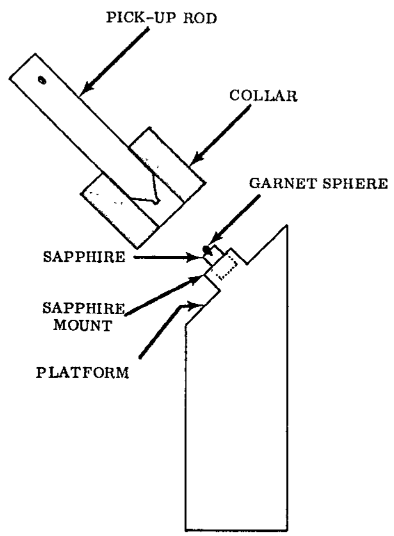

Fig. 5—Sphere mounting platform and pickup mechanism.

lowered until it touches the sphere, resulting in the sphere being cemented with the desired axis along the rod axis. Then the sphere can easily be mounted in whatever fixture is most adaptable to the device in question without losing the orientation.

Other investigators have oriented YIG spheres magnetically,[6,7] but to the authors' knowledge, this is the first attempt to orient single-crystal YIG spheres by means of switched magnetic fields.

The accuracy which has been achieved to date is ±3 degrees of the desired orientation in 100 percent of the attempts, with four out of five being aligned to within ±1 degree. This data refers to a sphere of 0.023 inch diameter. The same device can be used to orient larger spheres with the expectation of even greater accuracy.

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Superconducting Pulse Power Supply

A method of storing large quantities of of electrical energy inductively, using superconducting coils operating in liquid helium, has been developed. The stored energy can be released in the form of a high-power pulse of short duration in the order of milliseconds. An experimental device consisting of a 1200-joule storage coil and a superconducting discharge switch was operated successfully in the circuit shown in Fig. 1.

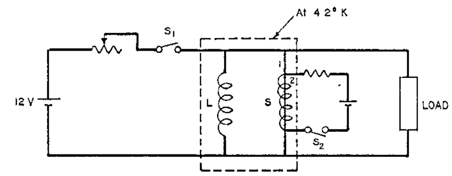

Fig. 1—Superconducting inductive energy storage system.

The superconducting switch S_s consists of a long wire of superconducting material which is wound noninductively on a suitable coil form. A wire material is selected which has a high resistivity in the normal state and a high critical current density in the superconducting state. Switching is accomplished by a superconducting-to-normal transition in wire 1. This can be obtained thermally, by increasing the temperature of wire 1 to above its critical temperature; or magnetically, as shown in Fig. 1, by generating an external field greater than the critical field of the wire.

Charging of the energy store is obtained with S_1 and S_2 closed. S_s is then in the normal state and a field is generated in L. When the current in L is stabilized to its maximum value, S_2 is opened causing S_s to become superconducting. Upon opening S_1 the current in L is diverted to the switch S_s and a persistent current is set up in L and S_s since this circuit has absolutely no resistance. Energy can then be kept in storage for an indefinite period of time as long as the low temperature environment is maintained. A pulsed energy discharge occurs in the load upon closing S_2, which causes wire 1 to go normal and build up a high resistance (large compared to the load resistance).

For a resistive load R, the output pulse voltage may be represented by[1]

$$E_t = I_0 kt\left(1 + \frac{kt}{R}\right)^{(R/Lk-1)} \exp^{-R/Lt}$$

where I_0 is the current in L prior to switching and k is the rate of increase of resistance in wire 1 in ohms/sec. Values for k in the order of 10^5ohms/sec have been obtained.

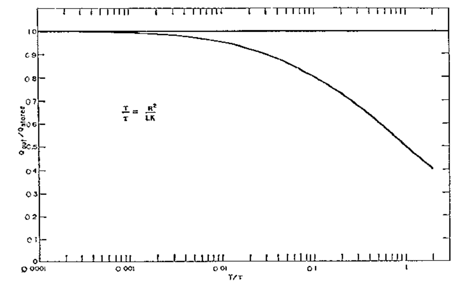

Fig. 2—Q_{out}/Q_{stored} vs T/τ.

The efficiency of the discharge can be found from Fig. 2, where Q_{out} represents the energy delivered to the load and Q_{stored} the stored energy in L ($\frac{1}{2}LI_0^2$) prior to switching. Efficiencies greater than 90 per cent have been obtained and even higher efficiencies are potentially possible.

The advantage of this method of energy storage compared to that of capacitor banks is that by this method energy can be stored at much higher densities. For instance, a field of 100 kilogauss represents a field energy of 40 joules/cm^3. In capacitors the obtainable energy densities are generally limited to about 0.3 joule/cm^3.

Experiments using a laser flash tube as a load were recently performed and have indicated the feasibility of this approach for operating high-energy laser systems.

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