UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD, and

SAMSUNG ELECTRONICS AMERICA, INC.,

Petitioners,

v.

CELLECT, LLC,

Patent Owner.

Case IPR2020-00512

U.S. Patent No. 9,186,052

PETITION FOR *INTER PARTES* REVIEW

TABLE OF CONTENTS

LIST OF EXHIBITS

Ex. 1001	U.S. Patent No. 9,186,052 ("'052")
Ex. 1002	U.S. Patent No. 9,186,052 File History
Ex. 1003	File History of U.S. Patent No. 6,043,839
Ex. 1004	Declaration of Dr. Dean Neikirk ("Neikirk")
Ex. 1005	WO Application Publication No. 95/34988 ("Swift")
Ex. 1006	U.S. Patent No. 5,835,141 ("Ackland")
Ex. 1007	U.S. Patent No. 5,919,130 ("Monroe")
Ex. 1008	Reserved
Ex. 1009	U.S. Patent No. 4,700,219 ("Tanaka")
Ex. 1010	Reserved
Ex. 1011	Reserved
Ex. 1012	Reserved
Ex. 1013	Reserved
Ex. 1014	Reserved
Ex. 1015	U.S. Patent No. 5,233,426 ("Suzuki")
Ex. 1016	JP Unexamined Patent Publication No. S62-104075 ("Tanuma")
Ex. 1017	Plaintiff Cellect LLC's Amended and Supplemental Objections and Responses to Defendants Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc.'s Interrogatory No. 2
Ex. 1018-Ex. 1025	Reserved

Ex. 1026	Declaration of Drago Gregov
Ex. 1027	U.S. Patent No. 5,903,706 ("Wakabayashi")
Ex. 1028	File History of U.S. Patent No. 9,667,896
Ex. 1029	U.S. Patent No. 5,541,640 ("Larson")
Ex. 1030	U.S. Patent No. 5,756,981 ("Roustaei")
Ex. 1031	U.S. Patent No. 4,630,110 ("Cotton")
Ex. 1032	European Patent Application Publication EP0610938 ("Crosetto")
Ex. 1033	Ricquier, N., *et al.* "CIVIS sensor: a flexible smart imager with programmable resolution," Charge-Coupled Devices and Solid State Optical Sensors IV. Vol. 2172. International Society for Optics and Photonics, 1994. ("Ricquier SPIE")
Ex. 1034	Reserved
Ex. 1035	Butler Affidavit (VISION VM5402 Camera Module Product Datasheet)
Ex. 1036	Mendis, S.K., *et al*. "Progress in CMOS active pixel image sensors," in M.M. Blouke (Ed.), Charge-Coupled Devices and Solid State Optical Sensors IV, pp. 19-29, 1994 ("Mendis")
Ex. 1037	Dickinson, A., *et al.*, "Standard CMOS Active Pixel Image Sensors for Multimedia Applications," Proceedings Sixteenth Conference on Advanced Research in VLSI. IEEE, 1995.
Ex. 1038	Ricquier, N., *et al.* "CIVIS sensor: a flexible smart imager with programmable resolution," Charge-Coupled Devices and Solid State Optical Sensors IV. Vol. 2172. International Society for Optics and Photonics, 1994. ("Ricquier")
Ex. 1039	Reserved
Ex. 1040	Reserved

Ex. 1041	U.S. Patent Publication No. 2001/0010551 ("Dierickx")
Ex. 1042	Hurwitz, *et al.*, "An 800K-Pixel Color CMOS Sensor For Consumer Still Cameras" ("Hurwitz")
Ex. 1043	U.S. Patent No. 5,837,994 ("Stam")
Ex. 1044	U.S. Patent No. 5,221,964 ("Chamberlain")
Ex. 1045	Charles Hamilton, *A Guide to Printed Circuit Board Design* (1984) ("PCB Design")
Ex. 1046	Hurwitz, *et al.*, "An 800K-Pixel Color CMOS Sensor For Consumer Still Cameras" ("Hurwitz Cornell")
Ex. 1047	Hurwitz, *et al.*, "An 800K-Pixel Color CMOS Sensor For Consumer Still Cameras" ("Hurwitz SPIE")
Ex. 1048	Fossum, E.R., "Active-pixel sensor challenge CDDs," *Laser Focus World* 29(6), p. 83-87, June 1993 ("Fossum93")
Ex. 1049-Ex. 1059	Reserved
Ex. 1060	"NASA's Tiny Camera Has A Wide-Angle Future," Business Week (March 6, 1995)
Ex. 1061-Ex. 1069	Reserved
Ex. 1070	Explanation of Multiple Petitions
Ex. 1071-Ex. 1084	Reserved
Ex. 1085	U.S. Patent No. 5,859,878 ("Phillips")

Pursuant to §§311-319 and §42,[1] Samsung Electronics Co., Ltd, and Samsung Electronics America, Inc. ("Petitioner") petition for *inter partes* review ("IPR") of claim 2 ("Challenged Claim") of U.S. Patent 9,186,052 ("'052") (Ex. 1001), assigned to Cellect, LLC ("PO"). There is a reasonable likelihood the Challenged Claim is unpatentable as explained herein. Petitioner requests review of the Challenged Claim, and judgment finding them unpatentable under §103.

I. INTRODUCTION

The '052's purported invention is a "reduced area imaging device…for use in medical or dental instruments such as an endoscope" with circuity rearranged to locate components on different "planes" to minimize the device's size. '052, Abstract, 3:32-37. The '052's image sensor and processing circuitry are placed on different boards or chips. As shown in Figure 2b, *e.g.*, a claimed embodiment includes a "first plane" with image sensor 40 (including a circuit board with an array of CMOS pixels and timing and control circuitry) that outputs a pre-video signal, and a "second plane" with video processing board 50 that converts the pre-video signal to a post-video signal.

[1] Section cites are to 35 U.S.C. or 37 C.F.R. as context indicates, and all emphasis/annotations added unless noted. Annotations generally apply the language of the Challenged Claim.

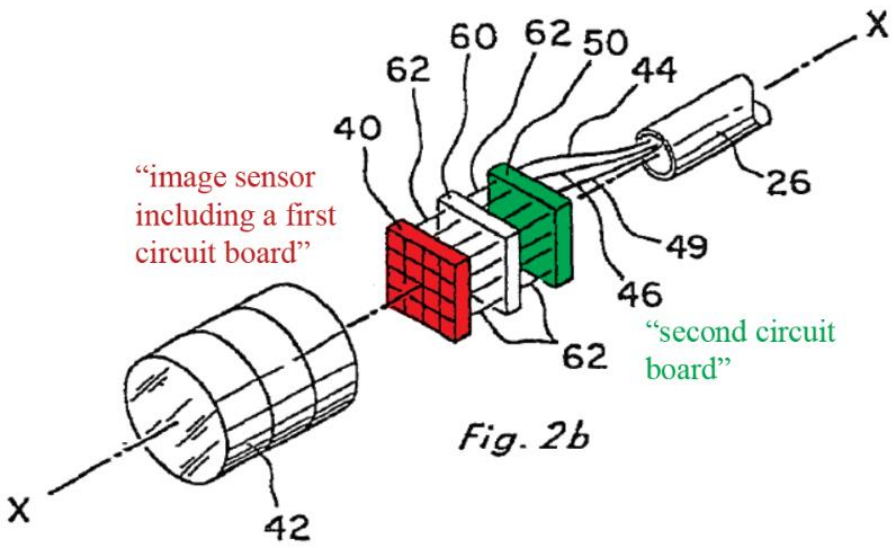

Fig. 2b

The ’052 admits that the individual components within the claimed imaging device were well-known in the art prior to the ’052. *See* ’052, 1:60-3:23, 14:4-10, 15:29-32. For example, the ’052 acknowledges that CMOS imaging devices were well-known, and were known to be smaller and have simpler system interfaces than other solid-state image sensors. *Id.*, 1:60-3:23. The ’052 acknowledges that “timing circuits” and “controls” were known, and it was known to “incorporate” these timing and control circuits “on the same circuit board containing the CMOS pixel array” or to use “multiple circuit boards.” *Id.*, 2:9-15, 2:25-34.

The only purportedly novel feature in the ’052 is the arrangement and relative size of the image sensor, the timing and control circuitry and the video processing board to minimize the imaging device’s size. For example, the Examiner only allowed the Challenged Claim after the following limitations were added to claim 2:

the "largest dimension of said image sensor along said first plane is between 2 and 12 millimeters"; and "said second circuit board being positioned in a stacked arrangement with respect to said first circuit board" rather than "offset from said first circuit board." '052 FH (Ex. 1002), 35-41. But, as discussed herein, it was well-known to configure a CMOS imaging device, including its image sensor and the related circuitry, in the very same way as the '052 to minimize the overall device size.

For example, as shown by **Swift**, it was known to organize the components of a CMOS imaging device such that the image sensor including a first circuit board located on a first plane, and the circuitry for converting the pre-video signal to a post-video signal is located on a second circuit board. *E.g.*, Swift (Ex. 1005), 8:31-9:18, 18:25-33, Fig. 2. An example embodiment of such an arrangement is shown by **Swift's** Fig. 2:

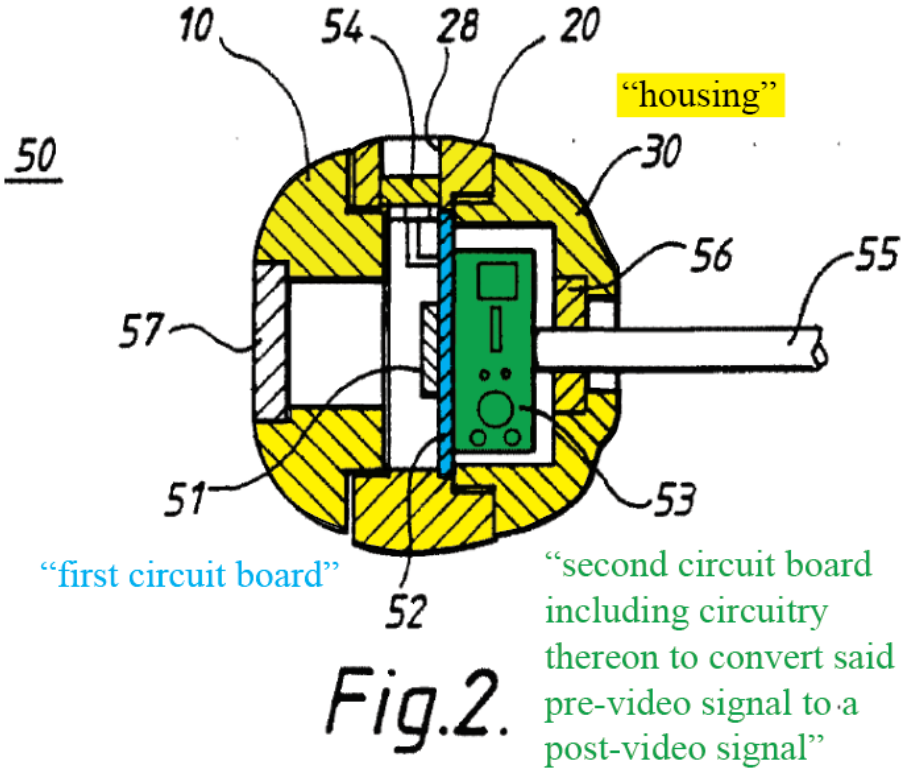

Fig.2.

Suzuki (Ex. 1015) discloses a second circuit board in a parallel plane to the first circuit board of an image sensor. Suzuki, 3:15-25, Fig. 2. Additionally, **Suzuki** (Ex. 1015) and **Dierickx** (Ex. 1041) both disclose that the image sensor has a largest dimension between 2 and 12 millimeters. *E.g.*, Suzuki, 4:6-11, 1:53-56, 4:58-61, Fig. 2; Dierickx, ¶32. **Ackland**, **Ricquier**, and **Dierickx** all disclose that the image sensor is of a generally square shape. *E.g.*, Ackland, Fig. 6; Ricquier, 3; Dierickx, ¶32.

The Challenged Claim is directed to an obvious combination of prior art elements combined according to known methods to yield predictable results. *KSR Intern. Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1731 (2007). There are only a "finite

number of identified, predictable solutions" for how to arrange the device elements, all of which would have been obvious to a POSITA. *Id.*; Neikirk, ¶¶38-47. Both the claimed components and the claimed arrangement of components was known in the prior art, and the combination amounts to little more than a "predictable use of prior art elements according to their established functions." *KSR*, 127 S.Ct. at 1732; *see also* PCB Design (Ex. 1045, published 1984), 15, 20.

The USPTO did not consider the above prior art during the '052's prosecution or any references providing analogous technical features. Had such references been available and considered previously, the Challenged Claim would have been found unpatentable.

Petitioner requests the Board institute trial and find the Challenged Claim unpatentable.

II. MANDATORY NOTICES (§42.8)

A. Real Party-In-Interest

Samsung Electronics Co. Ltd. and Samsung Electronics America, Inc. are real parties-in-interest. No other party had access to or control over the present Petition, and no other party funded or participated in preparation of the present Petition.

B. Related Matters

Cellect, LLC v. Samsung Electronics Co., Ltd et al., 1-19-cv-00438 (D. Colorado) ('052 claims 1-3, 7 asserted) (pending).

Petitioner is challenging the ’052 in two petitions due to the length and differences of the claims challenged, and provides a further explanation of these parallel petitions in Ex. 1070:

Petition	Claims
IPR2020-00475	1, 3, 7
This Petition	2

The following table lists matters regarding related patents:

Patent No.	IPR/Reexam
6,043,839	IPR2020-00472
6,275,255	IPR2020-00473
6,982,740	IPR2020-00474 *ex parte* reexam
9,198,565	IPR2020-00476
9,667,896	IPR2020-00477
6,982,742	IPR2020-00559 IPR2020-00560 IPR2020-00561 *ex parte* reexam
6,424,369	IPR2020-00562 IPR2020-00563 IPR2020-00564 *ex parte* reexam
6,452,626	IPR2020-00565 IPR2020-00566 IPR2020-00567 *ex parte* reexam

6,862,036	IPR2020-00568 IPR2020-00569
7,002,621	IPR2020-00571 IPR2020-00572 *ex parte* reexam

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Petitioner consents to electronic service of documents to the email addresses of the counsel identified above.

III. PAYMENT OF FEES

The undersigned authorizes the Office to charge the fee required by §42.15(a) and any additional fees to Deposit Account No. 18-1945, under Order No. 110797-0036-661.

IV. REQUIREMENTS FOR INTER PARTES REVIEW

A. Grounds for Standing

Pursuant to §42.104(a), Petitioner certifies the '052 is available for IPR. Petitioner is not barred or estopped from requesting IPR challenging the claim on the grounds identified herein.

B. Identification of Challenge

Pursuant to §§42.104(b)-(b)(1), Petitioner requests IPR of '052 claim 2, and that the Board cancel the same as unpatentable.[2]

1. The Specific Art on Which the Challenge is Based

Petitioner relies upon the following prior art:

Name	Ex.	Patent	Filed	Published / Issued	Prior art under at least
Swift	1005	WO95/34988		12/21/1995	§102(b)
Larson	1029	US 5,541,640		7/30/1996	§102(b)

[2] Petitioner takes no position as to, but reserves the right to challenge, the priority claims' propriety since the art presented herein predates the '052's earliest possible filing date.

Suzuki	1015	US 5,233,426		08/03/1993	§102(b)
Ricquier	1038, 1033			1994	§102(b)

These references were not cited in an Information Disclosure Statement, identified by the Examiner, or applied in a rejection during '052's prosecution. The Examiner never considered the grounds presented herein or the testimony of Petitioner's expert Dr. Dean Neikirk ("Neikirk," Ex. 1004) regarding the prior art's scope and content. *See* Ex. 1002. The presented grounds are not cumulative of any prior art previously considered, and are not the same or substantially the same as prior art or arguments previously considered. Co-pending district court proceedings also do not warrant the exercise of discretion under §314(a). *See, e.g., Precision Planting, LLC v. Deere & Company*, IPR2019-01044, Paper 17, *9-18. Moreover, litigation is it its early stages—PO only served its infringement contentions on 11/21/2019 and confirmed which claims it was asserting on 12/18/2019. The Board should not exercise its discretion to deny institution. §§314(a), 325(d).

2. Statutory Grounds on Which the Challenge is Based

Ground	References	Basis	Claims
1	Swift in view of Ricquier and Suzuki	§103	2
2	Larson in view of Swift, Ricquier, and Suzuki	§103	2

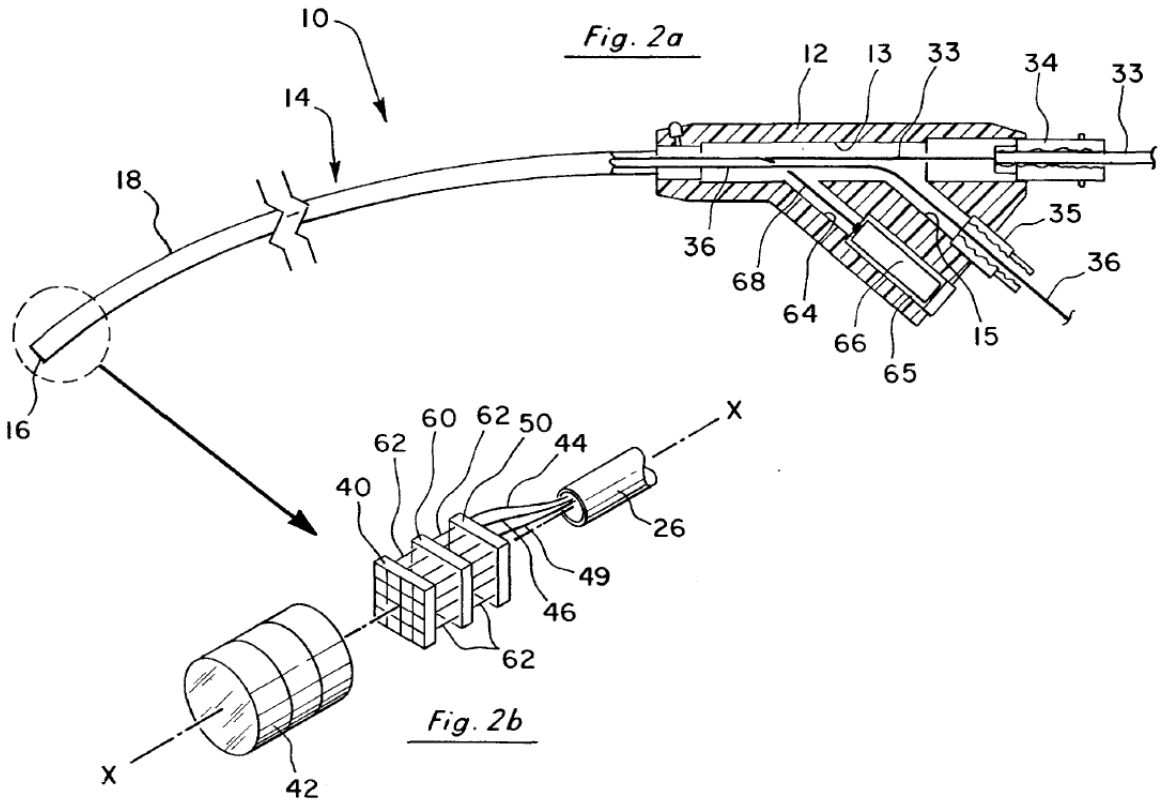
3. How the Challenged Claim Is Unpatentable

Petitioner provides the information required under §§42.104(b)(4)-(5) in §IX.

V. ’052 PATENT

The ’052 describes endoscopic instruments utilizing off-the-shelf solid state imaging technology. ’052, 1:52-57. The ’052 acknowledges CMOS image sensors and “timing circuits” and “controls” were well-known, and that it was known to “incorporate” these circuits “on the same circuit board containing the CMOS pixel array” or to use “multiple circuit boards.” *Id.*, 1:57-2:34. A CMOS imager incorporating this circuitry on a single chip is called “camera on a chip.” *Id.*, 2:15-19. The ’052 also acknowledges that image sensors utilizing active pixels “with an amplifier at each pixel site” were known (*id.*, 1:66-2:9) and that it was known to form image sensors on semiconductor substrates (*id.*, 2:42-46). Neikirk, ¶48.

The ’052 acknowledges that preexisting “camera on a chip” systems could combine elements “usually found on multiple circuit boards of much larger size…without significantly increasing the overall size” of the device. ’052, 2:9-15. The ’052 allegedly improves on this concept by “rearrang[ing] the circuitry [into] a stacked relationship so that there is a minimum profile presented when used within a surgical instrument.” ’052, 3:34-37. An example is depicted in Figs. 2a-2b:



In endoscope 10, "[i]mage sensor 40 is illustrated as…planar and square shaped" as opposed to "planar and circular shape[d]." *Id.*, 9:3-6. Board 50 is "longitudinally aligned with image sensor 40 along longitudinal axis XX" such that planes, respectively defined by the lengths and widths of image sensor 40 and board 50, are offset from one another in a parallel configuration. *Id.*, Fig. 2b, 10:4-8. Also housed in the endoscope is a lens group or system 42 used to focus the image onto the pixel array. *Id.*, 9:8-13. Board 50 may contain timing and control circuitry (*id.*, 9:58-10:19, 12:3-25, Fig. 2b) as well as processing circuitry that conditions the pre-video signal to place the signal in a form that can be viewed on a standard video device (*id.*, 9:31-37, 9:65-10:2). Timing and control circuitry can also be on the image

sensor 40 itself. *Id.*, 11:50-12:21. The imaging device may use a "wired connection[] for transferring video images to a video display." *Id.*, 4:32-35. Neikirk, ¶¶49-50.

VI. PROSECUTION HISTORY

U.S. Application 14/705,334, which matured into the '052, was filed 5/6/2015. The Examiner issued an Office Action on 8/13/2015 rejecting several claims as obvious, including claims specifying the image sensor has a generally square shape along a first plane. '052 FH, 50. Applicant cancelled all claims and submitted new claims 25-31 (which correspond to issued claims 1-7) on 9/10/2015, adding limitations to the previously rejected claims reciting: the "largest dimension of said image sensor along said first plane is between 2 and 12 millimeters" (claims 25, 26, 27); the "image sensor has a generally square shape along said first plane" (claim 25); and "said second circuit board being positioned in a stacked arrangement with respect to said first circuit board" rather than "offset from said first circuit board" (claim 26). *Id.*, 35-41. Notably, the Examiner previously found limitations requiring "a generally square shape" and the "second circuit board…in a stacked arrangement with respect to said first circuit board" obvious. *Id.*, 50 (rejecting as-filed claim 2); US9,667,896 FH (Ex. 1028), 120-122 (rejecting as-filed claims 7 and 19). A Notice of Allowance issued 9/21/2015 and the '052 patent issued 11/17/2015.

VII. LEVEL OF ORDINARY SKILL

On or before 10/6/1997, a person of ordinary skill in the art ("POSITA") would have had a minimum of a Bachelor's degree in Electrical Engineering, Physics, or a related field, and approximately two years of professional experience in the field of imaging devices. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education. Neikirk, ¶¶34-37.

VIII. CLAIM CONSTRUCTION

Terms of claims subject to IPR are to be construed according to the *Phillips* standard applied in district court. §42.100(b). Only terms necessary to resolve the controversy need to be construed. *Nidec Motor* v. *Zhongshan Broad Ocean Motor*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). For review purposes, Petitioner interprets the claim terms according to their plain and ordinary meaning consistent with the specification.

IX. GROUNDS OF UNPATENTABILITY

The '052 is directed to an imaging device that employs well-known features such as an array of CMOS pixels each including an amplifier, timing and control circuitry, circuitry for converting pre-video signals to post-video signals, a lens integral with the imaging device, a video screen for receiving the post-video signals, and a power supply. Nevertheless, as discussed in §VI, the Challenged Claim was

allowed after the following limitations were added: the "largest dimension of said image sensor along said first plane is between 2 and 12 millimeters" (claim 2); and "said second circuit board being positioned in a stacked arrangement with respect to said first circuit board" rather than "offset from said first circuit board" (claim 2). '052 FH, 35-41. Despite the recitation of various implementation choices, the claimed features were known in the prior art and would have been obvious to a POSITA before the '052 as explained below.

Swift describes an imager apparatus (*e.g.*, "CMOS/APS (Active Pixel Sensor) type") with a substrate and circuit board, and converting circuitry on a second circuit board connected to the image sensor. **Ricquier** makes explicit implementation details regarding the image sensor applicable to **Swift**, such as the pre-video signal output from the image sensor, arrangement of CMOS pixels on the sensor in an array, and the timing and control circuitry for reading out the image data. As the '052 acknowledges, and **Swift** citing to Fossum93 (Ex. 1048) confirms, each CMOS active pixel includes an amplifier. **Ricquier** discloses off-chip timing and control circuitry, which would have been obvious to place on the underside of Swift's first circuit board. **Swift** also describes circuitry that converts pre-video signals from the image sensor to post-video signals, a power supply for powering the imager apparatus, and a lens integral with the imager apparatus (as well as their location relative to other elements). **Swift** further describes a video screen to receive the

post-video signal from the circuit board. **Suzuki** makes explicit that the circuit boards can be in a stacked configuration and lie in planes that are substantially parallel. **Suzuki** also discloses an image sensor with a largest dimension between 2 and 12 millimeters. **Larson** (Ex. 1029) discloses that it was known to package the display within the same housing as the image sensor and related circuitry.

As shown below, the prior art renders the Challenged Claim unpatentable. This Petition is supported by the Declaration of Dr. Dean Neikirk, which describes the prior art's scope and content at the time of the '052's alleged invention. ("Neikirk," Ex. 1004 ¶¶1-56, 149-153, 161-165, 228-315).

A. Ground 1: Claim 2 Is Rendered Obvious by Swift in View of Ricquier and Suzuki

1. Overview of Swift

Swift teaches a miniature video camera that includes a housing and an image sensor mounted in the housing. *E.g.*, Swift, Abstract, 4:11-15, 8:31-9:5, Fig. 2. As shown in Figure 2 (below), the miniature video camera, includes housing, image sensor 51 mounted on a circular circuit board 52 lying in a first plane, and a rectangular circuit board 53, which includes various circuitry components "to provide power to the image sensor 51," and "process image signals received therefrom," including a video processor for converting the pre-video signal generated by the image sensor to a post-video signal. *E.g.*, Swift, 8:31-9:13, 3:31-

4:4; Neikirk, ¶¶228-229. **Swift**'s image sensor 51 is a CMOS Active Pixel Sensor (APS) type chip. Swift, 10:1-6. As the '052 recognizes, each pixel of a "CMOS/APS (Active Pixel Sensor)" includes an amplifier. '052, 1:66-2:1, 2:23-25. **Swift** confirms this, as it provides that "information on APS-type sensor can be found in" Fossum93 (Ex. 1048) at Page 83, which states that "[i]n the active-pixel sensor, several active transistors are monolithically integrated in the pixel…. These transistors are used for … amplifying … the pixel output signal." Swift, 10:1-6; Fossum93, 83. Similarly, **Dierickx** further confirms that "[a]n active pixel is configured with means integrated in the pixel to amplify the charge…." Dierickx, ¶6. Neikirk, ¶230.

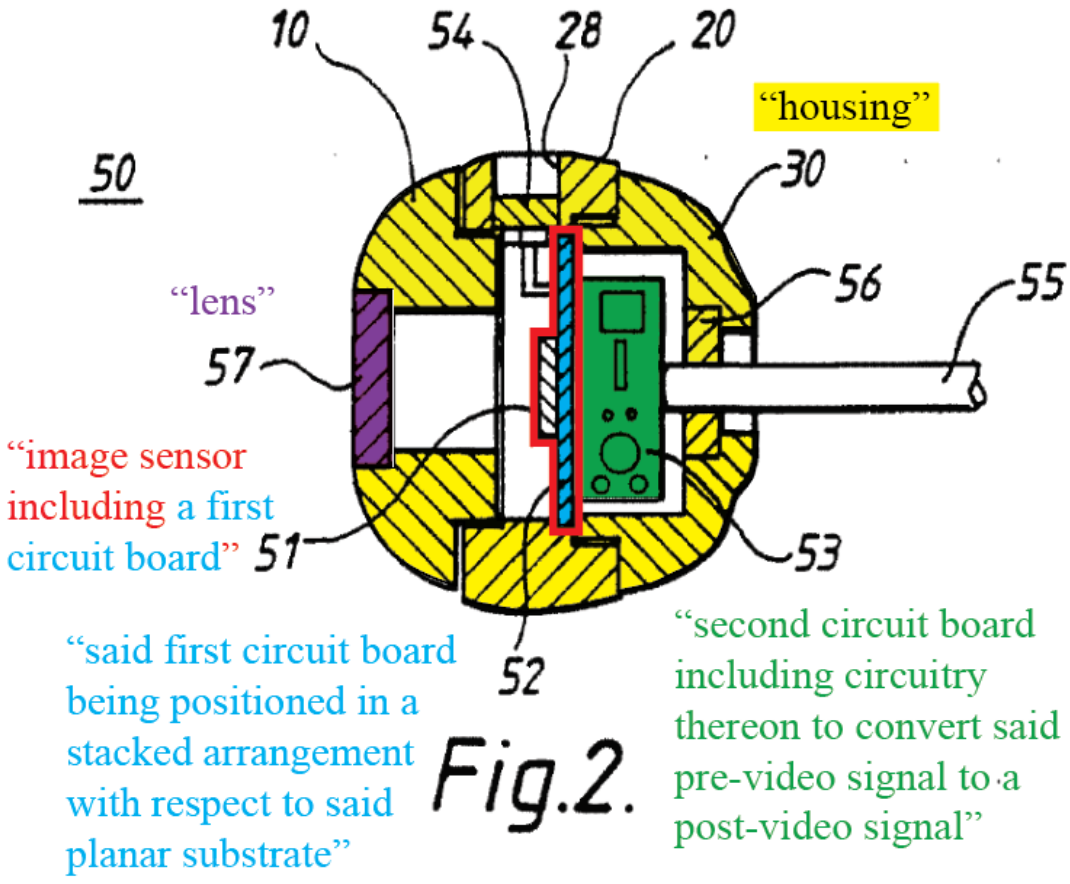


Fig.2.

Swift's image sensor 51 and circular circuit board 52 are mounted within the camera's housing by clamping the circular circuit board in position with the housing's rear portion. *Id.*, 8:33-9:5. Circuit board 53 is electrically connected to both circuit board 52 and image sensor 51, and has circuitry to process the image signals received from image sensor 51 and audio signals from microphone 54 connected to circuit board 52. *Id.*, 9:7-13. Neikirk, ¶231.

Swift discloses configuring circuit boards 52 and 53 and their associated circuitry in multiple different ways. Swift, 19:8-29. In one example configuration of circuit boards 52 and 53, **Swift** teaches disposing its components in other orientations. Swift, 18:25-33. Thus, while **Swift** shows circuit board 53 at a right angle to image sensor 51 in Fig. 2, a POSITA would have understood **Swift** to also teach circuit board 53 parallel to circuit board 52. Neikirk, ¶232. Indeed, given that **Swift** explicitly discloses that "rear housing portion 30" can be changed to "accommodate … [the] different configuration[]," circuit board 53 with the video processing circuitry also fits in housing 30 parallel to board 52. Swift, 10:12-16; Neikirk, ¶232. A POSITA would have understood that the orientation of circuit boards is often dictated by the housing's shape and dimensions. Thus, a more compact housing with less depth would naturally suggest stacking circuit boards parallel to one another. At minimum, a POSITA would have been motivated to orient the circuit board 53 in this manner to allow the device to be more compact. *E.g.*, Swift, 10:12-16; Roustaei (Ex. 1030, filed 08/1/1996), 43:38-44 ("*[T]he number of printed circuit boards is a design choice* …. whatever quantity *permits the device's components to be fitted into the dimensions of the intended housing*."), 54:7-11; Cotton (Ex. 1031, issued 12/16/1986), 13:30-35; Crosetto (Ex. 1032, published 8/17/94), 15:35-46. Neikirk, ¶¶232-233.

To power the sensor, **Swift** describes a battery and a voltage regulator within the camera's housing that provide power to the components on the printed circuit board(s) and the image sensor. *E.g.*, Swift, 3:31-4:4, 4:21-22, 9:7-13. **Swift's** battery and voltage regulator provide power to (and thus are electrically coupled to and drive) the "image sensor 51" (including its pixels) and circuit boards 52 and 53. Neikirk, ¶234. In addition, **Swift** discloses the voltage regulator is mounted on an assembly in the camera's housing. And based on Swift's disclosure that "the housing 50" has "sufficient room to house a battery," a POSITA would have understood that the battery is mounted in the housing. Neikirk, ¶234.

Swift describes a wide angle lens mounted on a front housing portion so that the lens focuses the image onto the image sensor. Swift, Fig. 2 (above), 9:23-28. Neikirk, ¶235.

Swift also discloses that the "signal … from the camera" is received by a "display" connected by a "cabling system" "to the camera." Swift, 15:7-14, 17:34-18:2. Thus, image signals received from image sensor 51 are processed and output from the circuit board in a form that can be viewed directly by a display. The "video monitor" is electrically coupled to "circuit board 53" to allow the "process[ed] image signals" to be transmitted to the video monitor. While **Swift** discloses the "video monitor" as a separate device from the miniature camera, a POSITA would have found it to be an obvious implementation choice to include the camera and the

display within close proximity (*e.g.*, a short cable), such that they are within the same enclosure. For example, a POSITA would have been motivated to mount the camera through a wall or door, *e.g.*, with a display on the other side of the wall/door to advantageously view the video of the other side for surveillance or security purposes. Neikirk, ¶236.

2. Overview of Ricquier and Motivation to Apply Its Teachings to Swift

As discussed above, **Swift** teaches miniature video camera that includes an image sensor mounted in the housing. *See* §IX.A.1.

Ricquier is a conference paper that was disseminated and available in libraries by 5/27/1994 and qualifies as a printed publication. Exs. 1033, 1038; Neikirk, ¶¶302-308. **Ricquier** describes a dedicated imager for a camera programmed to operate in several resolutions. *E.g.*, Ricquier, 2. The imager includes a CMOS array of 256*256 pixels addressable by column and row (*i.e.*, "X-Y addressable") using a timing controller on an off-chip driving unit. *E.g.*, *id.*, 3, 5, 9. Figure 1 shows a schematic representation of 2*2 of the 256*256 CMOS pixel array:

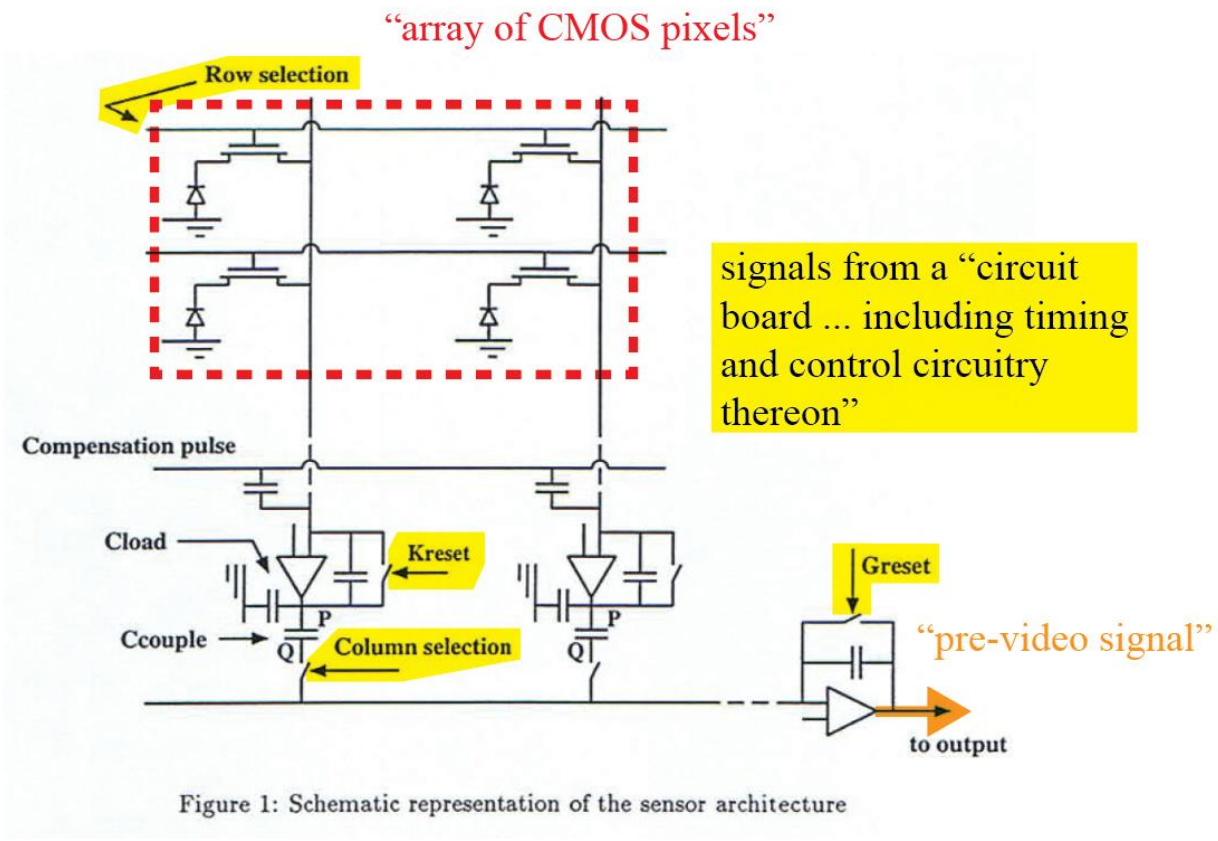


Figure 1: Schematic representation of the sensor architecture

E.g., *id.*, 1, 3, 5, 9, Fig. 1. Neikirk, ¶¶161-163.

Ricquier teaches the array acquires image data by sequentially driving row selection signals to "transfer[] in parallel a row of charges to 256 charge sensitive amplifiers" and outputting these signals from the array, as shown in Figure 1. *E.g.*, Ricquier, 2-3. A POSITA would have understood **Ricquier's** "image data" "output" as shown in Figure 1 is a pre-video signal produced by **Ricquier's** image sensor. *E.g.*, *id.*, 2-4; Neikirk, ¶¶164-165. **Ricquier** teaches the readout is done by "controlling the clocking scheme" using a "timing controller" on "an off-chip

driving unit" for driving the "row selection," "column selection," and reset signal inputs. Neikirk, ¶165.

While **Swift** does not expressly state that its CMOS active pixels are in an array, **Ricquier** provides this additional implementation detail of a "256*256 X-Y addressable photodiode array … realised in a 1.5 μm standard CMOS technology." *E.g.*, Ricquier, 9. Similarly, while **Swift** does not expressly disclose how the timing of its pixels is controlled other than referring to sensor "selection and readout" circuitry, **Ricquier** discloses that the readout from the "256*256 imager" is driven by a "timing controller (realised in an off-chip driving unit)," by "transfering … charges of different pixels" "to a single output amplifier." *E.g.*, Ricquier, 2-4, 9. **Ricquier** also teaches that its timing controller is "off-chip" from the array of pixels. *E.g.*, Ricquier, 3, 4. Neikirk, ¶238.

A POSITA would have been motivated to apply **Ricquier's** known teachings described above in implementing **Swift's** CMOS image sensor. Like **Swift**, **Ricquier** is in the same field of art and is analogous art to the '052—all are in the same field related to solid-state image sensors. *E.g.*, Ricquier, 2-3, 5, 9. In addition, like **Swift**, **Ricquier** is also reasonably pertinent to the alleged problem(s) identified in the '052 of arranging the circuitry of a CMOS image sensor, including to minimize the device's size or profile area, and to reduce image noise in CMOS sensors. *E.g.*, Ricquier, 2-3, 8 (noise reduction). Neikirk, ¶239. A POSITA would have been

further motivated to apply **Ricquier's** known teachings in implementing **Swift's** image sensors because of **Ricquier's** advantages of using an "timing controller" that can be located off-chip, which adds flexibility in selecting from the several design choices for "fitting … the components into the available space" and "plac[ing]" circuitry on "various layers" arranged "stackwise" to "allow[] for a more compact camera head." Ricquier, 3, 4; PCB Design, 15, 20; Tanuma (Ex. 1016, published 5/14/1987), 4-5; Neikirk, ¶239.

A POSITA would have been motivated to apply **Ricquier's** teachings of an off-chip timing and control circuitry in implementing Swift's image sensor by locating the timing and control circuitry on, for example, on the opposite side of **Swift's** "circuit board 52" to "image sensor 51" in order to minimize the camera's overall size. *E.g.*, Tanuma (Ex. 1016; published 5/14/1987), 4-5 (benefits of mounting image sensor chip on one side of a circuit board and other circuit components on the circuit board's underside include that it "does not require many lead wires, so there is a high degree of reliability, and excellent matching characteristics…[and] allow[s] for a more compact camera head"); Suzuki, Fig. 2 (mounting circuitry on the opposite side of chip-connecting board 226 from image pickup chip 221). Furthermore, it was well-known in the art that "fitting of the components into the available space" and "placement" of circuitry on "various layers" arranged "stackwise," is a common design consideration for portable

devices. PCB Design (Ex. 1045, published 1984), 15, 20; Tanuma, 3-4; Neikirk, ¶239. In addition, a POSITA would have been further motivated to apply Ricquier's known teachings in implementing Swift's CMOS solid-state imager because of Ricquier's express advantages of "selective addressability" and "multiple resolutions … [and] data rates upto 10 MHz." *See, e.g.*, Ricquier, 2. Neikirk, ¶239.

In light of the above, a POSITA would have found it routine, straightforward and advantageous to apply **Ricquier's** known teachings of an array of CMOS pixels and off-chip timing controller in implementing **Swift's** image sensor, and would have known that such a combination (yielding the claimed limitations) would predictably work and provide the expected functionality. Neikirk, ¶¶237-240.

3. Overview of Suzuki and Motivation to Apply Its Teachings to Swift as modified by Riquier

Suzuki discloses a camera head for a solid-state image pickup device and expressly discloses configuring an image sensor and multiple circuit boards such that they are parallel and longitudinally aligned. *E.g.*, Suzuki, 4:6-11, 3:1-49, Figs. 3A-3D, Fig. 2.

A POSITA would have been motivated to apply **Suzuki's** known teachings of an image sensor comprising a first circuit board lying in a first plane and second circuit board lying in a second plane parallel to the first, such that the first and second circuit boards are in a stacked arrangement with one another, in implementing

Swift's teachings of a miniature camera (as modified by **Ricquier's** teachings) where Swift's circuit board 53 is oriented parallel to circuit board 52 to reduce the camera's overall size and to improve the camera device's "stability and reliability." *E.g.*, Suzuki, 1:53-56, 3:61-4:12, 4:30-65; Neikirk, ¶¶241-242, 149-153. As discussed above, while **Swift** describes "circuit board 53" as being "substantially at right angles" to "circuit board 52," **Swift** also explains its "specification…denote[s] the usual orientation of items in normal use and/or as shown in the accompanying drawings" and that "such items could be disposed in other orientations." Swift, 18:25-33. **Swift** further acknowledges that the "rear housing portion 30 may be replaced by another portion of different configuration … to accommodate … components of different configurations." *Id.*, 10:12-16. By arranging the image sensor and circuit boards so that they are "aligned with each other" as illustrated in Fig. 2, **Suzuki** explains that its camera head "has an outer diameter closer to a diagonal length of a solid-state image pickup chip" which, **Suzuki** demonstrates, is "10 mm, … small [by] about 5 mm than that of the conventional camera head." Suzuki, 1:53-56, 3:15-19, 4:6-11. By applying the above teaching of **Suzuki** in implementing **Swift's** teachings of a miniature camera (as modified by **Ricquier's** teachings) the camera's overall size would be reduced, furthering **Swift's** express objective of make the "camera…as small as possible, so that it may be located

discretely in such a way that it is not readily observed." Swift, 1:10-13. Neikirk, ¶243.

A POSITA would have been motivated to apply **Suzuki's** known teachings of an image sensor comprising a "chip-connecting board 226" between 8.5 and 10 mm in implementing **Swift's** teachings of a miniature camera (as modified by **Ricquier's** teachings) such that the miniature camera's overall size is reduced thus improving the camera device's "stability and reliability." *E.g.*, Suzuki, 1:53-56, 3:1-49, 3:61-4:12, 4:30-65. **Suzuki** explains that its arrangement of image sensor and circuit boards allows "not only the solid-state image pickup chip but also the boards, including the electric circuits parts, [to] be sealed, and therefore … advantageously enhance[]" "the stability and reliability of the circuit." *E.g.*, Suzuki, 4:30-45, 3:61-4:6; Neikirk, ¶244.

A POSITA also would have been motivated apply **Suzuki's** known teaching in implementing **Swift's** imager apparatus because, as **Suzuki** expressly discloses, this arrangement of its image sensor and circuit board allows for the "camera head [to have] an outer diameter closer to a diagonal length of a solid-state image pickup chip" (*e.g.*, Suzuki, 1:53-56, 4:6-11, 4:58-65)—thus furthering **Swift's** objective of making the "camera … as small as possible" (*e.g.*, Swift, 1:10-18, 9:30-33). Neikirk, ¶245. While **Suzuki** uses a generic "solid-state image pickup chip of … 8.5 mm," Suzuki's teachings are applicable to CMOS image sensor chips of similar diagonal

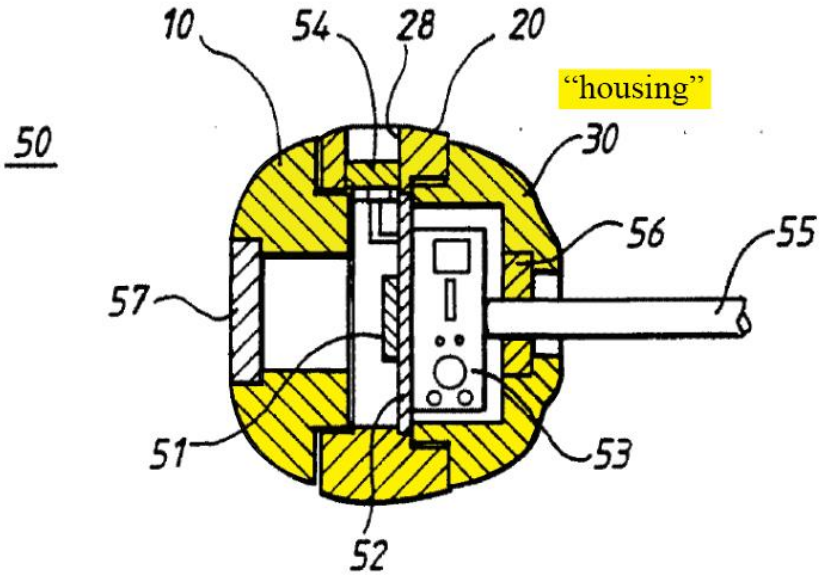
lengths, well know at the time. *E.g.*, Dierickx, ¶32 (disclosing CMOS image sensor chip with 8.5-mm diagonal length); Mendis, 21 (disclosing CMOS image sensor with 9.6-mm diagonal length); Dickinson, 222 (disclosing CMOS image sensor with 6.7-mm diagonal length). Neikirk, ¶245.

In light of the above, a POSITA would have found it routine, straightforward and advantageous to apply **Suzuki's** known teachings of arranging an 8.5-mm image pickup chip, a chip-connecting board, and a second circuit board, in parallel planes and in a stacked configuration to fit within a 10-mm diameter casing, in implementing **Swift's** teachings of an miniature camera (as modified by **Ricquier's** teachings), and would have known that such a combination (yielding the claimed limitations) would predictably work and provide the expected functionality. Neikirk, ¶¶241-246.

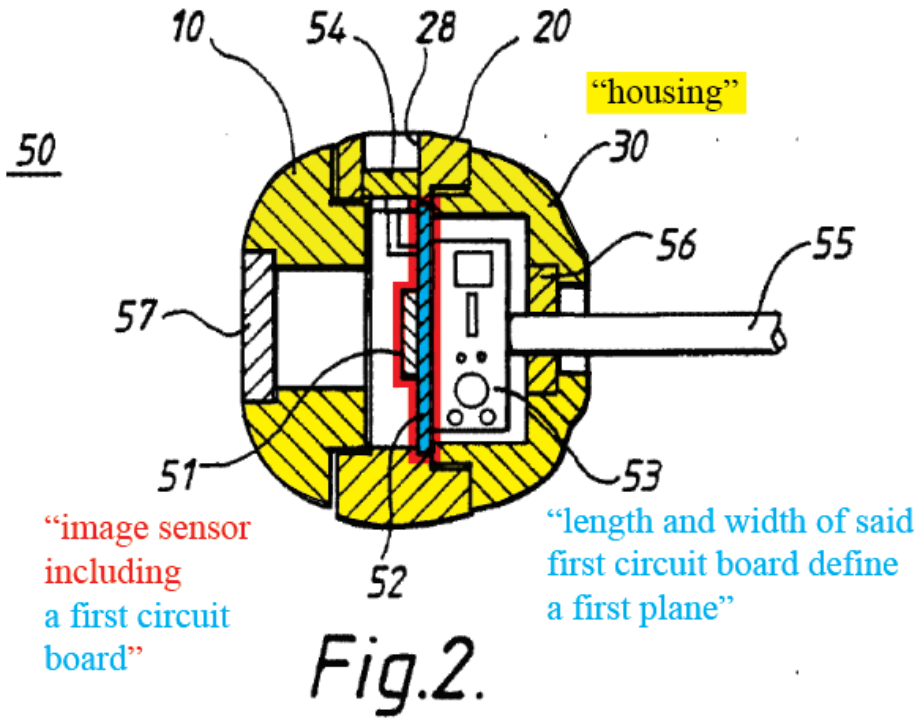
4. Claim Chart—Swift in view of Ricquier and Suzuki

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
[2.pre] An imaging device comprising:	**To the extent the preamble is limiting, Swift discloses an imaging device** (*e.g.*, "miniature camera" and "video monitor…to display a signal received from the camera"). ***E.g.*, Swift:** **Swift** discloses "miniature cameras" for various applications, including surveillance and security systems.

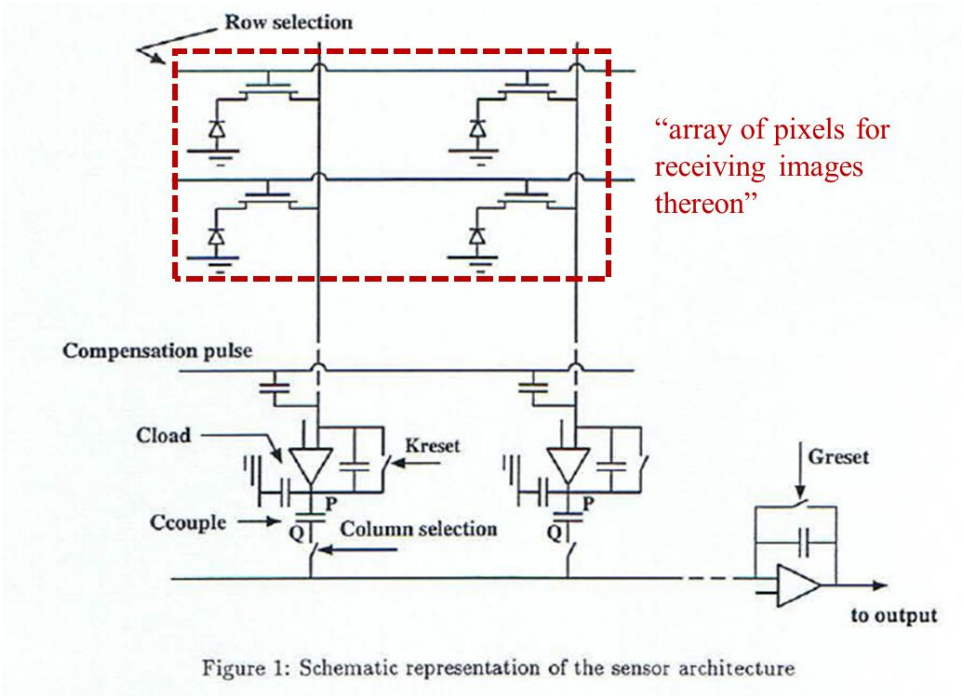
Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	• **1:2-5** ("This invention relates to cameras and is concerned particularly, although not exclusively, with *miniature cameras*.") • **15:7-9** ("A *video monitor* or TV 154 is provided, to *display a signal received from the camera 152*.") To the extent the claimed "imaging device" requires **Swift's** "video monitor" to be within the same physical housing as its "camera"—as opposed to the two components connected via a cable as disclosed in **Swift**, as discussed in §IX.A.3, a POSITA would have found it to be an obvious implementation choice to include the camera and the display within close proximity (*e.g.*, a short cable), such that they are within the same enclosure. • **1:7-10** ("Miniature cameras are finding increasing application in *surveillance and security systems*, and also in automated inspection apparatus, and for incorporation in other devices.") Neikirk, ¶¶247-249.
[2.a] a housing;	**Swift discloses a housing** (*e.g.*, "housing")**.** ***E.g.*, Swift:** **Swift** discloses that the "miniature camera" has a "housing" comprised of "three housing portions…engaged with one another." • **8:31-33** ("Figure 2 shows the *three housing portions 10, 20 and 30 engaged with one another*, to make up the *housing*, which is generally ovoid, or egg-shaped.") • **10:26-29** ("Figure 3 shows a miniature camera 60, which is generally similar to the camera 50 of Figures 1 and 2. In Figure 3, *the camera 60 comprises a housing 61* which is mounted on a stand 70 comprising a base 71 and an upstanding arm 72.")

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	• **8:15-16** ("In use, *the front and rear housing portions 10 and 30* screw-threadedly engage the *central housing portion* 20.") • **Fig. 2:**  Fig.2. • **Fig. 3** ***See also, e.g.*, 7:10-15, Figs. 1a-1c** (illustrating housing portions). Neikirk, ¶¶250-251.
[2.b] an image sensor mounted in said housing, said image sensor including a first circuit	**Swift discloses an image sensor** (*e.g.*, "image sensor 51," "a CMOS sensor" "mounted on a circular printed circuit board 52") **mounted in said housing** (*e.g.*, "mounted…in the central housing portion 20")**, said image sensor including a first circuit board** (*e.g.*, "circular printed circuit board 52") **having a length and a width thereto**, **wherein said length and width of said first circuit board define a first plane** (*e.g.*, as shown in Fig. 2 and Fig. 7), **said first circuit board including [image**

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
board having a length and a width thereto, wherein said length and width of said first circuit board define a first plane, said first circuit board including an array of CMOS pixels thereon,	**sensor 51] thereon** (*e.g.*, "image sensor 51," "a CMOS sensor" "mounted on a circular printed circuit board 52")**.** ***E.g.*, Swift:** **Swift** discloses the miniature camera includes an "image sensor 51 [] mounted on a circular printed circuit board 52," mounted in the miniature camera's "housing." **Swift**'s CMOS image sensor 51 is a CMOS Active Pixel Sensor (APS) type chip. Swift, 10:1-6. **Swift's** circuit board 52 has a length and a width equal to the "circular" board's diameter. • **4:11-13** ("In a camera or sensor according to any of the preceding aspects of the invention, *said image sensor is preferably a CMOS sensor*.") • **8:31-9:18** ("An *image sensor 51 is mounted on a circular printed circuit board 52*, *which engages within* the intermediate bore 23 *in the central housing portion 20*, *and is clamped in position there by the rear housing portion 30*, which interengages with the centre housing portion 20, and bears against the circuit board 52, which is slightly thicker than the axial extent of the intermediate bore 23.") • **10:1-6** ("*The image sensor 51 is preferably of a CMOS/APS (Active Pixel Sensor) type*. An APS acts similarly to a random access memory (RAM) device, *wherein each pixel contains its own selection and readout transistors*. Further information on APS-type sensors may be found in the publication "Laser Focus World", June 1993, Page 83.")

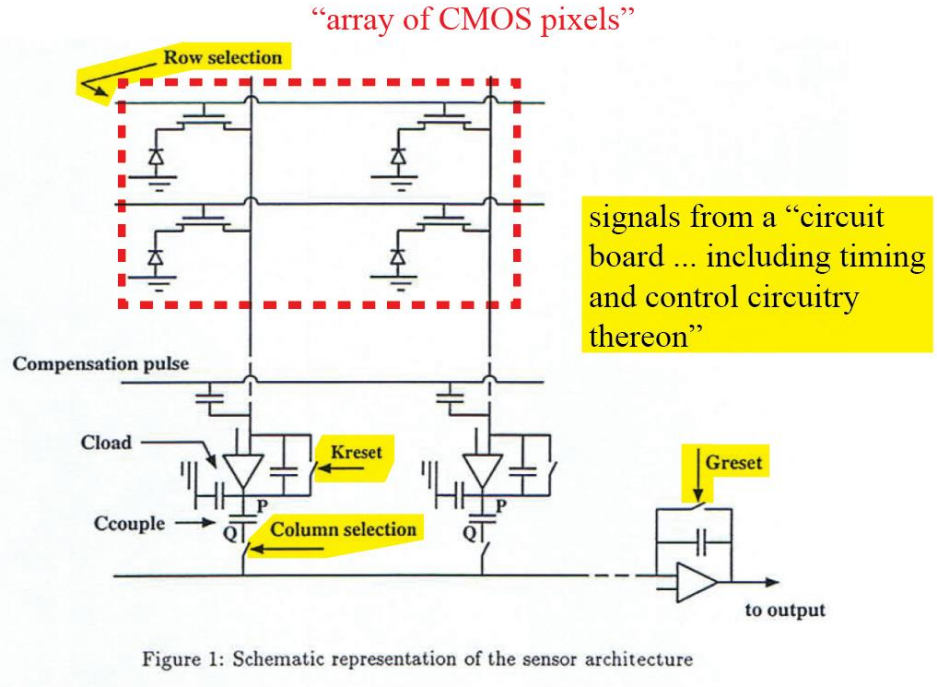
Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	• **Fig. 2**:  Fig.2. Neikirk, ¶¶252-254. **Ricquier discloses an array of CMOS pixels** (*e.g.*, "pixel array…realized in…CMOS technology"), **said array of said CMOS pixels for receiving images thereon** (*e.g.*, "[t]o realise the acquisition of image data" "images are formed on the sensor plane"). ***E.g.*, Ricquier:** While **Swift** does not expressly state that its CMOS active pixels for receiving images thereon are in an array, **Ricquier** provides this additional implementation detail of the "acquisition of image data" in an "image sensor" using a "256*256 X-Y addressable photodiode array … realised in a 1.5 µm standard CMOS technology." *E.g.*, Ricquier, 9.

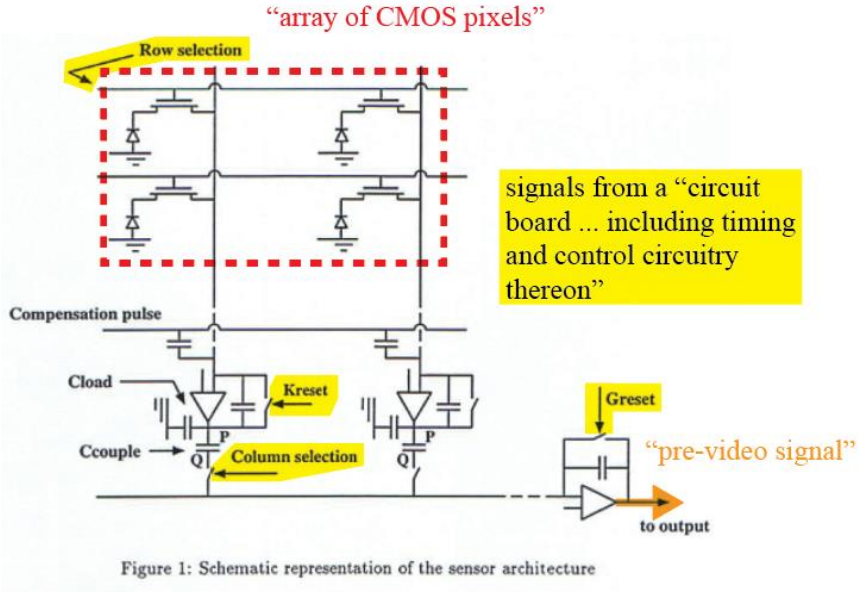
Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	As discussed in §IX.A.2, a POSITA would have been motivated to apply **Ricquier's** known teachings of a CMOS-implemented "X-Y addressable photodiode array" when implementing **Swift's** image sensor 51 of a CMOS/APS type, thus arranging the active pixels in an array. • **Abstract** ("*[A] dedicated imager* has been developed. The camera can be programmed to operate in several resolutions. This is done *by binning the signal charges of neighbouring pixels on the sensor plane itself*.…*This square 256*256 imager was fabricated in a standard 1.5 µm CMOS technology*.") • **3** ("[T]his imager belongs to a class of X-Y addressable imager architectures….") • **3** ("To realise the acquisition of image data …an X-Y addressable architecture was selected.") • **5** ("*The pixel array consists of 256 by 256 square pixels* arranged on a pixel pitch of 19 µm *and realised in a 1.5 µm n-well CMOS technology.*") • **6** ("*[I]mages are formed on the sensor plane*….") • **9** ("[A] 256*256 X-Y addressable photodiode array….")

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	• **Fig. 1:**  Figure 1: Schematic representation of the sensor architecture Neikirk, ¶¶255-256.
[2.c] wherein a plurality of CMOS pixels within said array of CMOS pixels each include an amplifier,	**Swift discloses a plurality of CMOS pixels each include an amplifier** (*e.g.*, amplifier for each "active pixel" of the "CMOS/APS (Active Pixel Sensor")**.** ***E.g.*, Swift:** **Swift** discloses that the preferable image sensor for "image sensor 51" is a "CMOS/APS (Active Pixel Sensor) type" such as those "found in the publication 'Laser Focus World', June 1993, Page 83." As discussed in §IX.A.1, and as each active pixel in a CMOS active pixel sensor includes an amplifier. • **10:1-6** ("*The image sensor 51 is preferably of a CMOS/APS (Active Pixel Sensor) type*. An APS acts similarly to a random access memory (RAM) device, wherein each pixel contains its own selection and readout transistors. *Further information on APS-type sensors may*

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	<u>*be found in the publication 'Laser Focus World'*</u>, June 1993, Page 83.") As discussed in §IX.A.2, it would have been obvious to apply **Ricquier's** known teachings of an array of CMOS pixels in implementing **Swift's** imager—such that the CMOS/APS pixels are arranged in an array. Neikirk, ¶¶257-258.
[2.d] said first circuit board further including timing and control circuitry thereon, said timing and control circuitry being coupled to said array of CMOS pixels,	**Swift discloses said first circuit board** (*e.g.*, "circuit board 52"). ***<u>E.g.</u>*****<u>, Swift:</u>** *See* [2.b]. **Ricquier discloses circuitry** (*e.g.*, "off-chip driving unit") **including timing and control circuitry thereon** (*e.g.*, "timing controller" to "drive…row selection and column selection signal[s]" of "X-Y addressable photodiode array")**, said timing and control circuitry being coupled to said array of CMOS pixels** (*e.g.*, "timing controller" "controlling the sequence of addresses and reset pulses of" "photodiode array" as illustrated in Fig. 1). ***<u>E.g.</u>*****<u>, Ricquier:</u>** While **Swift** discloses that it's "image sensor 51" is preferably a "CMOS … Active Pixel Sensor" (Swift, 10:1-6), **Swift** does not expressly disclose the how timing of its "image sensor 51" is controlled other than referring to sensor "selection and readout" circuitry. **Ricquier** expressly provides this additional implementation detail and discloses that a "timing controller" generates the "X-Y addresses and control pulses" and uses "decoders [to] drive…row selection and column selection signal" from the "X-Y addressable photodiode array." *E.g.*, Ricquier, 3, 4, 9. **Ricquier** further discloses that this "timing controller," while electrically coupled to the photodiode array to provide the selection signals, is "off-chip." As discussed in §IX.A.2, a POSITA would have been motivated to apply **Ricquier's** known teachings of an imager including an "off-

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	chip" "timing controller" in implementing **Swift's** "image sensor 51 [] mounted on a circular printed circuit board 52," for example, such that the timing and control circuitry is mounted on the other side of circuit board 52 relative to the image sensor 51 in order to make the camera more compact. • **Abstract** ("By *controlling the sequence of addresses and reset pulses of the amplifiers, charges of different pixels are accumulated*. This way multiple resolutions can be programmed….") • **3** ("…Based on *X-Y addresses and control pulses generated by an external driving unit, two decoders drive one particular row selection and column selection signal*.") • **3** ("*The readout of the charge packets* that are accumulated during the integration time, proceeds as follows. *After selecting one particular row of pixels, these charges are converted simultaneously to a voltage at the output* of the different charge sensitive amplifiers located *at the end of the column readout lines.* … Based on *the column selection signals* these nodes Q are again discharged to their starting value, at the same time *creating a voltage variation at the output amplifier proportional to the charges at that column*. *Every column selection is followed by a reset pulse on the Greset switch* bringing back the output amplifier into its initial state. After that, another charge packet can be received. *After reading out a particular row of pixels, the Kreset switch is closed* causing the integration capacitor to discharge.") • **4** ("*By using the Kreset switches and the Greset switch* in an appropriate way, it is possible to *accumulate charge packets* of different pixels or of different column amplifiers on the integration capacitors according to different patterns. So *by controlling the clocking scheme, the resolution of the imager can be altered* and it is even possible to create rectangular pixel patterns with a

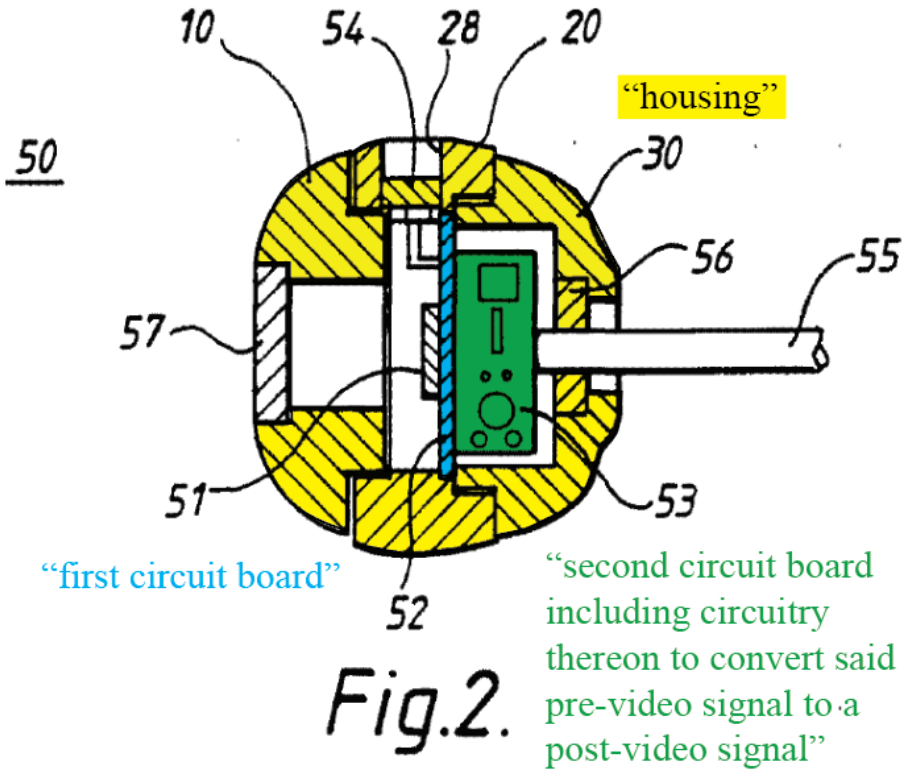
Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	resolution varying across the rows. …. In order to limit the complexity of *the timing controller (realised in an off-chip driving unit)* only timing configurations of some very common patterns are provided : apart from the normal resolution (1*1) also the addition of pixel charges in 2*2, 4*4 and 8*8 neighbourhoods was foreseen.") • ***See also* 9.** • **Fig. 1:**  Figure 1: Schematic representation of the sensor architecture Neikirk, 259-263.
[2.e] said image sensor producing a pre-video signal;	**Ricquier discloses said image sensor producing a pre-video signal** (*e.g.*, "image data" "output," as shown in Figure 1)**.** ***E.g.*, Ricquier:** While **Swift** does not expressly disclose the image sensor outputs a pre-video signal, **Ricquier** discloses that the readout from the "256*256 imager" is "output" from the array. Ricquier, Fig. 1, Abstract, 4. **Ricquier's** "output" as shown in Figure 1 is a pre-video signal produced by **Ricquier's** image sensor.

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	As discussed in §IX.A.2, a POSITA would have been motivated to apply **Ricquier's** known teachings of an "image sensor producing a pre-video signal" in implementing **Swift's** imager. • **Abstract** ("…*[R]eadout* occurs in two phases. After transfering in parallel a row of charges to 256 charge sensitive amplifiers, these *signals are coupled to a single output amplifier*….") • **3** ("To realise the *acquisition of image data* only in specific regions of interest, an X-Y addressable architecture was selected.") • **3** ("*[R]eadout of the charge packets* that are accumulated during the integration time…*selecting* one particular *row of pixels*, these *charges are converted* simultaneously *to a voltage at the output* of the different charge sensitive amplifiers located at the end of the column readout lines.") • **4** ("…*timing controller (realised in an off-chip driving unit)* only timing configurations of some very common patterns are provided ….") • **Fig. 1:**  Figure 1: Schematic representation of the sensor architecture

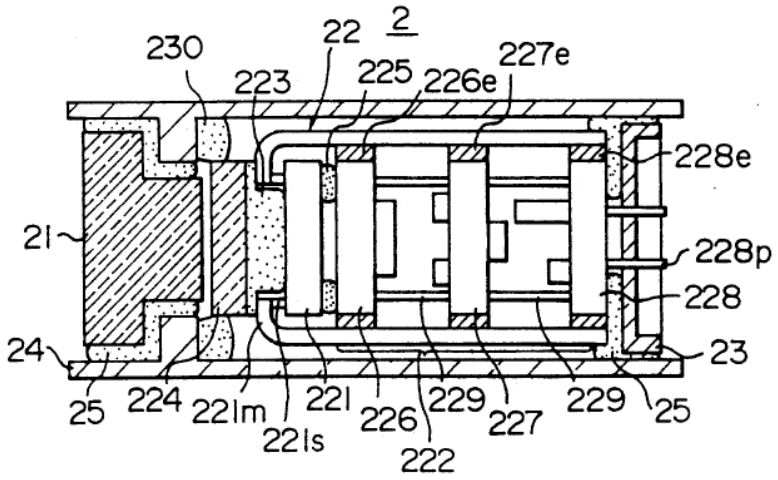
Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	Neikirk, ¶¶264-267.
[2.f] a second circuit board mounted in said housing, said second circuit board being electrically coupled to said first circuit board, said second circuit board having a length and a width thereto, wherein said length and width of said second circuit board define a second plane, said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal, said second circuit board being positioned in	**Swift discloses a second circuit board** (*e.g.*, "printed circuit board 53") **mounted in said housing** (*e.g.*, "printed circuit board 53" mounted in "rear housing portion 30" as shown in Fig. 2)**, said second circuit board being electrically coupled to said first circuit board** (*e.g.*, "circuit board 53" connected to "circuit board 52" "to … process image signals received" from "image sensor 51…mounted on…circuit board 52")**, said second circuit board having a length and a width thereto, wherein said length and width of said second circuit board define a second plane** (*e.g.*, length and width of "circuit board 53" define a second plane)**, said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal** (*e.g.*, "video processor"; "circuitry components are mounted on the circuit board 53, to … process image signals received [from image sensor 51]" into a "video signal" for a "video monitor or TV 154" to "display")**, said second circuit board being positioned in a stacked arrangement with respect to said first circuit board** (*e.g.*, "board 53" rotated parallel to and in a stacked arrangement with respect to "board 52")**, said second plane of said second circuit board being substantially parallel to said first plane of said first circuit board** (*e.g.*, plane of "board 53" being substantially parallel to plane of "board 52")**.** **Swift** discloses configuring circuit boards 52 and 53 and their associated circuitry in multiple different ways, at least one of which meets the limitation. While **Swift** shows circuit board 53 at a right angle to image sensor (51) in Fig. 2, **Swift** teaches disposing its components in various orientations. Swift, 18:25-33. A POSITA would have understood **Swift** to also teach circuit board 53 parallel to circuit board 52, such that circuit board 53 is positioned in a stacked arrangement with respect to circuit board 52 and the plane defined by circuit board 53 is parallel to the plane defined by circuit board 52. And, at minimum, a POSITA would have been

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
a stacked arrangement with respect to said first circuit board, said second plane of said second circuit board being substantially parallel to said first plane of said first circuit board;	motivated to orient the circuit board 53 in this manner as discussed in §IX.A.1—rendering the limitation obvious. • **8:33-9:7** ("An im*age sensor 51* is mounted on a circular printed circuit board 52…. *A further printed circuit board 53 is mounted* on the first printed circuit board 52, substantially at right angles thereto.") • **10:12-16** ("If desired, *the rear housing portion 30 may be* replaced by another portion of different configuration, *designed to accommodate* additional components or different components of *different configurations*.") • **18:25-33** ("In this specification, terms of absolute orientation are used conveniently to denote the usual orientation of items in normal use and/or as shown in the accompanying drawings. However, such items could be disposed in other orientations, and in the context of this specification, *terms of absolute orientation*, such as 'top', 'bottom', 'left', 'right', 'vertical' or 'horizontal', etc. *are to be construed accordingly, to include such alternative orientations*.") • **19:8-29** Neikirk, ¶¶268-270. **Swift** discloses the "circuit board 53" is electrically connected to and receives the "image signals" (pre-video signal) from "image sensor 51" and includes a "video processor" and "circuitry components" that convert the received signal into a signal that may be received by a monitor or television. • **9:7-13** ("Various *circuitry components* are mounted on the *circuit board 53, to* provide power to the *image sensor 51*, *process image signals received therefrom*, and also to process audio signals from a miniature microphone 54 which is mounted within the radially extending passage 28 and connected to the printed circuit board 52 and/or 53.") • **3:31-4:4** ("[T]here is provided an image sensor … comprising a printed circuit board and, mounted thereon,

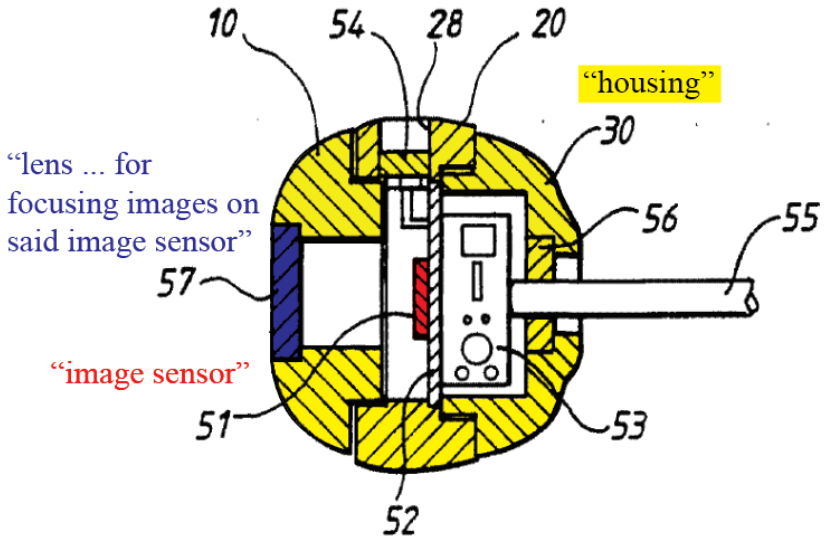
Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	the image sensor, *a video processor*, an audio processor, and a voltage regulator….") • **15:7-8** ("*A video monitor or TV 154 is provided, to display a signal received from the camera 152*.") • **15:13-14** ("*The camera 152 and monitor 154 are connected by* means of *a cabling system* 160.") • **17:34-18:3** ("The monitor 154 may comprise a domestic television set. With *the video signals provided from the camera 152 as* either *video* or UHF *signals*, *viewing of an image from the camera 152 may be selected on the television at will*, and need not interrupt normal television viewing.") • **18:8-11** ("*Any of the cameras mentioned above may* be connected to such a terminal box, in order to *distribute the video signals from the camera(s) to the* or each *TV* in the dwelling.")

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	• **Fig. 2:**  Fig.2. Neikirk, ¶269. **To the extent further disclosure of the arrangement of the circuit boards is required, Suzuki discloses a circuit board positioned in a stacked arrangement with respect to another circuit board attached to an image sensor chip, where the planes defined by the lengths and widths of the circuit boards are substantially parallel to one another** (*e.g.*, "circuit board 227" and "chip connecting board 226" "bonded" to "solid-state image pickup chip" "are aligned with each other" as shown in Figs. 2, 3C)**, wherein the planes defined by the lengths and widths of the circuits boards are substantially parallel** (*e.g.*, as shown in Figs. 2, 3C)**.** ***E.g.*, Suzuki:** While **Swift** discloses that "printed circuit board 53 is mounted on the first printed circuit board 52, substantially at right angles

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	thereto" but can be arranged in other orientations, **Suzuki** expressly teaches arranging "the boards" such that they are "aligned with each other." Suzuki, 3:15-25. Specifically, "circuit board 227" is positioned such that its "electrodes [227e] … are disposed in registry" with the "electrodes 226e" of the "chip-connecting board 226." Suzuki, 3:15-19. As discussed in §IX.A.3, a POSITA would have been motivated to apply **Suzuki's** known teachings of an image sensor comprising a first circuit board lying in a first plane and second circuit board lying in a second plane parallel to the first in implementing **Swift's** teachings of a miniature camera (as modified by **Ricquier's** teachings) where Swift's circuit board 53 is oriented parallel to and stacked with respect to circuit board 52 to reduce the camera's overall size and to improve the camera device's "stability and reliability." *E.g.*, Suzuki, 1:53-56, 3:61-4:12, 4:30-65. • **1:57-2:5** ("[A] *camera head for a solid-state image pickup device comprising* a chassis which has opposite open ends, and *an image pickup unit* housed in the chassis. *The image pickup unit includes a* solid-state image pickup chip constituted by a solid-state image pickup semiconductor device, *chip-connecting board disposed adjacent to said solid-state image pickup chip and* having an electric circuit mounted thereon, *a connector board* having external lead pins, leads connecting electrodes provided at an outer peripheral edge of at least one of said chip-connecting board and said connector board to electrodes of said solid-state image pickup chip, and a protective member sealing a light-receiving surface of said solid-state image pickup chip, said protective member being one of an optical glass plate and an optical filter. • **2:50-63** ("The *circuit module 222 comprises a chip-connecting board 226, a circuit board 227* including a circuit for driving the solid-state image pickup chip 221 and a circuit for amplifying the video signal from the

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	solid-state image pickup chip 221, and a connector board 228. Signals are fed between these boards via connection pins 229, and signals are fed between the solid-state image pickup chip 221 and each of these boards via the outer-leads 221m and side electrodes 226e, 227e and 228e of the boards. External lead pins 228p are mounted on the connector board 228, and are adapted to be connected to the plug 4 so as to send the signals to the camera control unit 3."), • **3:15-25** ("*The chip-connecting board 226, the circuit board 227* and the connector board 228 *are arranged in such a manner that their side electrodes 226e, 227e* and 228e *are disposed in registry with one another*, and *these three boards are aligned with each other*. They are connected together by the connection pins 229 to provide the circuit module 222. A surface of the solid-state image pickup chip 221 opposite to the light-receiving surface thereof is bonded to the chip-connecting board 226 through the adhesive 225.") • **Fig. 2:** FIG. 2  • **Fig. 3C**

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	Neikirk, ¶¶270-273.
[2.g] a lens mounted in said housing, said lens being integral with said imaging device, said lens focusing images on said array of CMOS pixels of said image sensor;	**Swift discloses a lens mounted in said housing** (*e.g.*, "wide-angle lens 57…mounted in the…front housing portion 10")**, said lens being integral with said imaging device** (*e.g.*, as shown in Fig. 2; "image sensor 201 engaged with a lens holder 202…to hold the lens 204 at a fixed…distance from the sensor")**, said lens focusing images on … said image sensor** (*e.g.*, "positioned as to focus an image onto the image sensor 51"). ***E.g.* Swift:** **Swift** discloses a lens "fixed" in the housing at a "predetermined distance from the sensor" and thus integral with said imaging device for focusing images on the "light-sensitive area" on said image sensor. • **9:23-28** ("*A wide-angle lens 57 is mounted in* the front bore 12 of *the front housing portion 10*, and bears against the annular abutment shoulder 13. *The lens 57 is so positioned as to focus an image onto the image sensor 51*."); • **18:13-23** "Figure 7 shows *an image sensor 201* (e.g. of APS type), *engaged with a lens holder* 202 of plastics material, with an aperture 203 *to receive a lens 204*. With the holder 202 and lens 204 mounted together, *the holder 202 serves to hold the lens 204 at a fixed, predetermined distance from the sensor 201, in order properly to focus an image onto* the sensor 201. *The light-sensitive area on the sensor 201* is located asymmetrically on the sensor, and the aperture 203 is positioned asymmetrically on the lens holder 202, in order to match the asymmetry of the sensor 201"

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	• **Fig. 2:**  Fig.2. • **Fig. 3** Neikirk, ¶¶274-276. As discussed in §IX.A.2, it would have been obvious to apply **Ricquier's** known teachings of an array of CMOS pixels in implementing **Swift**—thus the lens of **Swift** would focus images on said array of CMOS pixels. Neikirk, ¶277.
[2.h] a video screen, said video screen being electrically coupled to said second circuit board, said video screen receiving said	**Swift discloses a video screen** (*e.g.*, "video monitor"), **said video screen being electrically coupled to said second circuit board** (*e.g.*, "cable 55 is connected to the printed circuit board 53," "[t]he camera 152 and monitor 154 are connected by…a cabling system 160")**, said video screen receiving said post-video signal and displaying images from said post-video signal** (*e.g.*, "video monitor…to display a signal received from the camera")**.** ***E.g.*, Swift**:

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
post-video signal and displaying images from said post-video signal; and	**Swift** discloses a "video monitor" is "connected by … a cabling system" "to the camera" to "display a signal received from the camera." *E.g.*, Swift, 15:7-14. **Swift** further discloses that the cable is connected to the printed circuit board 53. *E.g.*, Swift, 9:5-18. The "video signals [are] provided from the camera 152 as…video" from the "circuit board 53," which "process[es]" "image signals received" from the "image sensor." While **Swift** further discloses that there can be additional "external processing circuitry (not shown)," for example, to convert the signal to UHF, this circuitry is not required to create the video signal that is output from the camera and, more specifically, board 53. • **9:5-18** ("A *further printed circuit board 53* is mounted on the first printed circuit board 52, substantially at right angles thereto. Various *circuitry components* are mounted on the *circuit board 53, to* provide power to the image sensor 51, *process image signals received therefrom*, and also to process audio signals from a miniature microphone 54 which is mounted within the radially extending passage 28 and connected to the printed circuit board 52 and/or 53. A *cable 55 is connected to the printed circuit board 53*, and passes through the rear bores 32, 33, to provide a connection between the miniature video camera 50 and external processing circuitry (not shown).") • **17:34-18:2** ("The monitor 154 may comprise a domestic television set. With *the video signals provided from the camera 152 as* either *video* or UHF *signals*, *viewing of an image from the camera 152 may be selected on the television at will*…") • **15:7-8** ("*A video monitor* or TV 154 *is provided, to display a signal received from the camera 152*.") • **15:13-14** ("*The camera 152 and monitor 154 are connected by* means of *a cabling system* 160.") • **18:8-11** ("*Any of the cameras mentioned above may* be connected to such a terminal box, in order to *distribute the*

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	video signals from the camera(s) to the or each *TV* in the dwelling.") Neikirk, ¶¶278-279.
[2.i] a power supply mounted in said housing, said power supply being electrically coupled to said first circuit board to provide power to said array of CMOS pixels and said timing and control circuitry, said power supply also being electrically coupled to said second circuit board to provide power thereto;	**Swift discloses a power supply** (*e.g.*, "battery," "voltage regulator") **mounted in said housing** (*e.g.*, "provided within the housing")**, said power supply being electrically coupled to said first circuit board to provide power to said array of CMOS pixels and said timing and control circuitry, said power supply also being electrically coupled to said second circuit board to provide power thereto** (*e.g.*, "a voltage regulator to…provide a substantially constant supply voltage to components" including "an image sensor assembly" and "a video processor" on the "circuit board")**.** ***E.g.*, Swift:** **Swift**'s battery and voltage regulator provide voltage to (and thus are electrically coupled to and drive) the "image sensor 51" (including its pixels) and the components of circuit boards 52 and 53. Furthermore, at minimum, a POSITA would have understood that **Swift's** battery and voltage regulator provide voltage to (and thus are electrically coupled to and drive) the "image sensor 51" (including its pixels) and circuit boards 52 and 53. *See* §IX.A.1. In addition, **Swift** discloses the voltage regulator is mounted on an assembly in the camera's housing. And based on Swift's disclosure that "the housing 50" has "sufficient room to house a battery," a POSITA would have understood that the battery is mounted in the housing. • **3:31-4:4** ("According to a further aspect of the present invention, there is provided an *image sensor assembly* for a miniature camera, the *assembly comprising a printed circuit board* and, mounted thereon, the image sensor, a video processor, an audio processor, and *a voltage regulator to* accept a plurality of different input voltages

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	and *provide a substantially constant supply voltage to components on the printed circuit board*.") • **4:21-22** ("A camera as above may incorporate a battery or voltage transformer means.") • **10:12-20** ("If desired, *the rear housing portion 30 may be* replaced by another portion of different configuration, *designed to accommodate additional components* or different components of different configurations. For example, *there may be provided within the housing 50 sufficient room to house a battery*, and/or a transmitter, and/or a converter in order to convert a video signal or combined video/audio signals into a UHF 20 signal.") • **9:7-13** ("Various circuitry components are mounted on the circuit board 53, to *provide power to the image sensor 51*, process image signals 10 received therefrom, and also to process audio signals from a miniature microphone 54 which is mounted within the radially extending passage 28 and connected to the printed circuit board 52 and/or 53.") Neikirk, ¶¶280-284. As discussed in §IX.A.2, it would have been obvious to apply **Ricquier's** known teachings of an array of CMOS pixels in implementing **Swift**—thus the power supply of **Swift** would provide power to the array of CMOS pixels. *See* [2.b]. Neikirk, ¶284.
[2.j] wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters.	**Swift discloses an image sensor along said first plane**. *See* [2.b]. **Suzuki discloses a largest dimension of an image sensor along said first plane is between 2 and 12 millimeters** (*e.g.*, image sensor along the first plane is at least "8.5 mm" and no greater than "10mm").

	***E.g.*, Suzuki:** While **Swift** discloses the image sensor including "circuit board 52" (to which the image sensor chip is mounted) on a first plane, **Swift** does not expressly disclose the circuit board's dimensions. **Suzuki** discloses this implementation detail. As discussed in §IX.A.3, **Suzuki** discloses that the largest dimension of "chip-connecting board 226" is between 8.5 and 10 mm. Suzuki, 4:6-11. As also discussed in §IX.A.3, it would have been obvious to apply **Suzuki's** known teachings of a "chip-connecting board 226" between 8.5 and 10 mm in implementing **Swift's** miniature camera (as modified by **Ricquier's** teachings)—such that the size of **Swift's** camera is minimized and the largest dimension of the image sensor along the first plane is between 2 and 12 mm. • **4:6-11** ("[I]n the case where *the solid-state image pickup chip of* 1/3 inch (*8.5 mm*) is used, *the outer diameter of the camera head is about 10 mm*….") • **1:53-56** ("It is an object of this invention to provide a camera head for a solid-state image pickup device which *camera head has an outer diameter closer to a diagonal length of a solid-state image pickup chip*.") • **4:58-61** ("[T]he *outer diameter of the camera head* can be *reduced to a small size close to the diagonal length of the solid-state image pickup chip*.") • **3:1-49** …The *chip-connecting board 226, the circuit board 227* and the connector board 228 are arranged in such a manner that their side electrodes 226e, 227e and 228e *are disposed in registry with one another, and these three boards are aligned with each other.* They are connected together by the connection pins 229 to provide the circuit module 222. A surface of the *solid-state image pickup chip 221* opposite to the light-receiving surface thereof *is bonded to the chip-connecting board 226* through the adhesive 225….*Each outer-lead 221m is bent through about 90° at a point near the chip 221, and is soldered to the side electrodes* 226e, 227e and 228e *of the*

Claim Elements	Ground 1: Swift in view of Ricquier and Suzuki
	boards 226, 227 and 228 to make electrical connections among the boards, *thereby constituting the image pickup unit 22. … The image pickup unit 22 is inserted into the chassis 24*…. With the above procedure, the assembling of the camera head is completed.") • ***See also, e.g.*, Fig. 1, Fig. 2, Figs. 3A-3D.** Neikirk, ¶¶285-289.

B. Ground 2: Claim 2 Is Rendered Obvious by Larson in View of Swift, Ricquier, and Suzuki

As discussed in §IX.A, **Swift** in view of **Ricquier** and **Suzuki** (Ground 1) renders obvious claim 2.

To the extent further disclosure of a physical camera within the same physical housing as the video monitor to form the claimed "imaging device" is required as discussed in [2.pre], **Larson** discloses the implementation details for an imaging device (*e.g.*, "A videophone includes a video camera" that is "mounted in a tilt and swivel housing" with a "flat panel liquid crystal display (LCD) for displaying images") with a physical camera and a display screen contained in a single housing. *E.g.*, Larson, Abstract, 7:8-27. For example, Fig. 8B1 of **Larson** illustrates a single "housing 131 for the CCD camera lens 44A and the LCD panel 56B." *E.g.*, Larson, 26:43-54. Although **Larson** is primarily concerned with displaying video transmissions received from other users, **Larson** also discloses that a user can use a

"local viewing button" to make the LCD display the image that is being captured by the local camera. *E.g.*, Larson, 26:37-43, Fig. 8A, 8B1-8B2. Neikirk, ¶¶290-292.

Like Swift, Ricquier, and Suzuki, **Larson** is in the same field of art and is analogous to the '052—all are in the same field related to solid state image sensors for use in cameras. *E.g.*, '052, Abstract, 1:32-36, 7:65-8:1; Larson, Abstract, 26:43-54, 1:13-23, 3:31-42. Like the '052, **Larson** is directed to the display of images from an image capturing device. *E.g.*, '052, 4:32-35, 16:10-14, 15:7-14; Larson, Abstract, 26:37-43. **Larson** is also reasonably pertinent to the problem identified in the '052 of minimizing the profiles of devices utilizing imaging devices. As **Larson** explains, using a single "tilt and swivel housing" can be used "for ease of positioning the video camera and viewing screen," and also "enables the videophone of the invention to be housed in a compact housing." Larson, 7:14-27. Moreover, **Larson** teaches that this design "enables the videophone of the invention to be much more compact and require less power." Larson, 7:6-13. Neikirk, ¶29.

While Larson teaches a "videophone" using a "CCD camera" (Larson, 7:22-26), as discussed in §IX.A.1 **Swift** teaches "incorporati[ng]" a "miniature camera" using a CMOS image sensor (Swift, 1:7-13). As discussed in §IX.A.2-3, **Ricquier** and **Suzuki** provide additional implementation details concern the camera and image sensor that would have been obvious to apply in implementing **Swift's** camera. As the '052 acknowledges, CMOS image sensors and readout circuitry for operating

such sensors, as disclosed in **Swift** and **Ricquier**, were well-known in the art. '052, 2:9-15, 2:25-34. Further, the '052 admits that it was known that CMOS active pixel sensor imagers result in lower noise than CCD or other solid state imagers, can be mass produced on standard semiconductor productions lines, can incorporate a number of other different electronic controls that are usually found on multiple circuit boards of much larger size, and require less power than CCD imagers. '052, 1:66-2:19; *see also* NASA (Ex. 1060) ("low power-consumption," "small[er] size," "made on standard semiconductor production lines," "cost[s] much less than CCDs," and can tolerate lower material quality). Moreover, **Swift** teaches "[m]iniature cameras are finding increasing application … for incorporation in other devices" where "it is often desirable for a camera to be as small as possible, so that it may be located discretely in such a way that it is not readily observed." **Swift**, 1:7-13.

Thus, a POSITA would have been motivated and found it advantageous to apply the teachings of **Swift's** miniature camera (as modified by **Ricquier's** and **Suzuki's** teachings as discussed in §IX.A) in implementing **Larson's** "camera" in the "videophone" with a "compact housing." Larson, 7:14-27. In light of the above, a POSITA would have found it routine, straightforward and advantageous to apply **Swift's** miniature camera (as modified by **Ricquier's** and **Suzuki's** teachings as discussed above) in implementing **Larson's** camera and would have known that

such a combination (yielding the claimed limitations) would predictably work and provide the expected functionality. Neikirk, ¶¶290-295.

X. SECONDARY CONSIDERATIONS

The Challenged Claim is obvious based on the references presented herein. PO's only purported evidence of secondary considerations during prosecution was an alleged unexpected result of decreased interference when image processing circuitry is removed from the same board or plane as the pixel array. Ex. 1003, 83-95. Notably, the '839 Examiner did not find the evidence persuasive. *Id.*, 110-118, 148, 157. As explained above (§IX.A.1), **Swift** teaches removing the processing circuitry from the image sensor and placing it on a separate circuit board placed closely adjacent the CMOS pixel array. Thus, it was already known to remove the processing circuitry from the image sensor, and thus, the results of doing so were already known. PO did not present any other evidence of secondary considerations during prosecution and the clear teachings in the prior art cannot be overcome by any supposed "secondary considerations." Neikirk, ¶¶296-301.

XI. CONCLUSION

Substantial, new, and noncumulative technical teachings have been presented for the '052's Challenged Claim, which is rendered obvious for the reasons set forth above. There is a reasonable likelihood that Petitioner will prevail as to claim 2. *Inter Partes* review of claim 2 is accordingly requested.

Dated: February 17, 2020

/Scott A. McKeown/
Scott A. McKeown

CERTIFICATE OF COMPLIANCE

Pursuant to 37 CFR §42.24(a) and (d), the undersigned hereby certifies that this Petition for Inter Partes Review complies with the type-volume limitation of 37 CFR §42.24(a)(i) because, exclusive of the exempted portions, it contains 10,651 words as counted by the word processing program used to prepare the paper.

Dated: February 17, 2020

/Scott A. McKeown/
Scott A. McKeown

CERTIFICATE OF SERVICE

The undersigned certifies service pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(b) on the Patent Owner by Fedex of a copy of this Petition for *Inter Partes* Review and supporting materials at the correspondence address of record for the '052 patent:

Clifford H. Kraft
320 Robin Hill Dr.
Naperville, IL 60540

Courtesy copies of the same documents were also served at the following email addresses of record for Cellect's litigation counsel for the subject patent in the district court litigation at the U.S. District Court for the District of Colorado, Case No. 1:19-cv-00438-CMA-MEH:

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