



[54] LOW COST FORCE FEEDBACK DEVICE WITH ACTUATOR FOR NON-PRIMARY AXIS

[75] Inventor: Louis B. Rosenberg, San Jose, Calif.

[73] Assignee: Immersion Corporation, San Jose, Calif.

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[52] U.S. Cl. 345/156

[58] Field of Search 345/156, 157, 345/161, 163

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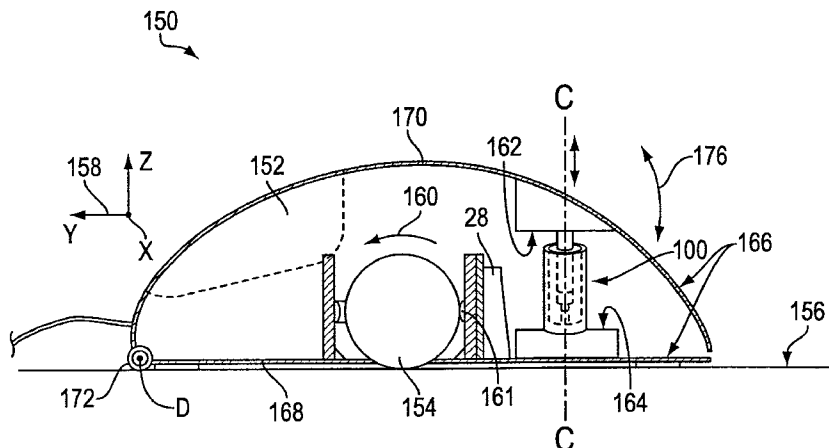
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Primary Examiner—Richard A. Hjerpe
 Assistant Examiner—Ronald Laneau
 Attorney, Agent, or Firm—James R. Riegel

[57] ABSTRACT

A force feedback interface and method including an actuator in a non-primary axis or degree of freedom. The force feedback interface device is connected to a host computer that implements a host application program or graphical environment. The interface device includes a user manipulatable object, a sensor for detecting movement of the user object, and an actuator to apply output forces to the user object. The actuator outputs a linear force on the user object in non-primary linear axis or degree of freedom that is not used to control a graphical object or entity implemented by the host computer, and movement in the non-primary degree of freedom is preferably not sensed by sensors. The axis extends through the user object, and there are preferably no other actuators in the device, thus allowing the force feedback device to be very cost effective. Force sensations such as a jolt, vibration, a constant force, and a texture force can be output on the user object with the actuator. The force sensations can be output in a direction perpendicular to a planar degree of freedom, radial to spherical degree of freedom, and/or along a lengthwise axis of the user object.

45 Claims, 5 Drawing Sheets



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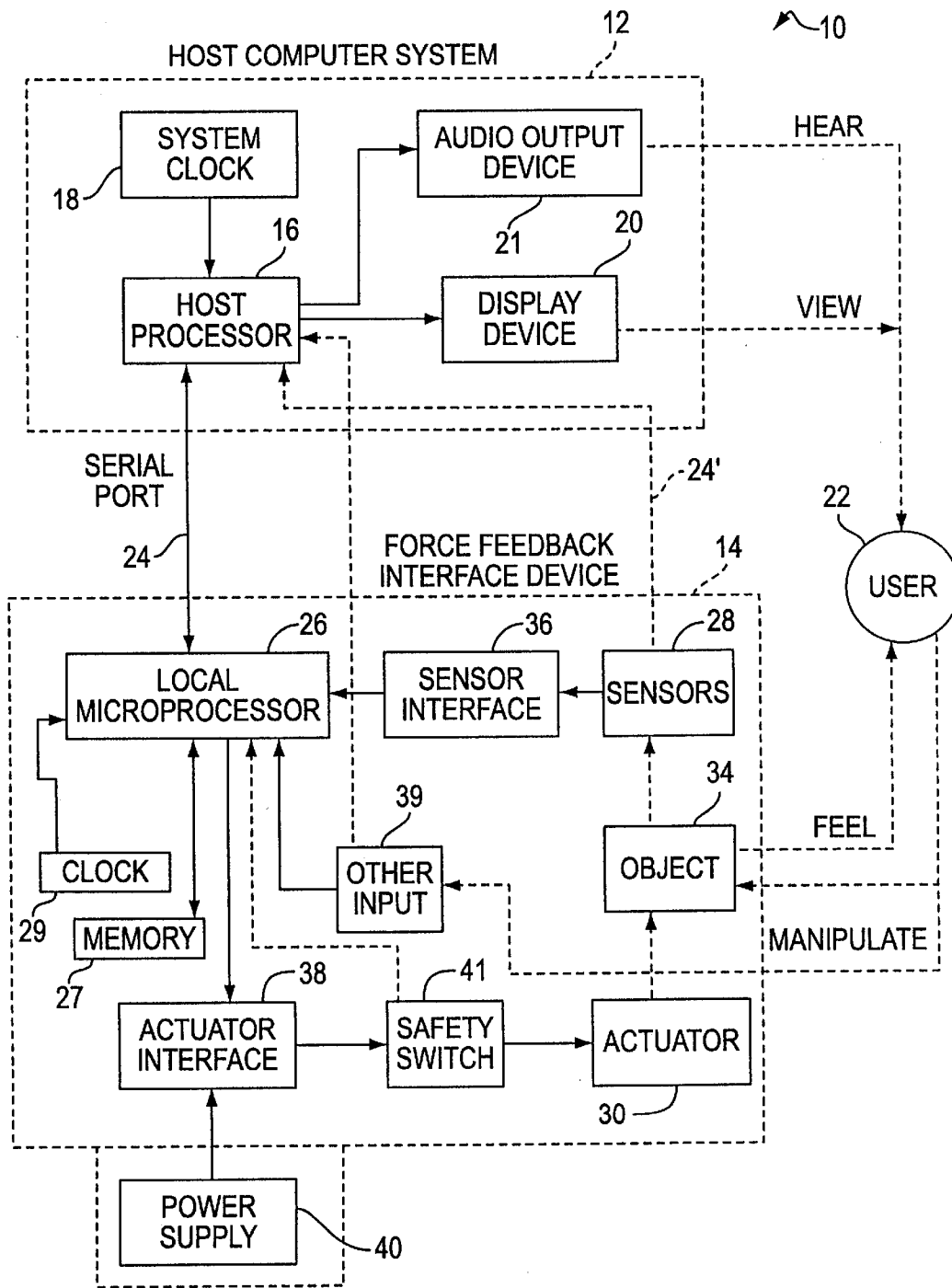


FIG. 1

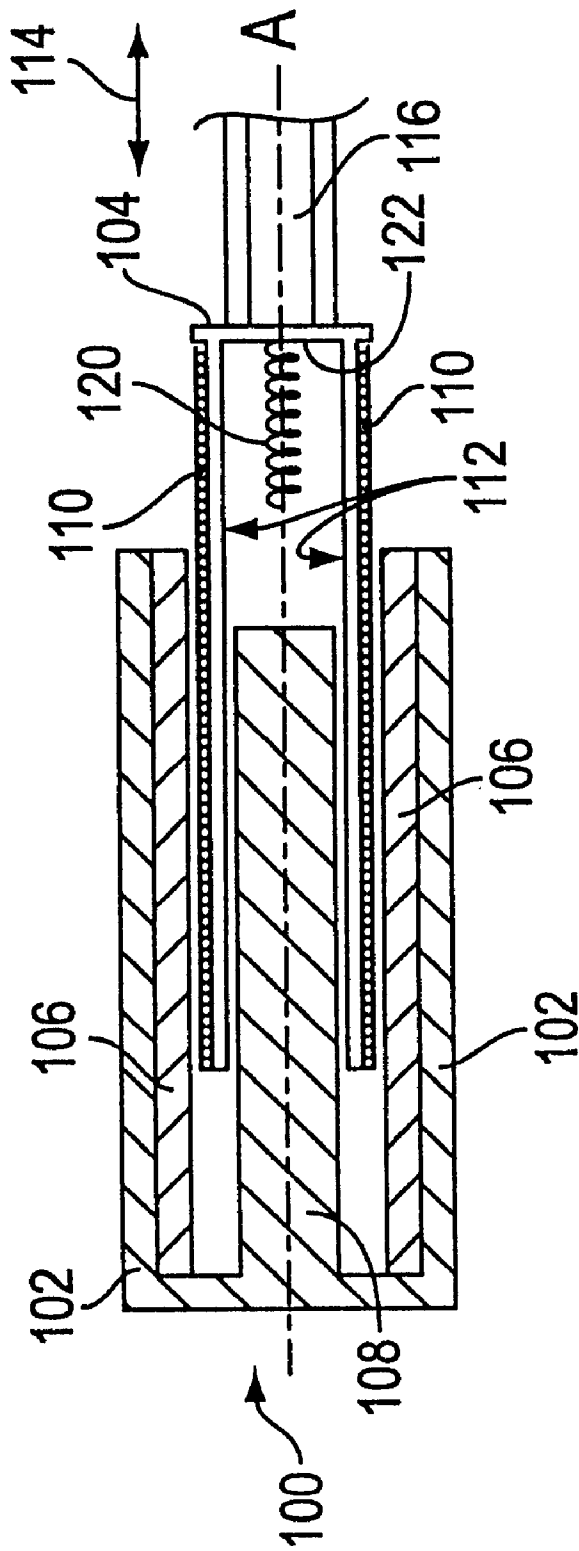


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