X—Mn alloy where X is a material selected from the group consisting of Pd, Ir, Rh, Ru, and alloys thereof, or a Pt—Mn—X' alloy where X' is a material selected from the group consisting of Pd, Ir, Rh, Ru, Au, Ag, and alloys thereof.

[**0606**] The pinned magnetic layer **331** and the free magnetic layer **333** are made of an Ni—Fe (nickel-iron) alloy, Co (cobalt), an Fe—Co (iron-cobalt) alloy, or an Fe—Co—Ni alloy, and the nonmagnetic electrically conductive layer **332** is made of a low electrical-resistance nonmagnetic electrically conductive material, such as Cu (copper).

[**0607**] Referring to **FIG. 37**, metallic layers **336** and **336**, made of Cr or the like, and functioning as a buffer layer or a alignment layer, extend from a horizontal portion thereof coextending a width dimension T8 of the antiferromagnetic layer **330** in the X direction, rising along the side end faces of the pinned magnetic layer **331**, the nonmagnetic electrically conductive layer **332**, and the free magnetic layer **333**. The use of the metallic layer **336** helps increase the strength of the bias magnetic field created by hard bias layers **337** and **337**.

[**0608**] Deposited on the metallic layers **336** and **336** are hard bias layers **337** and **337**, made of a Co—Pt (cobalt-platinum) alloy or a Co—Cr—Pt (cobalt-chromium-platinum) alloy.

[**0609**] In the magnetoresistive-effect device shown in **FIG. 37**, the hard bias layers **337** and **337** are deposited on the antiferromagnetic layer **330**. The thickness of the hard bias layers **337** and **337**, formed on both sides of the free magnetic layer **333**, are thicker than the counterparts in the spin-valve type thin-film devices shown in **FIG. 35** and **FIG. 36**. The hard bias layers **337** and **337** give a sufficient bias magnetic field to the free magnetic layer **333**, permitting the free magnetic layer **333** to be correctly shifted into a single-domain state in the X direction.

[**0610**] The intermediate layers **338** and **338**, made of a high-resistivity material having a resistance higher than that of the electrode materials **339** and **339** or an insulating material, are separated from the hard bias layers **337** and **337** by the nonmagnetic material layers **325** and **325**, made of Ta. The electrode layers **339** and **339**, made of Ta or Cr, are then respectively separated from the intermediate layers **338** and **338** by the nonmagnetic material layers **326** and **326**.

[**0611**] In the twenty-second embodiment, again, the intermediate layers **338** and **338**, formed between the hard bias layers **337** and **337** and the electrode layers **339** and **339**, control the sense current shunting into the hard bias layer **337**. With the electrode layers **339** and **339** extending over the multilayer film **335**, the electrode layer **339** is electrically connected to the multilayer film **335** on the top surface thereof. The sense current is directly conducted to the multilayer film **335** from the electrode layer **339** on the multilayer film **335** without passing the hard bias layer **337**. The magnetoresistive-effect device thus results in a high reproduction gain and a high reproduction output.

[**0612**] Referring to **FIG. 37**, the portion of the multilayer film **335** having a width dimension T9 is the sensitive region E while the portions of the multilayer film **335** having a width dimension T10 are the insensitive regions D and D. Since the electrode layers **339** and **339** extend over the insensitive regions D and D, the sense current is allowed to predominantly flow into the sensitive region E. This arrangement further increases the reproduction output.

[**0613**] Referring to **FIG. 37**, the electrode layer **339** on the multilayer film **335** does not fully cover the insensitive region D, with its width dimension T11 smaller than that of each insensitive region D. As already discussed, the insensitive region D may be fully covered with the electrode layer **339**.

[**0614**] When the electrode layer **339** on the multilayer film **335** does not fully cover the insensitive region D as shown in **FIG. 37**, the optical read track width O-Tw, which is defined as the width dimension of the top surface of the multilayer film **335** not covered with the electrode layer **339**, becomes larger than the magnetic read track width M-Tw, which is defined as the width dimension of the sensitive region E not covered with the electrode layer **339**.

[**0615**] The use of the intermediate layer **338** permits the thickness h6 of the electrode layer **339** to be made thinner relative to the multilayer film **335** and thereby reduces the size of a step between the top surface of the electrode layer **339** and the top surface of the multilayer film **335**. This arrangement allows an upper gap layer **379** to be formed over the border area between the electrode layer **339** and the multilayer film **335** with an improved step coverage and with no film discontinuity involved, and provides sufficient insulation.

[**0616**] **FIG. 38** is a cross-sectional view showing a twenty-third embodiment of the magnetoresistive-effect device of the present invention, viewed from an ABS side thereof.

[**0617**] This spin-valve type thin-film device is a so-called dual spin-valve type thin-film device, which includes a free magnetic layer **344**, nonmagnetic electrically conductive layers **345** and **343** respectively lying over and under the free magnetic layer **344**, pinned magnetic layers **346** and **342** respectively lying over and under the nonmagnetic electrically conductive layers **345** and **343**, and antiferromagnetic layers **347** and **341** respectively lying over and under the pinned magnetic layers **346** and **342**. The dual spin-valve type thin-film device provides a reproduction output higher in level than that of the spin-valve type thin-film devices (i.e., so-called single spin-valve type thin-film devices) shown in **FIG. 35** through **FIG. 37**. The layer lying at the bottom is the substrate **319**, while the layer lying on the top is a protective layer **315**. The laminate, composed of the layers from the substrate **319** through the protective layer **315**, constitutes a multilayer film **348**.

[**0618**] The antiferromagnetic layers **341** and **347** are preferably made of a PtMn alloy. Instead of the Pt—Mn alloy, the antiferromagnetic layers **314** and **347** may be made of an X—Mn alloy where X is a material selected from the group consisting of Pd, Ir, Rh, Ru, and alloys thereof, or a Pt—Mn—X' alloy where X' is a material selected from the group consisting of Pd, Ir, Rh, Ru, Au, Ag, and alloys thereof.

[**0619**] The pinned magnetic layers **342** and **346** and the free magnetic layer **344** are made of an Ni—Fe (nickel-iron) alloy, Co (cobalt), an Fe—Co (iron-cobalt) alloy, or an Fe—Co—Ni alloy, and the nonmagnetic electrically conductive layer **343** and **345** are made of a low electrical-resistance nonmagnetic electrically conductive material, such as Cu (copper).