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**Bezbaruah et al.**

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(54) **EFFICIENTLY PROVIDING VIRTUAL MACHINE REFERENCE POINTS**

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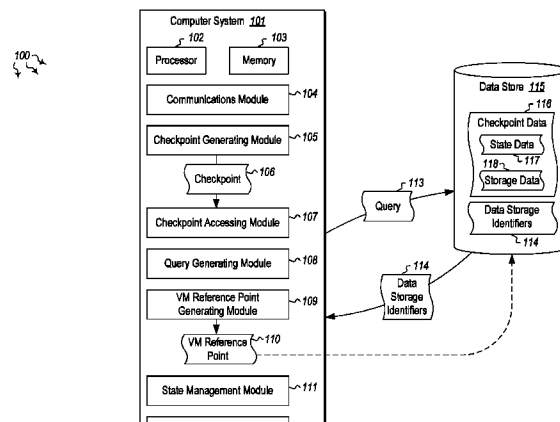
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(57) **ABSTRACT**

A computer system maintains identifiers that identify changed blocks of virtual machine (VM) storage. The computer system accesses a stable VM checkpoint comprising a restorable VM image at a time, and that stores a representation of data of at least one block as it existed at the time. The computer system converts the checkpoint to a reference point. Reference point information is transferable with the VM, such that if the VM is moved to a different computing system, any data identified by the reference point is recoverable. The conversion includes querying the storage to determine an identifier corresponding to the block of the checkpoint at the time, storing this identifier as a part of the reference point, and releasing the representation of the data

(Continued)



of the block from the checkpoint. The computer system then uses the reference point to identify changes in the blocks of the storage since the time.

### 20 Claims, 3 Drawing Sheets

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See application file for complete search history.

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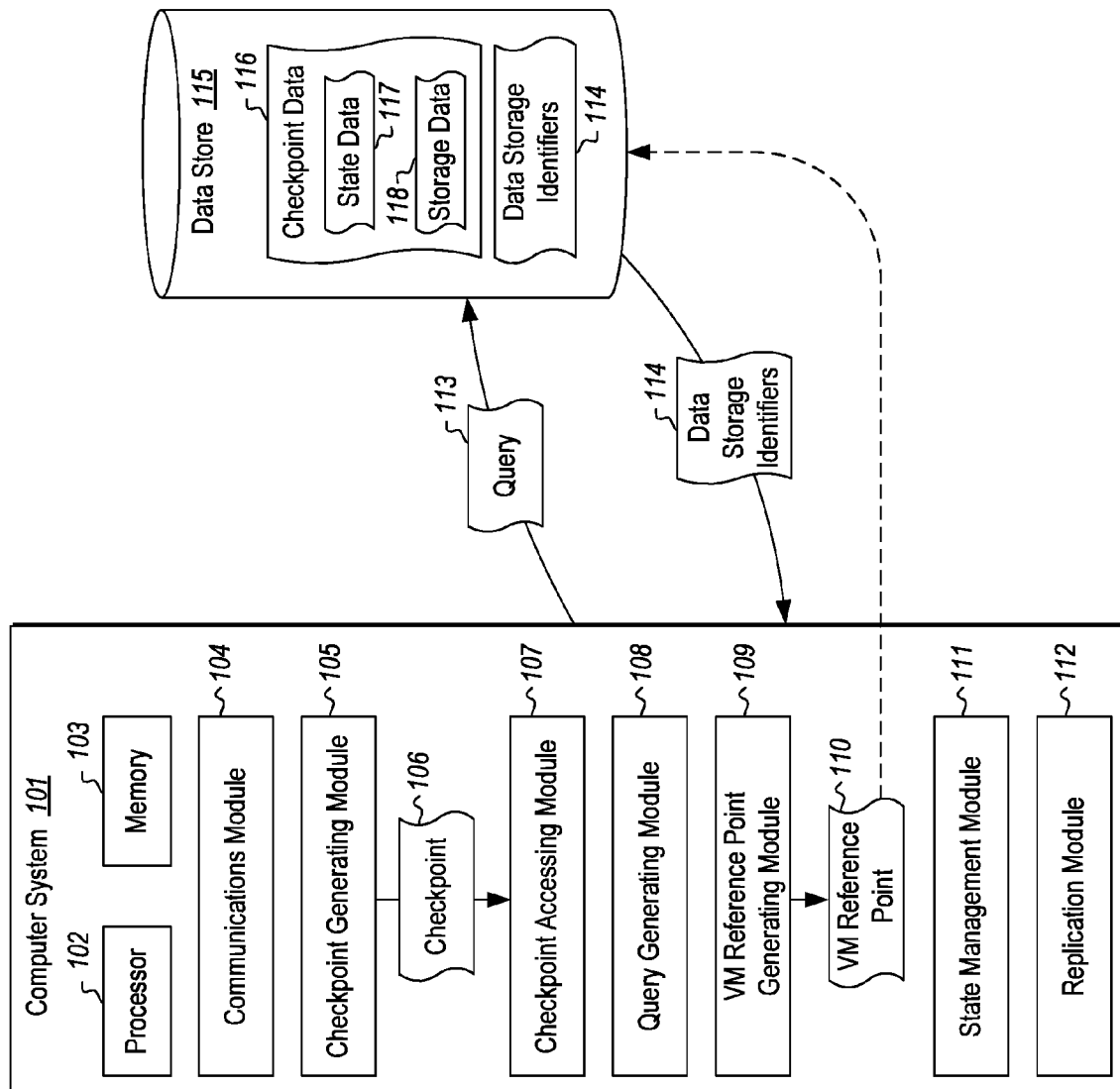
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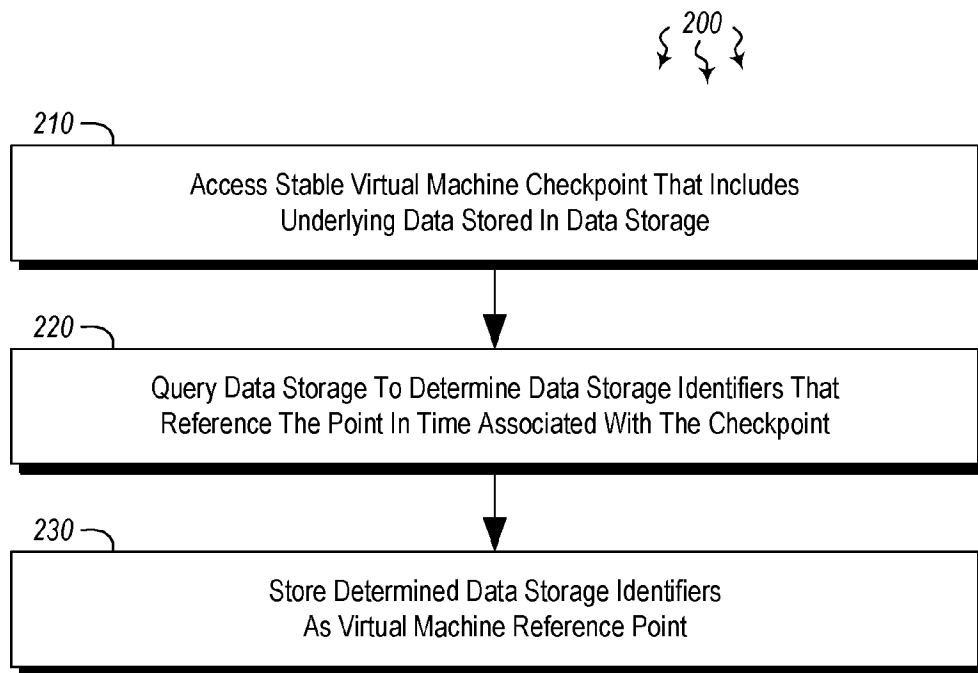
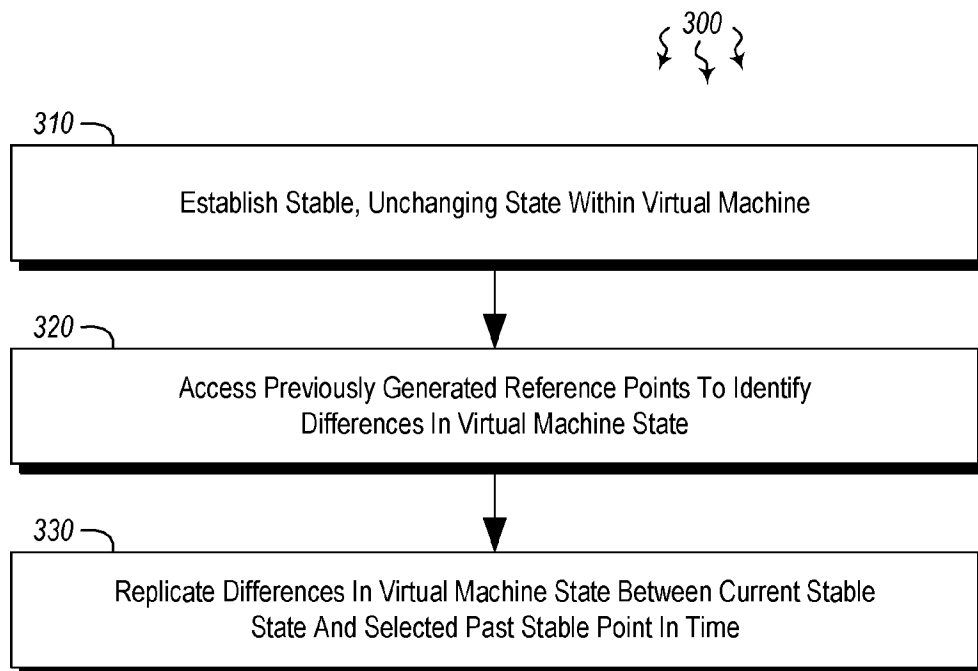
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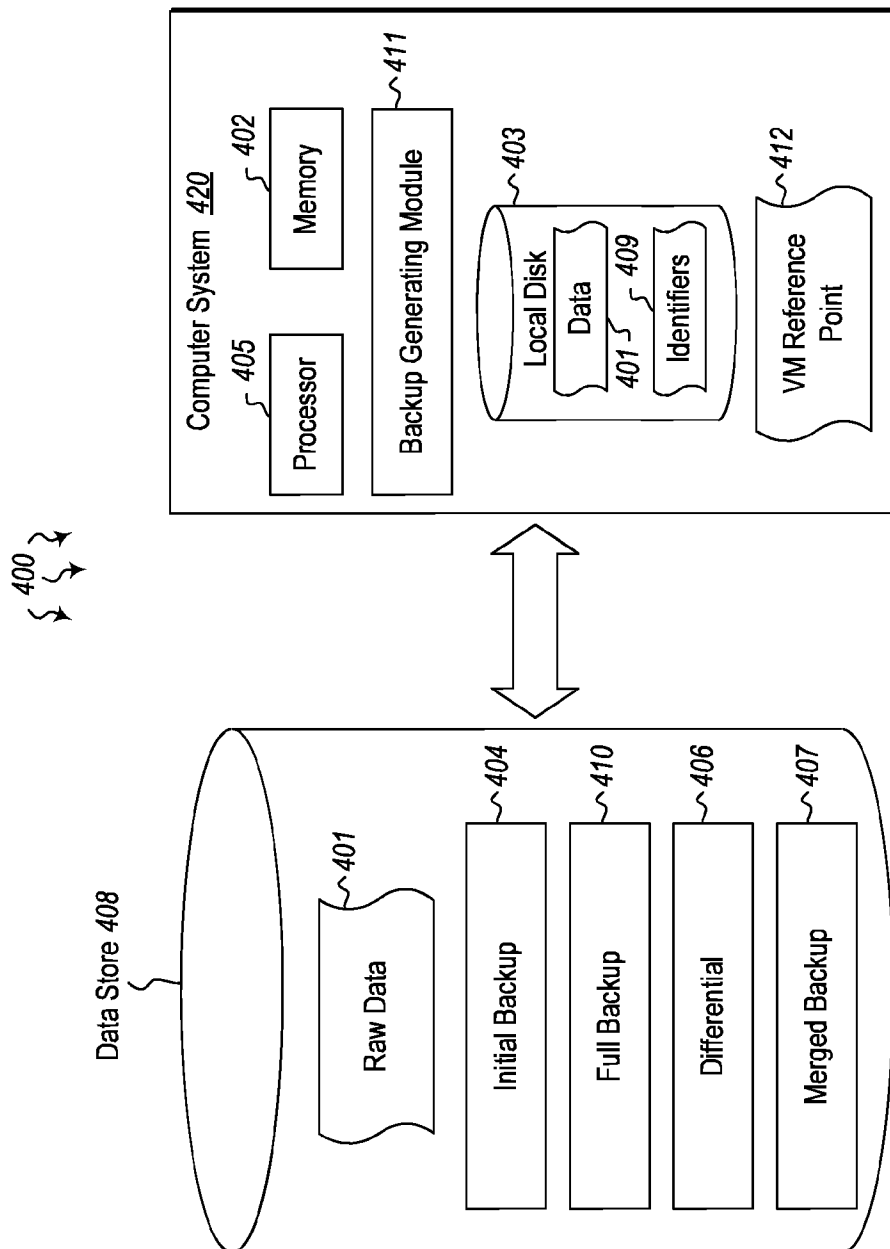
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**Figure 1**

**Figure 2****Figure 3**



**Figure 4**

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