MAGNETIC FIELD FLOW AROUND A SCREEN WITH A SLOT

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Current-free magnetic field configurations in the planar case are described by the Laplace equation for the potential or for the flux function. Then, the problem can be defined both as a hydrodynamic one for a potential incompressible fluid flow and as an electrostatic one for an electric field potential. In this context, the planar problem of a magnetic field flow around an ideally conducting screen with a slot possesses interesting features. In the problem, the screen is divided into two conductors and the no-full-current condition for both of them results in a considerable magnetic flux passing through a narrow slot of width Δ. The order of magnitude of the flux is , where  is the magnetic field at infinity, *D* is the screen width, and  and  are dimensionless constants on the order of unity. This means that the average magnetic field in the slot will grow with decrease in Δ as

 (1)

and, in a sufficiently narrow slot, can by far exceed  that can be used for magnetic field concentration in various devices. Calculations show that the constants  and  are approximately equal to , , so the magnetic flux passing through a slot of thickness Δ=0.01*D*, for example, will be 0.21*B*0*D*, and the slot-average magnetic field will be 21*B*0.

These results will hold true for the electrostatic problem, in which, instead of the magnetic field, there is an electric field perpendicular to the magnetic field, shown in the figure, i.e. in the figure plane, parallel to the screen. Then, one should consider that the figure shows the contours of potential instead of the magnetic field lines, and that the electrostatic problem will use the voltage in the slot between the plates instead of the magnetic flux, and the average electric field in the slot will concentrate according to the same law (1) as the magnetic field.

The results are also valid for the hydrodynamic problem of a potential incompressible fluid flow around a screen with a slot. Instead of the magnetic field, there will be a velocity, and instead of the magnetic flux, a fluid flux with an average velocity concentrated in the slot according to the same law (1). The hydrodynamic problem of a flow around a screen with a slot can also be given in an axially symmetric setup, in the *r* and *z* coordinates, when the screen and the opening are round. In this case, for a small enough opening, the fluid flux will be proportional to the opening diameter Δ, and the velocity of the flow through the opening will grow as 1/Δ with decrease in Δ, i.e. somewhat faster than according to (1).

Magnetic field lines around a screen with a slot