New Advanced Technologies for Electronic Precision Balances

A&D Company, Limited, a leading manufacturer of laboratory and industrial electronic balances, has recently released the FZ-i Series precision balances (120 ~ 300g × 1mg, 1200 ~ 3000g × 10mg). Naoto Izumo, chief engineer in A&D's research & development division, explains two principal technologies incorporated in the FZ-i Series.

Background

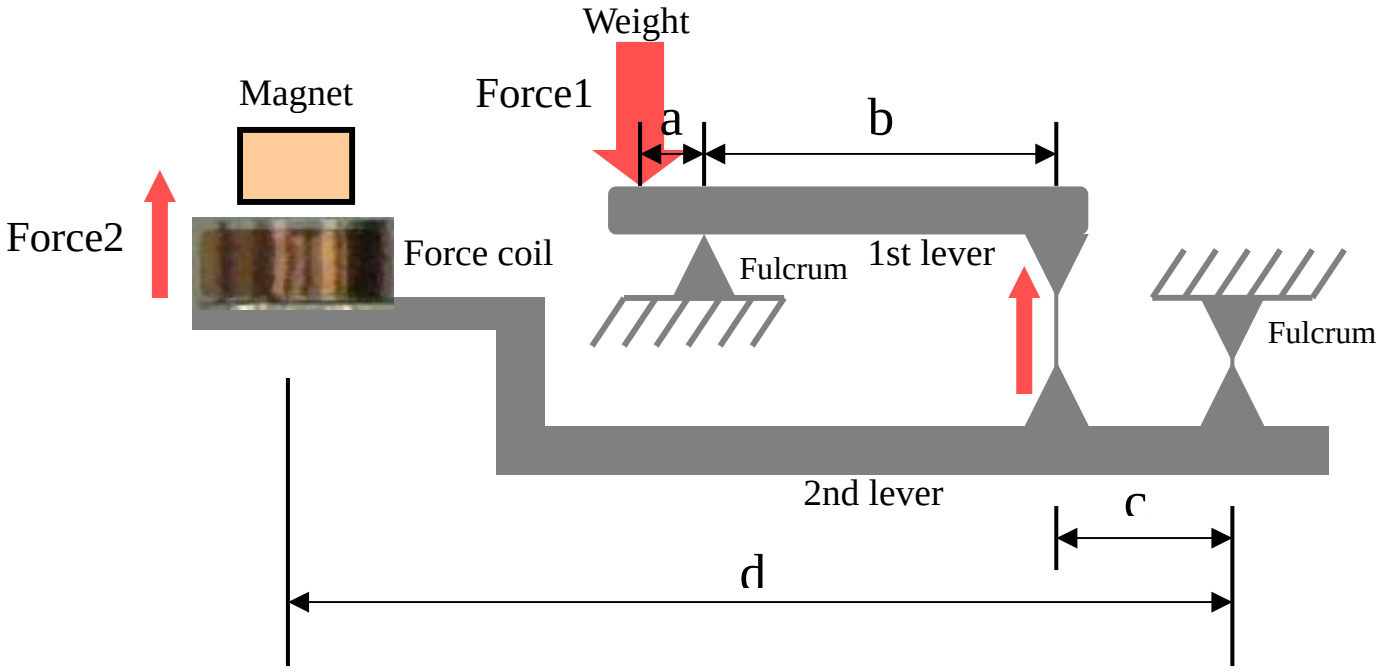
Social and industrial infrastructures rest upon products supported by technology. Particularly, weighing products are used in many fields and therefore occupy a role akin to a mother machine for industrials. In this regard, A&D believes that manufacturers of weighing products assume great responsibility.

For many years, A&D has made an effort to provide high-performance weighing products at reasonable prices in order to promote technology upgrades in as many fields as possible. The FZ-i Series is a result of these efforts. Two technological innovations characterize the FZ-i Series; the Compact Super Hybrid Sensor (C-SHS) and the air-pump controlled, direct-acting internal calibration unit.

C-SHS

Most electronic precision balances adopt an electro-magnetic compensation method for their weighing sensors. This method equilibrates the Lorentz (electro-magnetic) force generated by the electro-magnetic unit at one end of a beam with the weight of the object placed at the other end. The electro-magnetic unit consists of a force coil and a magnetic circuit, which requires an expensive rare-earth magnet to generate the Lorentz force. In order to achieve more competitive pricing for the FZ-i Series, A&D focused on reducing the size (and consequently the cost) of this magnet for the magnetic circuit.

Of course, reducing the size of the magnet lead to a smaller magnetic force. To compensate for the diminished magnetic force, A&D invented what we call the "double lever system." Using this system, the lever ratio has been dramatically increased (more than 300 to 1) by means of an integrated second lever (see Figure 1). The double lever system can only be realized when there is highly precise processing. For example, the second lever is made by pressing a material with a thickness of only 1mm, with the thinnest area as thin as 0.3 mm. This kind of highly precise processing is a field in which Japan has traditionally excelled. Thanks to the double lever system and other unique devices enabled by high-precision processing, the production cost of A&D's precision weighing sensor has been reduced by as much as three quarters in eight years.



(Figure 1: Force2 = Force1 × a/b × c/d)

Air-Pump Controlled, Direct-Acting Internal Calibration Unit

Balances with an internal calibration function, while useful, are generally expensive. By incorporating a mass inside the balance, it becomes possible to easily calibrate a balance and therefore ensure constantly accurate weighing. However, in such balances a very complex mechanism is also incorporated to move up and down the internal mass, which results in a substantial cost increase.

Conventionally, the device for moving the mass uses a geared motor. Despite the high cost of the geared motor, it is plagued by a number of inherent problems. For example, drive failure due to galling of the gear itself, mechanical problems due to increased complexity of the force transmission mechanism to convert the rotational motion of the motor to the up-and-down motion of the mass, or other problems such as those caused by dust getting inside the high precision driving mechanism.

In order to solve these problems, A&D has changed the rules of the game and adopted a direct-driving method with a balloon-like actuator, which utilizes air pressure for its power source. Using this method, the mechanism for generating the driving force has been significantly simplified to consist of three elements; namely, a low-cost air pump, an electromagnetic valve and an air container called a “bladder.” When there is an unexpected interruption to the power supply, the pump will halt and the valve will remain open, naturally releasing the air inside the bladder and automatically transferring the mass (load) from the weighing sensor back to the original position. This provides a fail-safe mechanism for the sensor. With enhanced reliability thanks to the simplified structure, it has become possible to minimize possible problems that users might have encountered otherwise.