metal disk 21 is positioned beneath the base of the tablet 19 in the cup 18, and is preferably adhesively bonded into the cup. The metal disk is tightly fitted to the base of the tablet so that good electrical contact is obtained over a substantial area of the semiconductor. An ear 22 on one edge of the disk is soldered to a lead wire 23 which extends through a short insulating sleeve 24 in a hole in the side of the metal envelope. The insulating sleeve 24 assures spacing of the lead wire 23 from the tube 16 and prevents accidental damage to the insulation on the lead wire which could lead to shorting to the metal case. Preferably, the insulating sleeve 24 is sealed with a small amount of plastic cement or the like in order to maintain clean air within the cylindrical envelope. Two other openings for leads through the tube 16, as hereinafter set forth, are also preferably sealed for maintaining cleanliness within the envelope.

A pair of circular metal disks 26 are fitted within the tube 16 and preferably cemented in place to prevent shifting. The two disks 26 are equally spaced from the opposite ends of the envelope and are spaced apart a little over 1.15 inch. Each of the disks 26 includes a central aperture 27, and there are a plurality of holes 28 extending through the disk in a circular array midway between the center of the disk and its periphery. The holes 28 are preferably in the size range of about 0.010 to 0.060 inch, and there are 12 on each disk on 30° centers around the circle. The two disks 26 thus divide the interior of the cylindrical envelope into three chambers, and the pattern of holes 28 provides communication between the chambers and affects the electrical properties of the cavity. It is believed that the pattern of holes affects the inductive coupling between the several cavities within the envelope for influencing oscillations therein. Although an arrangement of 12 holes on 30° centers has been found particularly advantageous in the illustrated embodiment, it is found in other arrangements that a pattern of 20 holes on 18° centers or a pattern of 8 holes on 45° centers, provides optimum operation. In either case, the circle of holes 28 is midway between the center and the periphery of the disk.

Mounted between the disk 26 is a plastic spool 29 having an inside distance of 1.1 inch between the ends. The plastic spool 29 is preferably relatively thin walled and has an internal bore diameter of ⅛ inch. A plastic mounting plug 31 is inserted through the central aperture 27 of one of the disks 26 remote from the semiconductor table 19, and into the bore of the spool 29. The plastic plug 31 is preferably cemented in place to the disk 26 for holding the assembly together.

Also mounted within the bore of the spool 29 is a cylindrical ferrite core 32 about ⅛ inch diameter and ¾ inch long. Although a core of any magnetic ferrite is preferred, other ferromagnetic materials having similar properties can be employed if desired. The core 32 is in electrical contact with a metal probe 33 about ¼ inch long. Half of the length of the probe 33 is in the form of a cylinder positioned within the spool 29, and the other half is in the form of a cone ending in a point 34 in contact with the domed surface of the semiconductor tablet 19. thereby making electrical contact with the semiconductor in a relatively small point.

Electrical contact is also made with the probe 33 by a lead 36 that passes through one of the holes 28 in the disk 26 nearer the semiconductor tablet and thence to a primary coil 37 wound on the plastic spool 29. The primary coil 37 is in the form of 800 to 1,000 turns wound along the length of the spool, and the lead 28 at the opposite end of the coil 37 is soldered to one of the external leads 39 of the power pack. This lead 39 proceeds through one of the holes 28 in the disk remote from the semiconductor tablet 19 and through an insulated sleeve 41 in the metal tube 16. The lead 39 is also connected to one end of a secondary coil 42 which is in the form of eight to ten turns around the center portion of the primary coil 37. A thin insulating sheet 43 is preferably provided between the primary and secondary coils. The other lead 44 from the secondary coil passes through one of the holes 28 in the disk nearer the semiconductor tablet and thence through an insulating sleeve 46 through the wall of the tube 16.

FIG. 3 illustrates schematically the electrical circuit employing an electric power pack constructed according to the principles of this invention. At the left-hand side of FIG. 3 the arrangement of elements is illustrated in a combination of electrical schematic and mechanical position within the tube 16 for ready correlation with the embodiment illustrated in FIG. 2. Thus, the semiconductor tablet 19, probe 33, and ferrite core 32 are shown in both their mechanical and electrical arrangement, the core being inductively coupled to the coils 37 and 42. The lead 23 from the metal base of the semiconductor tablet 19 is connected to a variable capacitor 47, the other side of which is connected to the lead 44 from the secondary coil 42. The lead 44 is also connected to a rectifying diode 48 shunted by a high resistance resistor 49.

It will be seen that the variable capacitor 47 is in a tank circuit with the inductive coils 37 and 42 which are coupled by the ferrite core 32, and this circuit also includes the semiconductor tablet 19 to which point contact is made by the probe 33. The mechanical and electrical arrangement of these elements provides a resonant cavity in which resonance occurs when the capacitor 47 is properly trimmed. The diode 48 rectifies the oscillations in this circuit to provide a suitable DC for operating an incandescent lamp 50 or similar load.

The rectifying diode 48 is connected to a complementary symmetry relaxation cricuit for switching power to the load 50. The diode is connected directly to the collector of a PNP transistor 51 which is in an inverted connection. The emitter of the PNP transistor is connected to one side of the load 50 by way of a timing resistor 55. The base of the transistor 51 is connected by way of a resistor 52 and a capacitor 56 to the collector of an NPN transistor 53, the emitter of which is connected to the other side of the load 50. The base of the NPN transistor 53 is coupled to the diode by a resistor 54. The emitter of the PNP transistor 51 is fed back to the base of the NPN transistor 53 by the resistor 55. Current flow through the lamp 50 is also limited by a resistor 57 which couples one side thereof and the emitter of the NPN transistor 53 to the two coils 37 and 42 by way of the common lead 39.

The electrical power pack is believed to operate due to a resonance amplification once an oscillation has been initiated in the cavity, particularly the central cavity between the disks 26. This oscillation, which apparently rapidly reaches amplitudes sufficient for useful power, is then half wave rectified by the diode 48 for use. With such an arrangement, a voltage level of several volts has been obtained, and power sufficient for intermittent operation of a lamp requiring about 170–250 milliwatt has been demonstrated. The resonant amplification is apparently due to the geometrical and electrical combination of the elements, which provide inductive coupling of components in a suitable resonant circuit. This amplification is also, at least in part, due to unique semiconductor properties in the tablet 19, which has electronic properties due to a composition giving a unique atomic arrangement, the exact nature of which has not been measured.

The semiconductor tablet has electronic properties which are determined by the composition and three such semiconductors satisfactory for use in the combination have been identified. In two of these, the base semiconductor material is selenium provided with suitable dopant elements, and in the third, the base element is germanium, also suitably doped. The semiconductor tablets are made by melting and casting in an arrangement that gives a large crystal structure. It has not been found necessary