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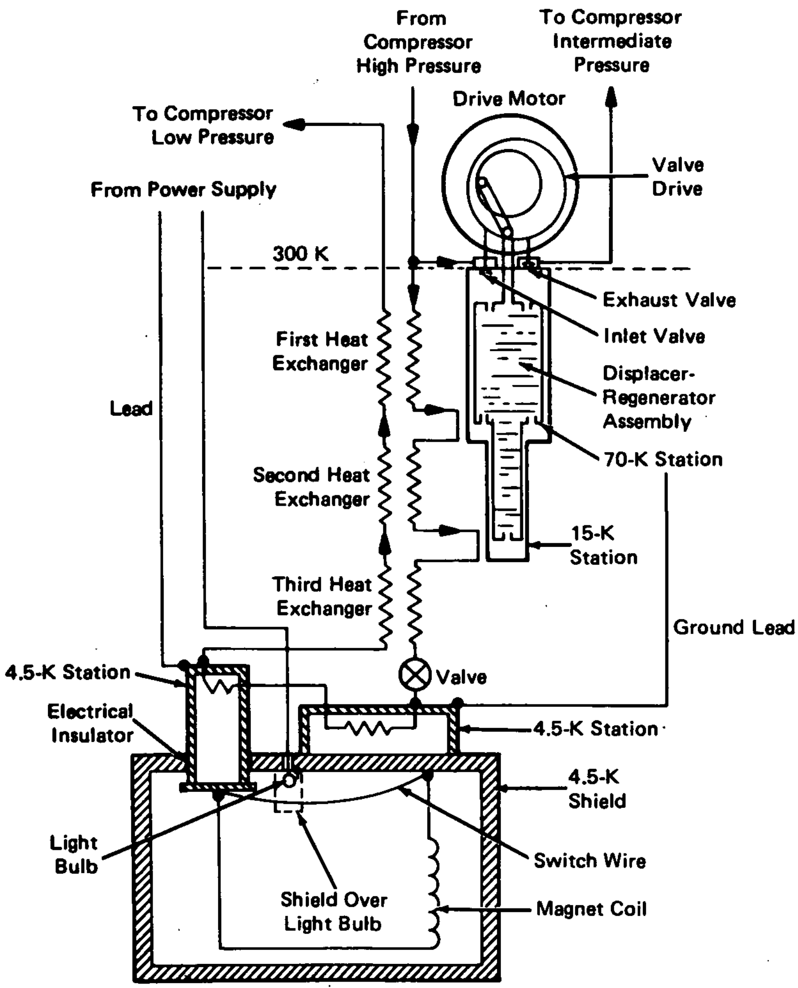
NASA TECH BRIEF

NASA Pasadena Office

Improved Thermal Isolation for Superconducting Magnet Systems



Cooling System for Superconductive Magnet To Be Used in a Maser

The problem:

Masers designed for operation above S-band frequencies require large magnetic fields which can be generated using superconductive magnets. These fields must be constant to maintain uniform gain and frequency stability. However, before superconductive magnets are utilized, two problems must be resolved. First, the magnets operate in the temperature range between 4.5 and 5 K, depending on conductor composition; they are cooled by direct contact with cryogenic fluids. Cooling by conduction is necessary because a high vacuum must be retained within the maser. Second, once the magnet is

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cooled to a superconductive state, the current flow in the magnet coil is initiated by an external power source. Wires leading from this source conduct heat from the external environment. This heat often reverts the magnet to the nonsuperconducting state.

The solution:

A closed-cycle refrigerating system for the superconductive magnet and maser is operated in a vacuum environment. In addition, each wire leading from the external power source passes through a cooling station which blocks heat conduction. In connection with these stations, a switch with a small incandescent light bulb, which generates heat, is used to stop the superconduction.

How it's done:

The system includes three stations, as shown in the figure, to progressively cool helium from gas to liquid state. The station temperatures are maintained at 78 K, 15 K, and 4.5 K, respectively. An additional or fourth station is used which maintains helium at 4.5 K.

Each of the two 4.5-K stations is connected in series by resistive stainless steel tubes and is used in connection with a wire leading from the external power source. These stations remove the heat from the wires generated by the current flow and any additional heat picked up from surrounding environment. Both of these stations are made from copper, forming plenums within which liquid helium flows.

Superconduction is interrupted by a switch which operates with a tiny incandescent light bulb connected to the external power supply. When the bulb is turned on, it radiates heat which raises the temperature of the switch wire above the critical point, reverting the magnet coil to the nonsuperconductive state. The bulb is shielded from the magnet coil by a copper housing which is cooled by one 4.5-K station.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
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Reference: TSP74-10158

Patent status:

NASA has decided not to apply for a patent.

Source: Ervin R. Wiebe of
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