I. INTRODUCTION

The discovery of a close relationship between the nature of quantum gravity and the thermodynamics of black holes has been one of the most important developments in general relativity in the past decades. Strong motivation for studying thermodynamics of black holes originates from the fact that they have a very natural thermodynamic description. For example, black holes have an entropy and temperature related to their horizon area and surface gravity, respectively, and also one can investigate their thermal stability. With the appearance of the anti-de Sitter/conformal field theory correspondence (AdS/CFT) [1], such black holes in asymptotically AdS space become even more interesting since one can gain some significant relations between the thermodynamical properties of the AdS black holes and the dual conformal field theory [2–4].

On the other hand, it is a general belief that in four dimensions the topology of the event horizon of an asymptotically flat stationary black hole is uniquely determined to be the two-sphere S^2 [5, 6]. Hawking's theorem requires the integrated Ricci scalar curvature with respect to the induced metric on the event horizon to be positive [5]. This condition applied to two-dimensional manifolds determines uniquely the topology. The "topological censorship theorem" of Friedmann, Schleich and Witt is another indication of the impossibility of non spherical horizons [7, 8]. However, when the asymptotic flatness of spacetime is violated, there is no fundamental reason to forbid the existence of static or stationary black holes with nontrivial topologies. It has been shown that for asymptotically AdS spacetime, in the four-dimensional Einstein-Maxwell theory, there exist black hole solutions whose event horizons may have zero or negative constant curvature and their topologies are no longer the two-sphere S^2. The properties of these black holes are quite different from those of black holes with usual spherical topology horizon, due to the different topological structures of the event horizons. Besides, the black hole thermodynamics is drastically affected by the topology of the event horizon. It was argued that the Hawking-Page phase transition [9] for the Schwarzschild-AdS black hole does not occur for locally AdS black holes whose horizons have vanishing or negative constant curvature, and they are thermally stable [10]. The studies on the topological black holes have been carried out extensively in many aspects (see e.g. [11–15]). In this paper we shall consider topological black branes in the presence of dilaton and electromagnetic fields in all higher dimensions. The action of the $(n+1)$-