Magnetic Support for Nonferromagnetic Bodies

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gating current sheets are found to be practically identical, whereas some variation is noted in the current sheet widths and amplitudes, and in profiles measured close to the chamber walls (Fig. 2). More extensive results obtained with many probes of this type, and further details of their construction are presented elsewhere.[7]

The use of miniature Rogowski coils thus seems justified for rapid semiquantitative surveys of current density distributions in various transient plasmas, and in some cases may completely replace the more tedious magnetic probe technique.

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MAGNETIC support systems have been used for freely suspending ferromagnetic bodies in air, in a vacuum and under liquids.[1,2] Such systems when properly designed are almost friction free supports for rotors.[3] Also they are found to serve as sensitive microbalances, densitometers, etc.[2] In all cases the temperature of the supported body is not changed by the support. However, in some experiments it is desirable to have the magnetically suspended body free of ferromagnetic material. In the past this has been acomplished by the electromagnetic generation of eddy currents in the suspended body which in turn interact with the inducing alternating field to support the body.[4,5] This type of support drastically heats the body and, in fact, has been used for simultaneously levitating and melting of specimens in metallurgical research.[5] A magnetic support is described in this note which does not excessively heat the suspended nonferromagnetic body.

Figure 1 shows a schematic diagram of the apparatus.

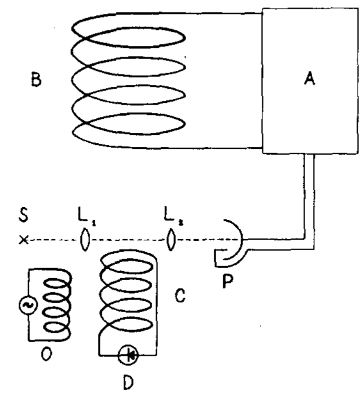

FIG. 1. Schematic of magnetic support for nonferromagnetic bodies. The oscillator coil O is considerably larger in diameter and concentric with C.

The coil C is freely supported magnetically by the solenoid B which may or may not have an iron core. The magnetic moment M of the coil C is produced by a direct current which is generated by the rectification by the diode D of the ac induced in C by an oscillator O. The upward force F on C is given by $F \sim M\partial H/\partial z$, where H is the magnetic field of B and z is the vertical distance. As C moves upward it reduces the light intensity which falls upon the photoelectron multiplier or photodiode P. This causes the servo circuit A to reduce the current in B in such a way as to stop the upward motion of C. If C starts downward the P-A system stops it. It is found that no vertical motion of C is observable. The maximum magnetic field H is along the axis of the solenoid so the freely supported coil C will seek a stable position along this axis. This apparatus is identical to that previously described[1–3] in detail for supporting ferromagnetic bodies except that the magnetic moment of the suspended body is produced by a direct current in a coil instead of being induced in the body by the magnetic field of the solenoid. In these experiments C contains from 100 to 1000 turns of No. 35 copper wire and D is a nonferromagnetic solid state diode rectifier. The suspended body is attached to the coil. Since both the magnetic field H and its gradient may be made large, the current in C can be made small. This greatly reduces the heat generated in C and D. It is clear that D and O may be replaced by a small battery, solar cells, or any means of producing a direct current in C. Also P may be replaced by other types of height sensors. This suspension was devised primarily for use in a magnetic densitometer where the float is almost supported by the displaced liquid and where the current in C is so small that heating is not a troublesome factor.

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