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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/862,314	04/12/2013	James M. Higgins	058752-01-5201-US	5737

82474 7590 09/25/2019

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EXAMINER	
SAIN, GAUTAM	

ART UNIT	PAPER NUMBER
2135	

NOTIFICATION DATE	DELIVERY MODE
09/25/2019	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte JAMES M. HIGGINS, JAMES M. KRESSE, RYAN JONES, and MARK DANCHO[1]

Appeal 2017-010643
Application 13/862,314
Technology Center 2100

Before ROBERT E. NAPPI, JOHNNY A. KUMAR, and CARL L. SILVERMAN *Administrative Patent Judges*.

NAPPI, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134(a) of the Final Rejection of claims 1 through 5, 7, 10 through 15, 17, 19, and 20.

We reverse.

INVENTION

The invention is directed to a method of operation of a storage control system, including: receiving a recycle write from a recycle write queue; receiving a host write from a host write queue; and scheduling the recycle write and the host write for writing to a memory device. The writes scheduler maintains a target ratio of recycle writes and host writes and

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[1] According to Appellant, the real party in interest is Sandisk Technologies LLC. App. Br. 4.

adjusts the target ratio based upon the pool of erased memory that can be written to. Spec., paras. 7, 62, 72.

Claim 1 is illustrative of the invention and is reproduced below:

> 1. A method of operation of a storage control system for a memory device comprising:
>
> receiving at least one recycle write from a recycle write queue;
>
> receiving at least one host write from a host write queue;
>
> identifying a target recycle ratio in accordance with a current size of a spare pool of erased non-volatile memory blocks available to be written to, wherein the target recycle ratio is a targeted ratio of recycling page writes to host page writes;
>
> placing the at least one recycle write and the at least one host write in a write operation queue in accordance with the target recycle ratio;
>
> dispatching the at least one recycle write and the at least one host write from the write operation queue for writing data to the memory device;
>
> during operation of the storage control system, updating the target recycle ratio in accordance with a change in the current size of the spare pool; and
>
> after updating the target recycle ratio:
>
> placing one or more recycle writes and one or more host writes in the write operation queue in accordance with the updated target recycle ratio; and
>
> dispatching the one or more recycle writes and the one or more host writes from the write operation queue for writing data to the memory device.

REJECTIONS AT ISSUE

The Examiner rejected claims 1 through 5, 7, 10 through 15, 17, and 20 under 35 U.S.C. § 103 as being unpatentable over Ebsen (US

2012/0278530 A1, published Nov. 1, 2012), Kang (US 8,725,931 B1, issued May 13, 2014) and Post (US 2011/0055455 A1, published Mar. 3, 2011). Final Act 2–14.[2]

The Examiner rejected claim 19 under 35 U.S.C. § 103 as being unpatentable over Ebsen, Kang, Post and Higashino (US 2009/0179707 A1, published Jul. 16, 2009). Final Act 14–15.

ANALYSIS

Appellant argues that the Examiner's rejection of independent claims 1 and 11 is in error as the combination of the references does not teach identifying a target recycle ratio in accordance with a current size of a spare pool of erased non-volatile memory blocks to be written to as recited in each of the independent claims. App. Br. 12–18, Reply Br. 7–10. Appellant argues that Ebsen teaches a priority ratio, but never discusses this ratio as the ratio of recycling writes to host page writes as claimed. App. Br. 13–14. Further, Appellant acknowledges that Kang teaches a throttling ratio based upon the number of pages of invalid data in a memory block undergoing garbage collection but does not teach that the ratio is adjusted according to the current size of a spare pool of erased non-volatile memory blocks as claimed. App. Br. 14 (citing Kang, col. 2). Finally, Appellant argues that Post teaches adjusting the recycle ratio in accordance with a block's proportion of valid data, not the current size of a spare pool of erased non-volatile memory blocks as claimed. App. Br. 15 (citing, paras. 43, 60. 69, 70, 71. Concerning Post's teaching in Figure 3, Appellant states:

[2] Throughout this Opinion, we refer to the Appeal Brief, filed February 17, 2017 ("App. Br."), the Reply Brief, filed August 14, 2017 ("Reply Br."), the Examiner's Answer, mailed June 16, 2017 ("Answer"), and the Final Office Action, mailed July 20, 2016 ("Final Act").

> In Post, the number of memory locations in an erased state is used to determine which of three modes of garbage collection, incremental, full-on, or no garbage collection, should be used (see Figure 3, reproduced below). In particular, the number of memory locations in an erased state is compared to a predetermined threshold (i.e., threshold 302), and the result of that comparison is used to enable or disable incremental garbage collection. However, Post does not teach or suggest, "identifying a target recycle ratio in accordance with a current size of a spare pool of erased non-volatile memory blocks available to be written to." Post's threshold, based on memory locations in the die, is merely used to determine if incremental garbage collection should be initiated.

App. Br. 16

The Examiner finds Kang teaches a throttling ratio for garbage collection, which the Examiner equates to the claimed recycling ratio and finds that Kang teaches the ratio can be adjusted based upon monitored conditions including wear level, erase counts. Answer 17 (citing Kang, col. 4, ll. 1–15, 22–27, col. 2, ll. 26–37, col. 3, ll. 24–31, and Figs. 3, 4A, 4B); Final Act. 4. Further, the Examiner finds that

> Post discloses that number of memory locations in a die of NVM that are in erased state, para 0039, Fig. 3. Fig. 4 shows two blocks in an erased state 410, 412, to program additional data into blocks 410, para 0042, which is interpreted as claimed spare pool since the blocks in erase state are available to be written to and are spare storage since they are not being currently used to store data.

Answer 18. Based upon these findings, the Examiner concludes it would be obvious to adjust the throttling ratio based upon the number of pages with invalid data undergoing garbage collection. Answer 18, Final Act. 5.

We disagree with the Examiner's conclusion. Each of the independent claims, 1 and 11, recites "identifying a target recycle ratio in

accordance with a current size of a spare pool of erased non-volatile memory blocks available to be written to, wherein the target recycle ratio is a targeted ratio of recycling page writes to host page writes." We concur with the Examiner that Kang teaches adjusting a recycle ratio and that Post teaches a number of erased non-volatile memory blocks available to be written. However, we do not find that either of the references teaches or suggests the ratio is adjusted in accordance with the size of the spare pool. As argued by the Appellant, Post uses the number of erased state blocks to determine which of three modes to operate in. *See* Post, para. 69 and Fig. 3. In Post's no garbage collection mode and the full-on garbage collection mode there is no discussion of a ratio, as there is either no recycle writes or no host writes. (see Post Fig.3) In the incremental garbage collection mode, the ratio of garbage collection is used and adjusted based upon the proportion of valid data. *See* Post, para. 70. The Examiner has not adequately explained, nor is it apparent to us, how this aspect of Post teaches or suggests adjusting the recycle ratio as claimed. Accordingly, we do not sustain the Examiner's rejection of independent claims 1 and 11 or dependent claims 2 through 5, 7, 10, 12 through 15, 17, and 20.

The Examiner has not shown that the teachings of Higashino, used in the rejection of claim 19, make up for the deficiencies, noted in the rejection of independent claims 1 and 11. Accordingly, we similarly do not sustain the Examiner's rejection of claim 19.

DECISION

The decision of the Examiner to reject claims 1 through 5, 7, 10 through 15, 17, 19, and 20 is reversed.

Claims Rejected	Basis	Affirmed	Reversed
1–5, 7, 10–15, 17 and 20	§ 103 Ebsen, Kang, and Post		1–5, 7, 10–15, 17, and 20
19	§ 103 Ebsen, Kang, Post, and Higashino		19
Outcome			1–5, 7, 10–15, 17, 19, and 20

REVERSED