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Automation Compatible Multiple Form-factor Screwless Storage Drive Sled

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ABSTRACT

Storage servers use shelves, known as sleds, to secure hard drives in place. Sleds frequently include screws or more complicated latching mechanisms to grip storage drives. Such latching mechanisms can be tricky and time consuming for a human to operate and difficult to automate. This disclosure describes a storage-server sled that enables the automated loading and unloading of storage drives into server racks without the use of screws, latching mechanisms, or moving parts.

KEYWORDS

- Datacenter automation
- Equipment loading
- Server rack
- Screwless storage-drive sled
- Hard drive disk (HDD)
- Solid state drive (SDD)

BACKGROUND

Storage servers use shelves, known as sleds, to secure hard drives in place. Sleds are pervasive in a data center. Screws or more complicated latching mechanisms are commonly used to grip storage drives. Such latching mechanisms can be tricky and time consuming for a human to operate and difficult to automate. While conventional sleds are perhaps acceptable for long-term storage of drives in servers, these can be impractical for applications that involve automatic and rapid changeover of drives into servers. Although equipment that can perform loading and unloading of electronics in an automated fashion exists, such equipment typically makes extensive use of expensive, custom mechatronics incompatible with other automation technologies. Further, these also only load or unload into test equipment, not rack-based servers, making such equipment unsuitable for production server applications.

DESCRIPTION

This disclosure describes a storage-server sled that enables the automated loading and unloading of storage drives without the use of screws, latching mechanisms, or other moving parts. Storage drives can be, for example, solid state drives (SSD), which are typically 2.5” in dimension, hard disk drives (HDD), which are typically 3.5” in dimension, but are also produced in 2.5” form factor for use in servers, etc.

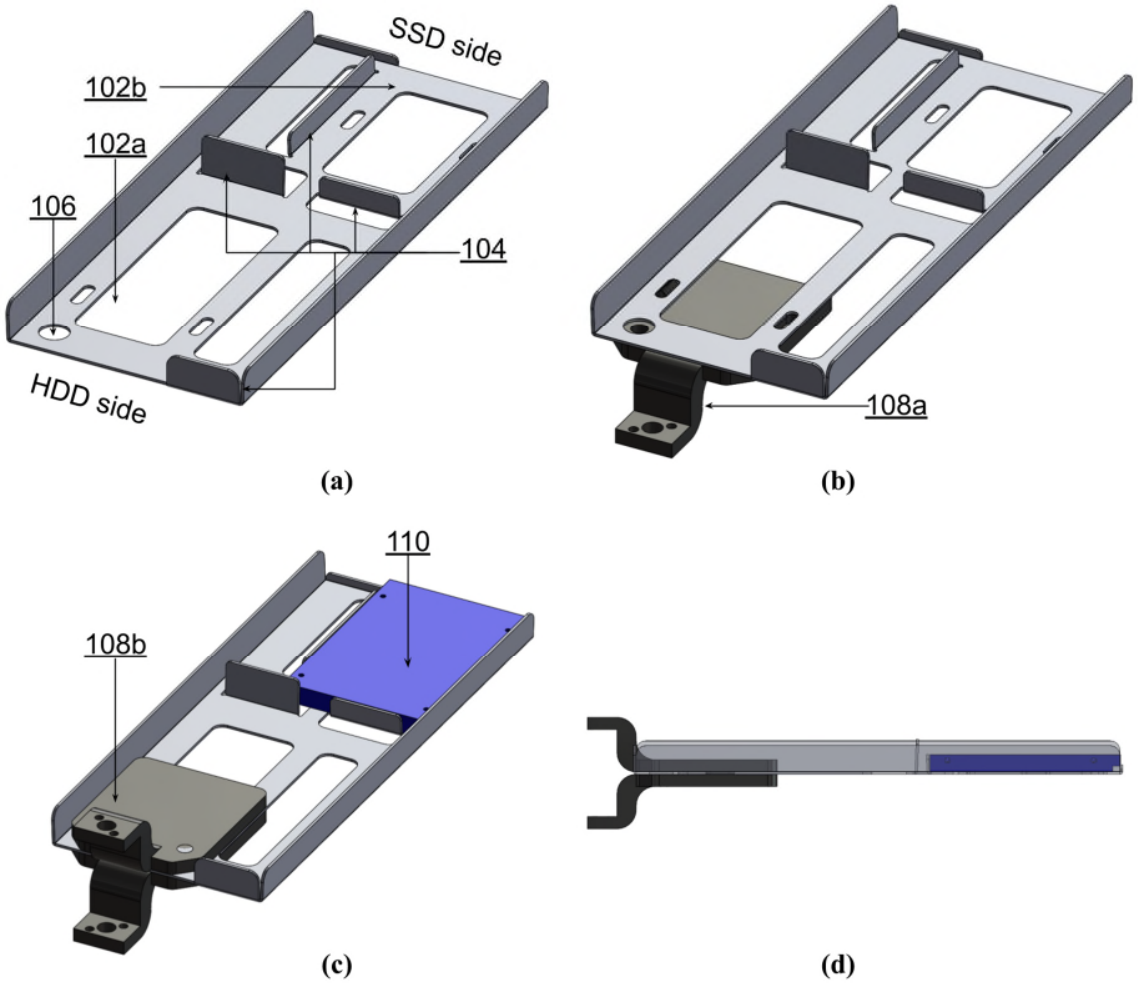

Fig. 1: (a) Perspective view of sled; (b) Sled with a finger of an end-of-arm tool (EOAT); (c) Sled with two fingers of the EOAT and an inserted SSD; (d) Side view of the sled with an inserted SSD, being picked up by the fingers of an EOAT

Fig. 1 illustrates the storage sled. As illustrated in Fig. 1(a), the storage sled is made of a single sheet-metal part and has on opposite ends slots (102a-b, also known as buckets) for 2.5” and 3.5” drives. A slot is defined by nearly vertical tabs (104) that serve to snugly hold an inserted drive. A slot can have offset, flat features, and index holes such that a robotic end-effector (also known as a finger) can grip the sled with drive and insert it into or retract it from a transfer appliance. The sled has back and front stops to secure the drive during engagement or disengagement from the SATA connection of a server. The slots have cutouts to provide a resting surface for hard drives during automated loading or unloading from the sled.

The sled can also have a sensor hole (106) that a robotic effector can use to detect which side, e.g., SSD or HDD, of the sled is facing out of the server rack. Fig. 1(b) illustrates how an end-of-arm tool (EOAT), or top finger (108a), can be used in conjunction with the sled to determine which side is being picked up. The finger has a proximity sensor that mates with the sensor hole and provides feedback that the sled is being picked up, e.g., from the 3.5” (HDD) side.

Fig. 1(c) illustrates both top (108a) and bottom (108b) fingers in place to pick up the sled containing an inserted 2.5” (SSD) drive (110, in blue). Fig. 1(d) illustrates a side view of the SSD being held by the sled and being picked up by the fingers.

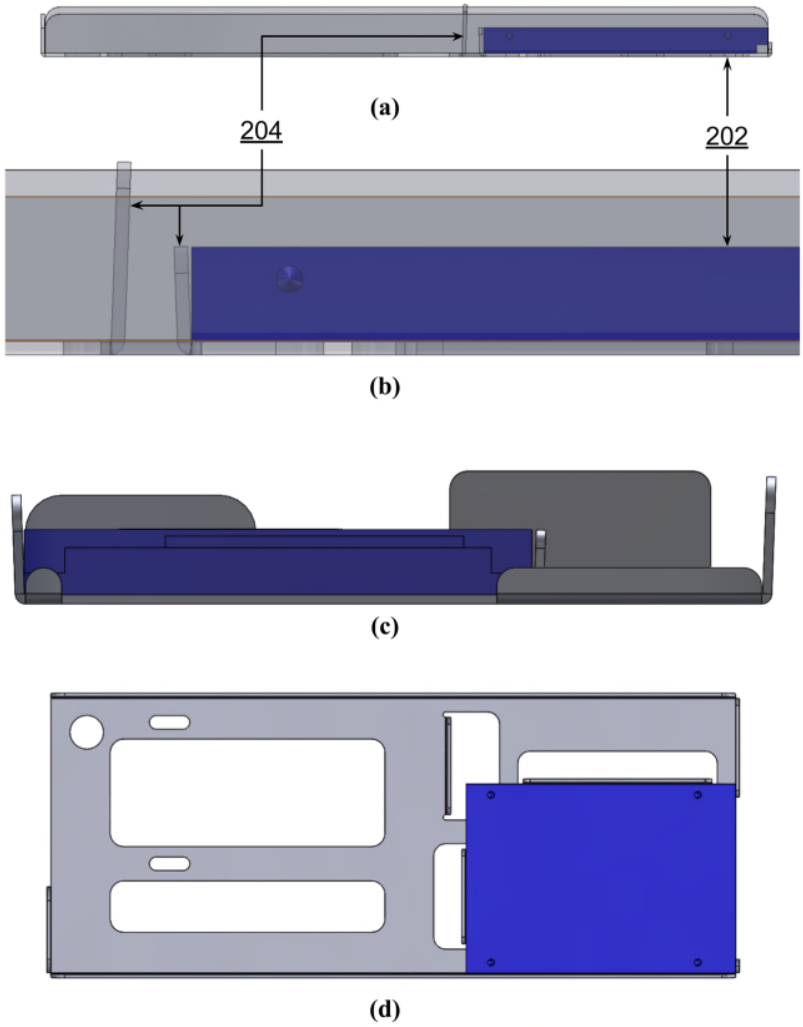

Fig. 2 (a) Side view of a sled; (b) Side view, magnified; (c) Back view; (d) Top view of the sled

Fig. 2 illustrates various views of the sled. Fig. 2(a) illustrates a side view of the sled with an inserted SSD (202) and Fig. 2(b) illustrates a magnified side view. The angles of the tabs (204) that hold the SSD in place enable easy placement by hand or automation, since they have a slight angle (not exactly vertical), which provides a lead-in. Fig. 2(c) illustrates a back view of the SSD, where the SATA connector plugs into the rack. Fig. 2(d) illustrates a top view of the sled and inserted SSD.

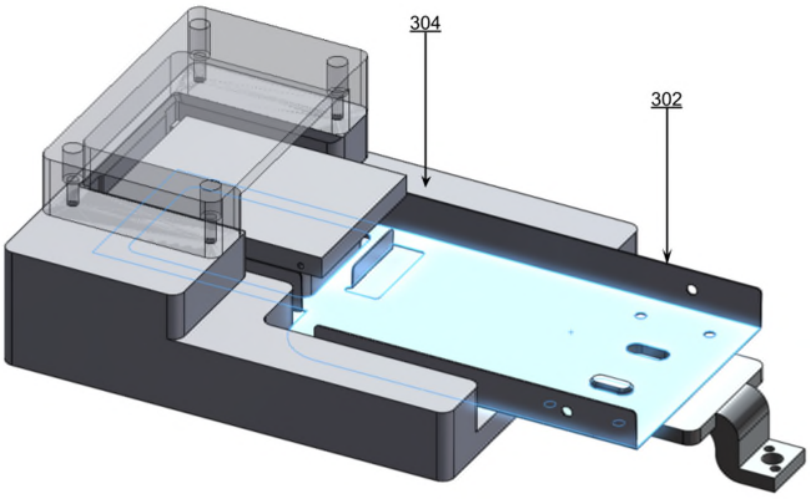

Fig. 3: A sled (cyan) interacting with a drive loading platform

Fig. 3 illustrates a sled (302, indicated in cyan color) interacting with a drive loading platform (304) as part of an automated workflow.

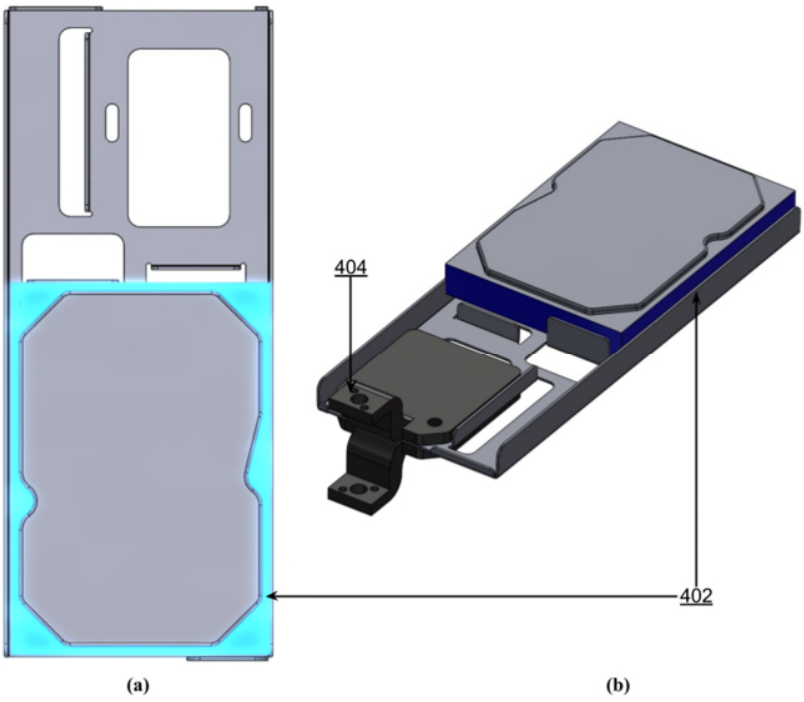

Fig. 4: (a) Top view of a sled holding a 3.5” HDD; (b) Perspective view of the sled along with robotic fingers

As mentioned earlier, the described sled can house either a 2.5” SDD or a 3.5” HDD. Fig. 4 illustrates a sled holding a 3.5” HDD (402). Fig. 4(a) illustrates a top view of a sled holding the 3.5” HDD, while Fig. 4(b) illustrates a perspective view of the sled along with EOAT fingers (404).

Aside from enabling the automated loading and unloading of storage drives into server racks, the described sleds minimize human interaction with data storage drives.

CONCLUSION

This disclosure describes a storage-server sled that enables the automated loading and unloading of storage drives into server racks without the use of screws, latching mechanisms, or moving parts.

REFERENCES

[1] https://www.teradyne.com/products/test-solutions/storage-test last accessed Oct 12, 2020.