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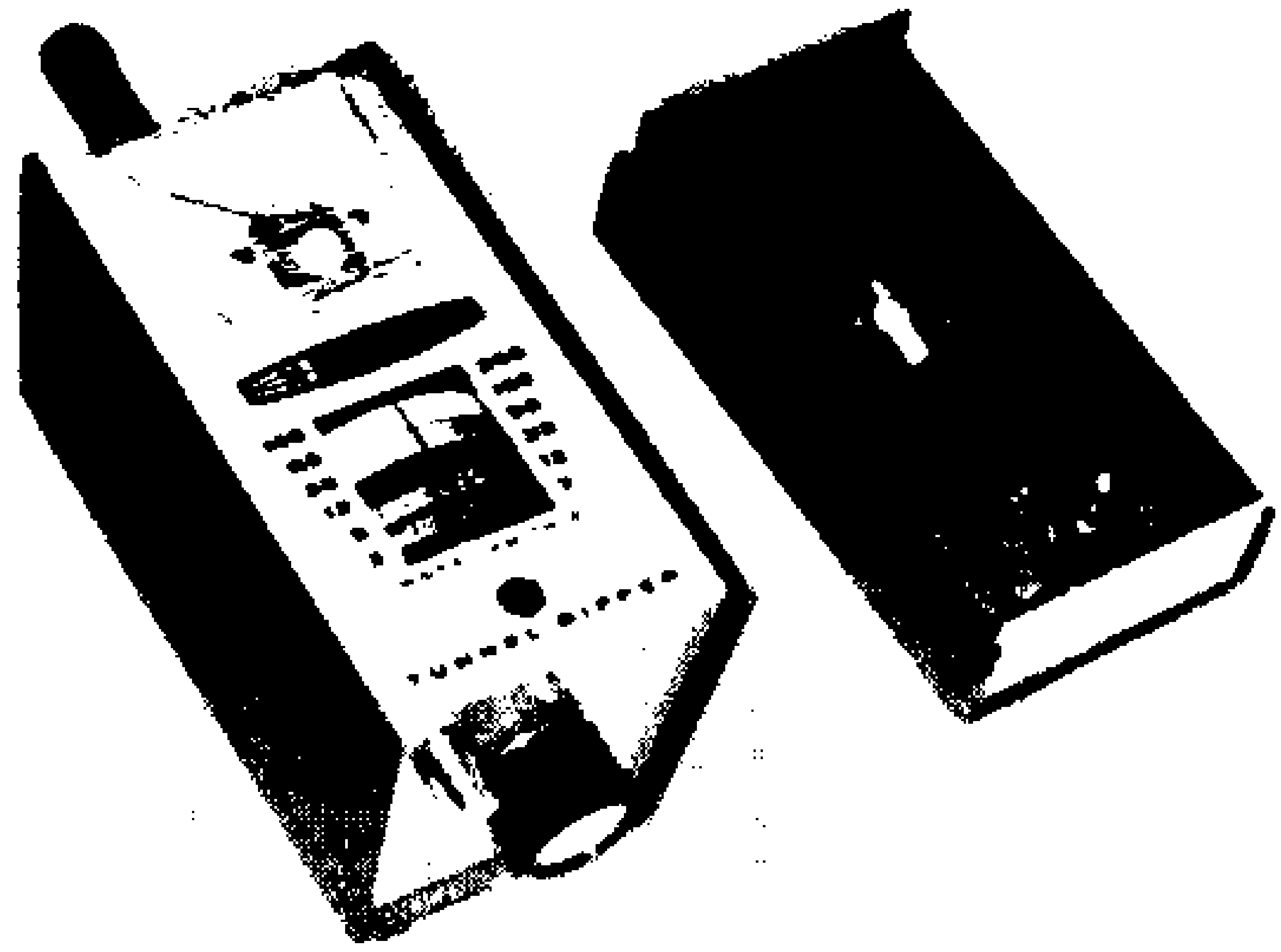
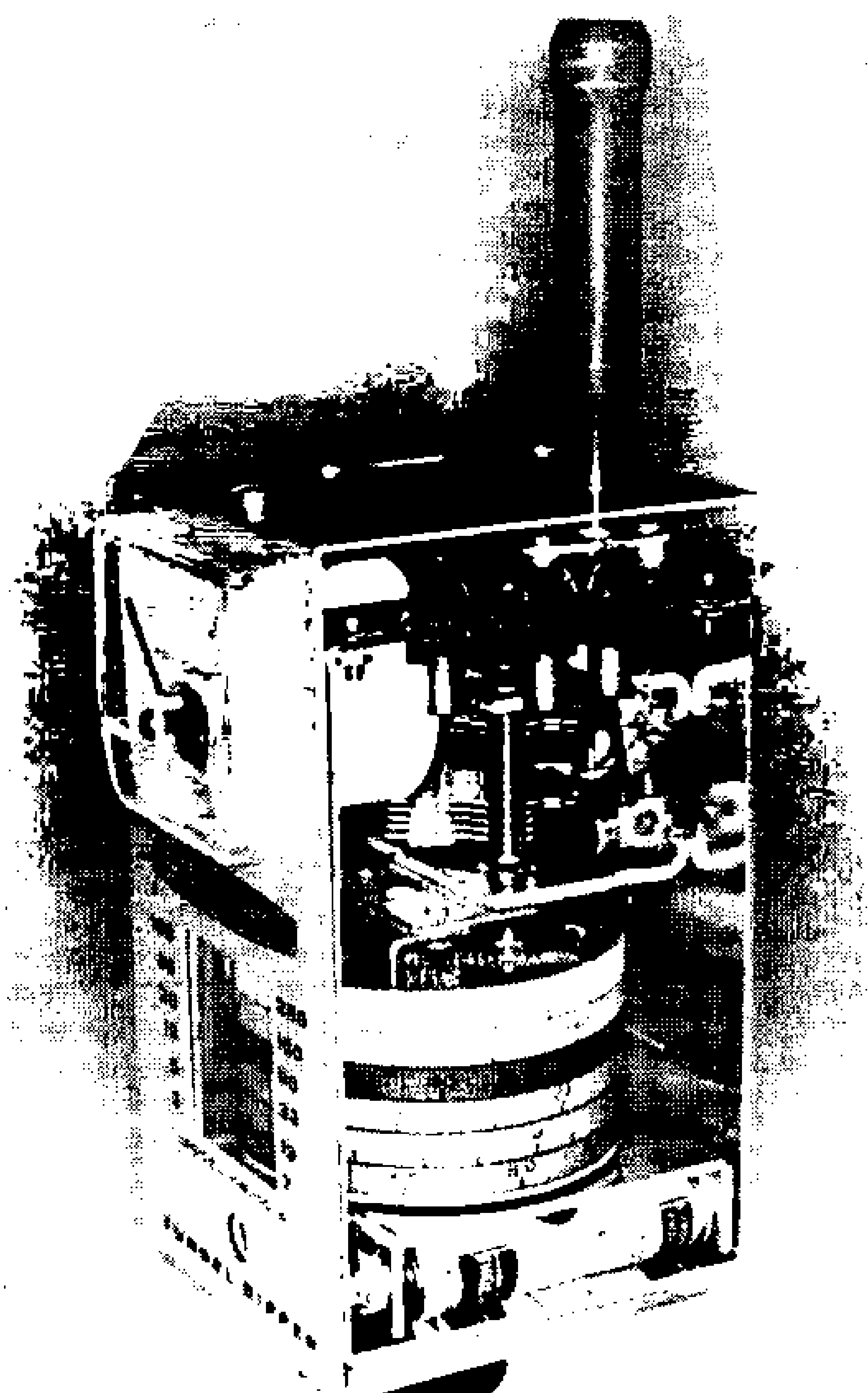
The Heath Tunnel Dipper



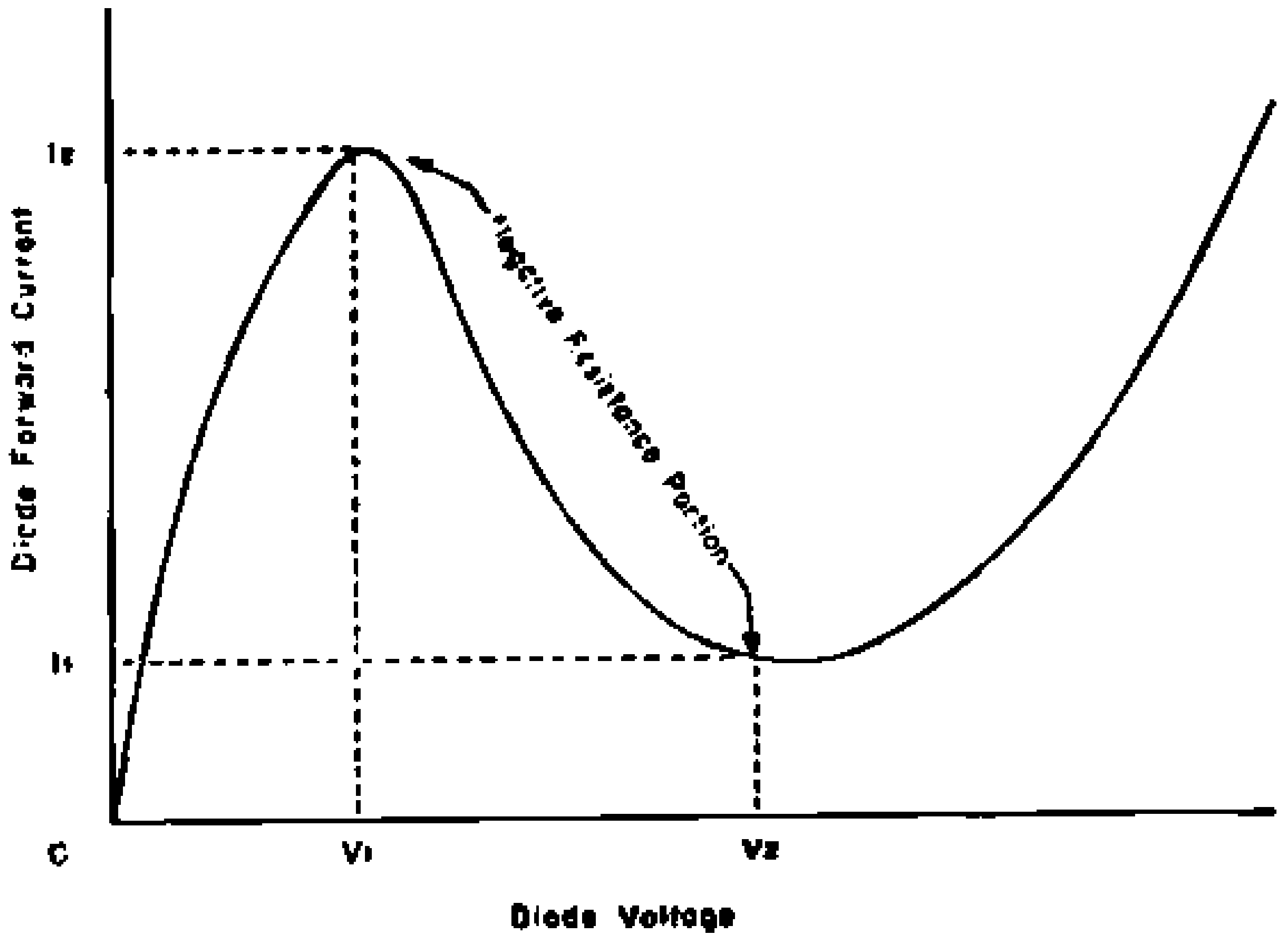
Relatively little time passed between the announcement of Dr. Leo Esaki's research with his specially doped germanium diode junction with its unique "negative resistance" characteristics and Heath's announcement of their replacement for the familiar grid-dip meter. Anyone who has seen the Tunnel Dipper will be quick to agree that Heath has added another winner to their long and growing list.



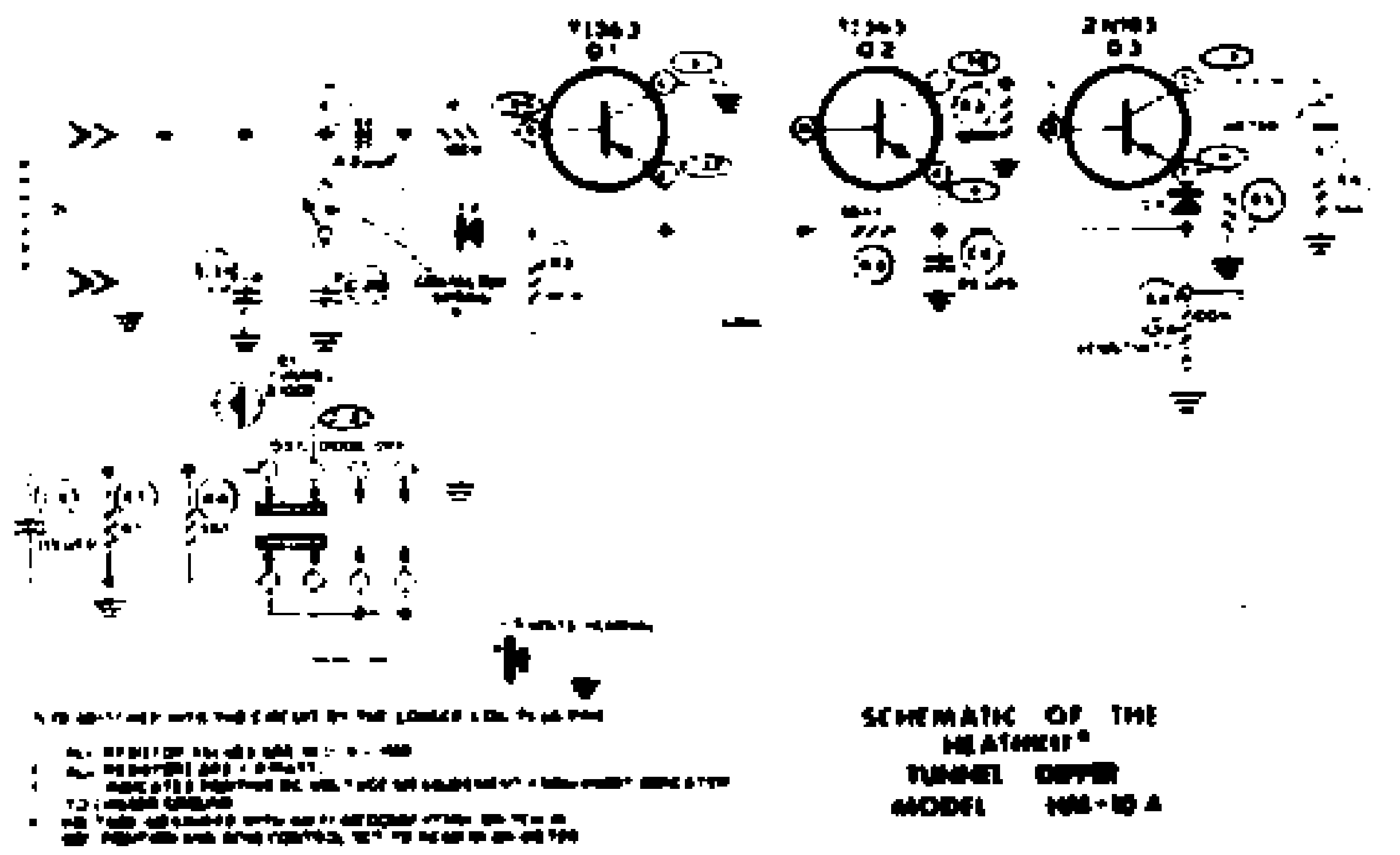
Retaining all of the features of the now familiar conventional grid-dip meter, this instrument provides an additional advantage . . . freedom from external power requirements. This opens up new areas of utilization which previously have not been convenient, such as tuning antennas on the house roof or at the top of a tower, and adjusting mobile rigs and antennas.

Covering a frequency range of 3 to 260 mc, the Tunnel Dipper contains a completely solid-state circuit requiring only a 1.5 volt battery and draws only 5 mils! The complete schematic is shown in Fig. 1. The tunnel diode functions within the oscillator circuit, the frequency of which is determined by the inductance of the plug-in coil in parallel with variable capacitor C2. The oscillating voltage developed across this tank circuit is rectified by D2, an ordinary diode, applied to the base of transistor Q1 operating as an emitter follower, and amplified by the dc amplifier consisting of transistors Q2 and Q3. The meter is in series with the collector of Q3 and measures the current, which of course is proportional to the amount of rf voltage being developed at the other end of the circuit, the oscillator tank. When the tank circuit coil is placed adjacent to a tuned circuit of the same resonant frequency, inductive coupling results in absorption of energy from the tunnel diode oscillator circuit, in turn producing the characteristic dip of the meter, indicating resonance.

For those who are puzzled about how a diode is able to function as an oscillator, a few brief words of explanation might be justified at this point. Ohm's law tells us that when voltage across a resistance is increased, the current through the resistance also increases. The same law also applies to an ordinary diode which is, after all, a resistance too. However,



a tunnel diode, due to its special doping during manufacturing, displays a characteristic resistance curve as shown in Fig. 2. Notice that between voltage levels of 0 and V_1 the diode current increases as would normally be expected. However, as the voltage increases be- V_1 and V_2 the diode current defies Ohm's law and decreases! The diode is actually displaying "negative resistance!" Increasing the applied diode voltage beyond V_2 produces a normal current response. Therefore, it is the region of "negative resistance" that interests us and in which the oscillation is produced in the tank circuit in the following manner: as the voltage supplied by the 1.5 volt battery reaches its maximum across the tank circuit, consisting of the plug-in coil and C2, the voltage across the tunnel diode is at a minimum, operating near point V_1 of the curve shown in Fig. 2. This results in a large current flow to the tank circuit from the battery. Conversely, when the voltage across the tunnel diode becomes maximum, near point V_2 of the curve, the current through the tank circuit becomes minimum. By this process, each cycle of current in the tank circuit is replenished by current from the battery. The tunnel diode itself does not actually oscillate, but simply acts to maintain the oscillations in the tank circuit.



Specifications

Frequency Range	3 to 260 mc. (using six plug-in coils)
Circuitry	Solid State: 1 tunnel diode 1 silicon diode 1 crystal diode 3 transistors
Controls	Tuning, Switch (Off-Diode-Oscillate)
Power Supply	AA penlite cell (1.5 volt) not furnished
Dimensions	5⅞" long, 2 13/16" wide, 4 3/16" high
Weight	1½ pounds
Price	$34.95

Construction of the Tunnel Dipper is relatively easy, thanks to a small etched circuit board and a well written assembly manual. Approximately 4 to 5 hours are all that is required to perform the 73 (how about that!) construction steps and operation checks.

Operation of the unit is simple, requires no warm-up, and employs vernier gear-driven tuning. Other features of the instrument well worth mentioning are the color coded plug-in coils and corresponding colored dial scales, built in storage space for the coils, and sturdy RCA type phono plugs and sockets for the coils . . . an improvement over earlier model grid-dip meters whose coil-socket arrangements sometimes became intermittent after extensive use.

Priced at $34.95, Heath's Tunnel Dipper is a worthwhile addition to any ham shack . . . and will cause you to wonder how you ever got along without one.

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