be produced by a large solenoid. We have taken a long step in this direction, and although our resolution does not yet permit observation of the true line width, we believe the results obtained so far are of some interest.

Apart from the increased resolution, our experiment provides a severe test of the theory, for the "strong" magnetic field, H_0, is here actually comparable in magnitude to the perturbing intermolecular magnetic fields.

The proton resonance in one liter of water at room temperature was observed at a frequency of 50 kilocycles per second, in a magnetic field of approximately 11.7 gauss. The magnetic field was produced by a solenoid four feet long, one foot in diameter, with a correcting coil 16 inches long wound over the central portion. The calculated magnetic field inhomogeneity over the volume of the sample was of the order of one milligauss. The signal was detected by means of a lock-in amplifier with a band-width of about one cycle per second. The observed signal voltage was roughly 15 times noise.

The observed line width, taken here as the distance between the points of maximum and minimum slope on the absorption curve, was 7 milligauss; on a frequency scale, this is comparable to the 30 cycles-per-second modulation frequency, a situation seldom occurring in previous experiments. In such cases there is reason to believe that the line width is determined by the modulation frequency rather than by field inhomogeneities. A similar effect has been observed and explained in Stark effect patterns in the microwave region.[2,3]

These experiments are being continued with the aim of increasing the resolution and of testing for possible shifts of the resonant frequency from γH_0, arising from second-order effects.

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[1] Bloembergen, Purcell, and Pound, Phys. Rev. **73**, 679 (1948).
[2] Robert Karplus, Phys. Rev. **73**, 1027 (1948).
[3] C. H. Townes and F. R. Merritt, Phys. Rev. **72**, 1766 (1947).

On the Diffraction of a Plane Wave by a Semi-Infinite Conducting Sheet

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IN the usual discussion[1,2] of the Sommerfeld theory of diffraction by a semi-infinite conducting plane, approximate expressions are derived which are valid only in the regions outside two parabolas.[3] At optical frequencies this is not a serious restriction, but at radar frequencies the detecting unit is much smaller than the excluded region.

Dr. R. B. Watson and the writer are engaged in some diffraction measurements that involve the diffraction field inside the parabolas mentioned above. For this region, approximate analytic expressions have been developed which, in connection with the formulas already known, cover the entire plane. To save space, all of the symbols used are those defined by Baker and Copson.[2]

When the electric vector is parallel to the edge of the screen, the electric vector in regions S_2 and S_3, except for the parts inside the parabola $T'^2=1/\pi\epsilon^2$, is given by

$$\begin{aligned} d_z = {} & (1/2)\exp\{ik\rho\cos(\phi-\phi')+ikct\} \\ & +\{\csc\tfrac{1}{2}(\phi+\phi')/2(2\pi k\rho)^{\frac{1}{2}}\}\exp\{-ik\rho+ikct+i3\pi/4\} \\ & \pm\{(C^2+S^2)/2\}^{\frac{1}{2}}\exp\{ik\rho\cos(\phi-\phi') \\ & \qquad -i\tan^{-1}S/C+ikct+i\pi/4\}. \quad (1) \end{aligned}$$

The plus and minus signs apply in the illuminated and in the shadow regions, respectively. C and S denote the Fresnel integrals as defined by Jahnke and Emde.[4] The argument of these functions is $k\rho\{1+\cos(\phi-\phi')\}$. The error of Eq. (1) is not greater than $\pi\epsilon^3/2$. It is seen readily that the first two terms of (1) represent a plane and a cylindrical wave, respectively.

When the electric vector is parallel to the edge of the screen, the electric vector in regions S_1 and S_2, except for the parts inside the parabola $T^2=1/\pi\epsilon^2$, is given by

$$\begin{aligned} d_z = {} & \exp\{ik\rho\cos(\phi-\phi')+ikct\} \\ & -(1/2)\exp\{-ik\rho\cos(\phi+\phi')+ikct\} \\ & +\{\sec\tfrac{1}{2}(\phi-\phi')/2(2\pi k\rho)^{\frac{1}{2}}\}\exp\{-ik\rho+ikct+i3\pi/4\} \\ & \mp\{(C^2+S^2)/2\}^{\frac{1}{2}}\exp\{-ik\rho\cos(\phi+\phi') \\ & \qquad -i\tan^{-1}S/C+ikct+i\pi/4\}. \quad (2) \end{aligned}$$

The minus and plus signs apply inside and outside the region of geometric reflection, respectively. C and S again represent the Fresnel integrals, but the argument is $k\rho\{1-\cos(\phi+\phi')\}$. The error of (2) is not greater than $\pi\epsilon^3/2$. It is readily seen that the first term of (2) is the incident plane wave, the second term is a plane wave traveling in the direction of the reflected wave, while the third term is a cylindrical wave diverging from the edge.

When the incident plane wave is polarized so that the magnetic vector is parallel to the diffracting edge, the above discussion will apply to the magnetic vector, provided that the second term on the right side of (1) has its sign changed, and that the second and fourth terms on the right side of (2) have their signs changed. The corresponding electric field can be readily calculated.

[1] H. Bateman, *Partial Differential Equations* (Dover Publications, New York, 1944), pp. 483–86.
[2] B. B. Baker and E. T. Copson, *The Mathematical Theory of Huygens' Principle* (Oxford University Press, London, 1939), pp. 138–149.
[3] Reference 2, p. 145, Fig. 26.
[4] E. Jahnke and F. Emde, *Tables of Functions* (Dover Publications, New York, 1943), p. 36.

The Influence of the Length of a Hot Wire on the Measurements of Turbulence*

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LET us consider a perfectly compensated hot-wire anemometer with a wire of non-negligible length l. If I_b is a factor by which the measured intensity of longitudinal turbulence should be multiplied to give the correct intensity of turbulence then $(1/I_b^2)=(2/l^2)\int_0^l(l-s)R_y(s)ds$ where R_y is the transverse correlation coefficient. This relation was first found by H. K. Skramstad[1] by a rather complicated method and was obtained by the author[2] by a much simpler method. In the case of isotropic turbulence I_b can be expressed[2] in function of the longitudinal correlation coefficient R_x by $(1/I_b^2)=(1/l)\int_0^l R_x(s)ds$.

If the length l is large compared with the transverse scale of turbulence $L_y=\int_0^\infty R_y(s)ds$ then[3] $(1/I_b^2)=2[(L_y/l)-(L_y^{(1)}/L_y^2)(L_y/l)^2]$ where $L_y^{(1)}=\int_0^\infty sR_y(s)ds$. In homogeneous isotropic turbulence $L_y^{(1)}=0$ and $L_x=2L_y$. With wires for which $l\gg L_x$ we have then $(1/I_b^2)=L_x/l$. As

$$\lim_{(l/L_y)\to\infty}(1/I_b^2)=0,$$

it appears that the longitudinal turbulent energy measured with a hot wire of an indefinitely increasing length (compared to L_y) will approach zero even if the real energy is not negligible.

If now we consider the case when l/λ (λ being the microscale of turbulence) is small, then developing $R_y(y)$ in a Taylor's series and computing the value of the factor I_b we find[3] $(1/I_b^2)=1-l^2/6\lambda^2+Gl^4/120\lambda^4$, where $G=\lambda^4R_x^{\mathrm{IV}}(0)$. If l/λ is sufficiently small the simple relation $(1/I_b^2)=1-l^2/6\lambda^2$ can be used to correct the measured intensity of longitudinal turbulence.