each said portion without affecting the conductor therein, whereby a conductor end is left projecting from each said cleaved surface; depositing a film of conductive material over each said cleaved surface in insulated relationship with the conductor end projecting therefrom; depositing, in the case of each said portion, a continuous film of semi-conductive material over the resulting exposed surface of said conductive film and said conductor end; bringing the exposed surface of said semi-conductive film and said conductor end; bringing the exposed surface of said semi-conductive film of each said portion into intimate contact with that of the other said portion; and securing said portion in the position so established.

2. The method of producing a semi-conductor device which comprises the steps of embedding a longitudinal conductor in a mass of insulating material to form an assembly; cleaving said assembly into two portions along a plane perpendicular to the longitudinal direction of said conductor; selectively etching the cleaved surface of each said portion without affecting the conductor therein, whereby a conductor end is left projecting from each said cleaved surface; selectively etching each said projecting end to substantial pointedness; depositing a film of conductive material over each said cleaved surface in insulated relationship with the conductor end projecting therefrom; depositing, in the case of each said portion, a continuous film of semi-conductive material over the resulting exposed surface of said conductive film and said conductor end; bringing the exposed surface of said semi-conductive film of each said portion into intimate contact with that of the other said portion; and securing said portion in the position so established.

3. The method of producing a semi-conductor device which comprises the steps of embedding a longitudinal conductor in a mass of insulating material to form an assembly; cleaving said assembly into two portions along a plane perpendicular to the longitudinal direction of said conductor; selectively etching the cleaved surface of

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each said portion without affecting the conductor therein, whereby a conductor end is left projecting from each said cleaved surface; depositing a film of conductive material over each said cleaved surface in insulated relationship with the conductor end projecting therefrom; depositing, in the case of each said portion, a continuous film of semi-conductive material over the resulting exposed surface of said conductive film and said conductor end; bringing the exposed surface of said semi-conductive film of each said portion into intimate contact with that of the other said portion; and securing said portions in the position so established while simultaneously making contact with at least one of said conductive films.

4. The method of producing a semi-conductor device which comprises the steps of embedding a longitudinal conductor in a mass of insulating material to form an assembly; cleaving said assembly into two portions along a plane perpendicular to the longitudinal direction of said conductor; selectively etching the cleaved surface of each said portion without affecting the conductor therein, whereby a conductor end is left projecting from each said cleaved surface; selectively etching each said projecting end to substantial pointedness; depositing a film of conductive material over each said cleaved surface in insulated relationship with the conductor end projecting therefrom; depositing, in the case of each said portion, a continuous film of semi-conductive material over the resulting exposed surface of said conductive film and said conductor end; bringing the exposed surface of said semi-conductive film of each said portion into intimate contact with that of the other said portion; and securing said portions in the position so established while simultaneously making contact with at least one of said conductive films.

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