Water waves trapped by thin horizontal cylinders in one- and two-layer fluid

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The phenomenon of trapping of water waves by submerged cylinders was discovered by Ursell back in 1951 for cylinders with circular cross-section of small radius. Their frequencies are eigenvalues of the Dirichlet-Neumann operator corresponding to the problem for the velocity potential. Ursell's result was generalized to thin cylinders with arbitrary cross-section symmetric with respect to a vertical plane parallel to the axis of the cylinder by P. McIver in 1990. He used the technique of matching asymptotic expansions in order to obtain explicit formulas for the eigenvalues. We remove the assumption concerning the symmetry of the cylinder cross-section by means of solving the corresponding integral equations on the boundary and obtaining exact solutions in the form of convergent series in powers of the small parameter involved. Generalizations to the case of a cylinder submerged in a two-layer fluid are also presented.