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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/453,574	08/06/2014	Wei Chen	P22921US1	1297
65015	7590	01/31/2020	EXAMINER	
Treyz Law Group 15279 N. Scottsdale Rd., Suite 250 Scottsdale, AZ 85254			PATEL, PREMAL R	
			ART UNIT	PAPER NUMBER
			2623	
			NOTIFICATION DATE	DELIVERY MODE
			01/31/2020	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte WEI CHEN, STEVEN P. HOTELLING, JOHN Z. ZHONG,
WILLIAM C. ATHAS, and WEI H. YAO

Appeal 2018-007943
Application 14/453,574
Technology Center 2600

Before JASON V. MORGAN, BARBARA A. BENOIT, and
PHILLIP A. BENNETT, *Administrative Patent Judges*.

BENNETT, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant¹ appeals from the Examiner's decision to reject claims 1–6, 8, 12–21, 25, 26, 28, 29, and 31,. Claims 7, 9–11, 22–24, 27, and 30 have been cancelled. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm-in-part.

¹ We use the word “Appellant” to refer to “Applicant” as defined in 37 C.F.R. § 1.42(a). Appellant identifies the real party in interest as Apple Inc. Appeal Br. 2.

CLAIMED SUBJECT MATTER

The claims are directed to an electronic device display with array of discrete light-emitting diodes. Spec., Title. Claim 1, reproduced below, is illustrative of the claimed subject matter:

1. A display, comprising:
 - a rigid display cover layer having a concave inner surface;
 - a flexible substrate having a convex outer surface that conforms to the concave inner surface;
 - an array of light-emitting diodes mounted on the concave outer surface of the flexible substrate, wherein the array of light-emitting diodes comprises an array of discrete crystalline semiconductor light-emitting diodes each having first and second terminals; and
 - conductive bonding material under each discrete crystalline semiconductor light-emitting diode that bonds each discrete crystalline semiconductor light-emitting diode to the flexible substrate and that electrically connects one of the first and second terminals of each discrete crystalline semiconductor light-emitting diode to a signal path on the flexible substrate, wherein the conductive bonding material under each of the discrete crystalline semiconductor light emitting diodes is electrically isolated from the conductive bonding material under neighboring discrete crystalline semiconductor light-emitting diodes.

Appeal Br. 24 (Claims Appendix).

REFERENCES

The prior art relied upon by the Examiner is:

Name	Reference	Date
Handschy	US 2007/0216617	Sept. 20, 2007
Kahen	US 2008/0217602	Sept. 11, 2008
Cok	US 2011/0057861 A1	Mar. 10, 2011

Name	Reference	Date
Shirouzu	US 2011/0175885 A1	July 21, 2011
He	US 2011/0215153 A1	Sept. 8, 2011
Ohba	US 2012/0049306 A1	Mar. 1, 2012
Miyamoto	US 2012/0200546 A1	Aug. 9, 2012
Lau	US 2012/0223875 A1	Sept. 6, 2012
Lynch	US 2012/0243151 A1	Sept. 27, 2012
Lee	US 2012/0249444 A1	Oct. 4, 2012
Spinar	US 2012/0306522 A1	Dec. 6, 2012
Rogers	US 2012/0320581 A1	Dec. 20, 2012
Kim '424	US 2013/0134424 A1	May 30, 2013
Kim '758	US 2013/0307758 A1	Nov. 21, 2013
Holman	US 2013/0343053 A1	Dec. 26, 2013
Kim '534	US 2014/0135234 A1	May 15, 2014
Hu	US 2014/0333571 A1	Nov. 13, 2014

REJECTIONS

Claim 8 stands rejected under 35 U.S.C. § 112(a) as failing to comply with the written description requirement. Final Act. 3–4.

Claims 3 and 5 stand rejected under 35 U.S.C. § 112(b) as being indefinite. Final Act 4.²

² Appellant presents no argument with respect to this rejection. Accordingly, we summarily affirm the rejection made under 35 U.S.C. § 112(b).

Claim 1 stands rejected under 35 U.S.C. § 103 as being unpatentable over Lynch, Rogers, and Lau. Final Act. 4–8.

Claims 2 and 25 stand rejected under 35 U.S.C. § 103 as being unpatentable over Lynch, Rogers, Lau, and Kim '424. Final Act. 8–9.

Claim 5 stands rejected under 35 U.S.C. § 103 as being unpatentable over Lynch, Rogers, Lau, and Kahen. Final Act. 9–10.

Claim 6 stands rejected under 35 U.S.C. § 103 as being unpatentable over Lynch, Rogers, Lau, Kahen, and Kim '424. Final Act. 10–11.

Claim 26 stands rejected under 35 U.S.C. § 103 as being unpatentable over Lynch, Rogers, Lau, Holman, and Handschy. Final Act. 11–13.

Claim 3 stands rejected under 35 U.S.C. § 103 as being unpatentable over Lynch and Kahen. Final Act. 13–15.

Claim 4 stands rejected under 35 U.S.C. § 103 as being unpatentable over Lynch, Kahen, and Kim '424. Final Act. 16.

Claim 8 stands rejected under 35 U.S.C. § 103 as being unpatentable over Cok, Rogers, Hu, Kim '424, and Spinar. Final Act. 16–20.

Claim 12 stands rejected under 35 U.S.C. § 103 as being unpatentable over Cok, Rogers, Hu, Kim '424, Spinar, and Lee. Final Act. 20–21.–

Claims 13–17 stand rejected under 35 U.S.C. § 103 as being unpatentable over Cok, Rogers, Hu, Kim '424, Spinar, Lee, and Miyamoto. Final Act. 21–24.

Claim 18 stands rejected under 35 U.S.C. § 103 as being unpatentable over Cok, Rogers, Hu, Kim '424, Spinar, Lee, Miyamoto, and Ohba. Final Act. 24–25.

Claims 28 and 29 stand rejected under 35 U.S.C. § 103 as being unpatentable over Cok, Rogers, Hu, Kim '424, Spinar, and He. Final Act. 25–26.

Claims 19 and 20 stand rejected under 35 U.S.C. § 103 as being unpatentable over Cok, Hu, Kim '534, and Kim '758. Final Act. 26–30.

Claim 21 stands rejected under 35 U.S.C. § 103 as being unpatentable over Cok, Hu, Kim '534, Kim '758, and Kim '424. Final Act. 30–31.

Claim 31 stands rejected under 35 U.S.C. § 103 as being unpatentable over Cok, Hu, Kim '534, Kim '758, and Shirouzu. Final Act. 31–32.

ISSUES

First Issue: Has the Examiner erred in finding the limitation “a display driver integrated circuit die mounted to a solder pad on the first surface of the substrate,” as recited in claim 8, lacks written description in the Specification?

Second Issue: Has the Examiner erred in rejecting claim 1 under § 103 because Lynch is incompatible with or otherwise teaches away from Lau?

Third Issue: Has the Examiner erred in determining Kahen teaches or suggests “an array of light-emitting diodes mounted on the curved inner surface of the flexible substrate,” as recited in claim 3?

Fourth Issue: Has the Examiner erred in finding Kim '424 teaches or suggests “pixel driver integrated circuits mounted to the flexible substrate between the light-emitting diodes,” as recited in claim 4?

Fifth Issue: Has the Examiner erred in finding Kim '424 and Spinar teach or suggest “a display driver integrated circuit die mounted to a solder pad on the first surface of the substrate,” as recited in claim 8?

Sixth Issue: Has the Examiner erred in finding Cok teaches or suggests “circuitry formed at least partially within the semiconductor substrate,” as recited in claim 19?

ANALYSIS

First Issue

The Examiner rejects independent claim 8 for lack of written description. Final Act. 3–4. Specifically, the Examiner finds that although “the specification in general recites all the claimed words separately, . . . none of the portions describe ‘a display driver integrated circuit die mounted to a solder pad on the first surface of the substrate,’” as recited in claim 8. Final Act. 4. Appellant asserts support for this limitation is found in the Figure 11 and paragraphs 53–54 of the Specification. Appeal Br. 5–6. We agree with Appellant.

Figure 11 shows a substrate 24 with various components placed thereon, including components 76, 78, and 80. Paragraph 53 of the Specification indicates that the components may be integrated circuits. Spec. ¶ 53 (“Components such as components 76, 78, and 80 may be integrated circuits.”). The Specification further teaches that these integrated circuits may be circuit die that include display driver circuitry. Spec. ¶ 53 (“[M]iniature integrated circuits (e.g., circuit die such as illustrative components 80 . . . display driver circuitry (e.g., circuitry for performing signal demultiplexing and display pixel control operations).”). The Specification further describes that the integrated circuits shown in Figure 11 “may be soldered to the solder pads using solder.” Spec. ¶ 54. Taken together, these portions of the Specification demonstrate the inventors had possession of “a display driver integrated circuit die mounted to a solder pad

on the first surface of the substrate.” Accordingly, we do not sustain the rejection of claim 8 under 35 U.S.C. § 112(a).

Second Issue

The Examiner rejects independent claim 1 as obvious over Lynch, Rogers, and Lau. Final Act. 4–8. The Examiner finds that Lynch teaches a display having a rigid display cover with a concave inner surface along with a flexible substrate that conforms to the concave inner surface, and an array of light-emitting diodes (LEDs) mounting on the outer surface of the flexible substrate. Final Act. 4–5. The Examiner acknowledges that Lynch does not teach the specific configuration of the array of LEDs, namely that the array of LEDs “comprises an array of discrete crystalline semiconductor” LEDs. The Examiner relies on Rogers to cure this deficiency, finding that Rogers teaches the use of discrete crystalline semiconductor LED arrays, and that a person of ordinary skill in the art would have combined Rogers with Lynch in order to “achieve high performance attributes and beneficial thermal properties.” Final Act. 5 (citing Rogers ¶ 5). The Examiner further concedes Lynch and Rogers fail to teach the use of conductive bonding material having the specific properties recited in claim 1. Final Act. 6. To address this deficiency, the Examiner introduces Lau, finding that it teaches the remaining limitations of claim 1. Final Act. 6–8. Combining Lau with the remaining references, the Examiner finds:

It would have been obvious to one of ordinary skill in the art before the filing date of present application to have modified the LED array of Lynch and Rogers with the teaching of Lau, because this will provide device wherein the cross-talk between neighboring LED pixels is prevented and further providing good luminance uniformity.

Final Act 8 (citing Lau ¶ 101).

Appellant asserts the rejection is in error because “Lynch’s flexile substrate is formed from polymer, which is an insulating material,” and “Lau specifically teaches away from forming light-emitting diodes on insulating layers.” Appeal Br. 9. Appellant contends Lau teaches that circuitry layers formed on insulating layers “can only be a thin film device” and such devices “have low field effect mobility and cannot provide enough current for the LEDs.” Appeal Br. 9 (quoting Lau ¶ 6). Appellant further asserts that because of the problems associated with circuitry formed on insulating layers, “[t]he LED control circuitry, including the transistors, bus lines, and other circuitry on the silicon substrate are formed using a Complementary Metal-Oxide Semiconductor (CMOS) process.” Appeal Br. 9 (citing Lau ¶ 63). According to Appellant, “[o]ne of ordinary skill in the art would therefore be led away from using the bus lines and solder of Lau on the flexible polymer substrate of Lynch.” Appeal Br. 9.

We are not persuaded by Appellant’s argument. Appellant asserts that the flexile substrate taught in Lynch is insulating layer formed of flexible sheets of polymer. Although Lynch describes that the display layer “may be formed using flexible sheets of polymer,” Lynch also indicates that the display layer may also be formed using “other substrates.” Lynch does not indicate that the use of flexible sheets of polymer is necessary or otherwise critical to its convex display devices. Nor does it indicate that the use of a conductive substrate would impair the functionality of the convex display. The premise of Appellant’s argument—that Lynch *requires* an insulating, polymer substrate—is flawed. Because Lynch does not require a polymer

substrate, we agree with the Examiner that Lau does not teach away from Lynch, and we sustain the rejection of claim 1.

Third Issue

The Examiner rejects independent claim 3 as obvious over Lynch and Kahan. Final Act. 14–15. In rejecting claim 3, the Examiner relies primarily on Lynch, finding that it teaches each of the limitations except the limitation final limitation of claim 3 which recites “an array of light-emitting diodes mounting on the curved inner surface of the flexible substrate, wherein light from the light-emitting diodes passes through the flexible substrate and through the display cover layer.” Final Act. 14. For this limitation, the Examiner turns to Kahan, finding that it teaches a light emitting device with an array of LEDs mounted on a light transmissive, flexible substrate. Final Act. 15 (citing Kahan ¶ 29, 31, 33; Figure 6).

Appellant argues Kahan is deficient because the substrate is flat and not curved as required by the claim. Appeal Br. 12–13. Appellant further argues that “Kahan fails to show or suggest light-emitting diodes on a curved inner surface of a flexible substrate.” Appeal Br. 13; *see also* Reply Br. 5 (“[N]othing in Kahan shows or suggests that substrate 160 is curved.”).

We are not persuaded by Appellant’s arguments. The Examiner finds that Lynch teaches a flexible and curved substrate. Final Act. 13–14 (citing Lynch Figs. 5, 6). The Examiner cites Kahan to demonstrate that it was known in the art to mount LEDs to an inner surface of a flexible substrate, and also to make the substrate transparent to allow light to pass through it and out the display cover. Appellant asserts that Kahan is deficient because it does not describe a curved substrate. However, we agree with the Examiner that Kahan teaches a flexible substrate, and applying Kahan’s

flexible, transparent substrate with Lynch's curved configuration is sufficient to teach or suggest "an array of light-emitting diodes mounting on the curved inner surface of the flexible substrate, wherein light from the light-emitting diodes passes through the flexible substrate and through the display cover layer." Accordingly, we sustain the rejection of claim 3.

Fourth Issue

Appellant also challenges the Examiner's findings with respect to claim 4, which depends from claim 3 and recites the additional limitation of "pixel driver integrated circuits mounted to the flexible substrate between the light-emitting diodes." Appeal Br. 25 (Claims Appendix).

In rejecting claim 4, the Examiner finds that Lynch and Kahan do not teach the additional limitation of claim 4, and turns to Kim '424 to address the deficiency. Final Act. 16 (citing Kim '424 Fig. 1). Appellant argues the pixel circuitry of Kim '424 is merely a series of transistor and capacitors, and cannot be considered integrated circuits. Appeal Br. 13–14; *see also* Reply Br. 6 ("Kim '424 discloses pixel circuits formed from thin-film transistor circuitry, not integrated circuits.").

We are not persuaded of Examiner error. This issue turns on the meaning of "pixel driver integrated circuits," which is accorded its broadest reasonable interpretation in light of the Specification. *In re Bigio*, 381 F.3d 1320, 1324 (Fed. Cir. 2004) ("[T]he PTO gives a disputed claim term its broadest reasonable interpretation."). The Specification does not define "pixel driver integrated circuits." The Examiner interprets "pixel driver integrated circuit" to mean "any circuit element used in [a] pixel circuit." Ans. 42.

Appellant asserts that Kim '424's pixel circuits are not integrated circuits. However, Appellant does not offer any explanation for why this is so. Appellant also does not challenge the definition provided by the Examiner, by, for example, offering a competing interpretation of the phrase. Nor does Appellant provide any explanation why thin-film transistor circuitry, such as that described in Kim '424, cannot be considered a "pixel driver integrated circuit" under the Examiner's unchallenged interpretation of the phrase. As such, we are not persuaded the Examiner erred in finding Kim '424 teaches the disputed limitation of claim 4, and we sustain its rejection under 35 U.S.C. § 103.³

Fifth Issue

Independent claim 8 stands rejected under 35 U.S.C. § 103 as being obvious over Cok, Rogers, Kim '424, and Spinar. Final Act. 16–20. Relevant to this issue, claim 8 recites the limitation:

a display driver integrated circuit die mounted to a solder pad on the first surface of the substrate in between the discrete crystalline semiconductor light-emitting diodes, wherein the display driver integrated circuit controls at least two of the discrete crystalline semiconductor light-emitting diodes.

Appeal Br. 26–27. The Examiner finds this limitation would have been obvious over the combined teachings of Kim '424 and Spinar. Final Act. 18–20. Appellant argues the cited references fail to teach or suggest this limitation because "even if one were to combine the teachings of Spinar

³ We further note, that although not necessary to our decision, Kahan describes the use of discrete data and selection drivers which "are conventional integrated circuits . . . [and may be] attached onto the same side of the substrate as row and column electrodes." Kahan ¶ 33.

with that of Kim '424, the result would merely be a pixel circuit (not a display driver integrated circuit die) and a probe integrated circuit die.”

Appeal Br. 15. Appellant further contends this limitation is absent from the references between Kim '424's pixel circuitry controls only a single pixel, whereas the claim requires that “the display driver integrated circuit controls at least two of the discrete crystalline semiconductor light-emitting diodes.”

Appeal Br. 15.

We are not persuaded of Examiner error. Appellant's first argument—that the combined teaching would result only in a pixel circuit and a probe integrated circuit die—is not responsive to the rejection made by the Examiner. Appellant asserts that Spinar teaches only a probe integrated circuit die. As the Examiner explained, however, Spinar is cited only to show that it was known to mount integrated circuit dies on solder pads.

Ans. 43 (“[P]rior art Spinar is relied upon only to teach ‘integrated circuit **die** mounted to a **solder pad on** the first surface of the substrate’, as described in [paragraph 21].”). Spinar is not relied upon to teach the recited “display driver integrated circuit,” as the Examiner finds the “display driver integrated circuit” taught by Kim '424.

We also do not find persuasive Appellant's second argument that Kim '424's pixel circuitry is deficient because it controls only a single LED. The claim recites “a display driver integrated circuit die,” which means “one or more display driver integrated circuit die.” *Baldwin Graphic Sys., Inc. v. Siebert, Inc.*, 512 F.3d 1338, 1342 (Fed. Cir. 2008) (“[T]his court has repeatedly emphasized that the indefinite article ‘a’ or ‘an’ in patent parlance carries the meaning of ‘one or more’ in open-ended claims containing the transitional phrase ‘comprising.’”). The view in Kim '424 shows only a

single pixel, but one of ordinary skill in the art would have appreciated that a display device would have many pixels and many integrated circuits for controlling those pixels. Because the limitation encompasses multiple (i.e., one or more) pixel circuits, and because Kim '424 teaches or at least suggests multiple pixel circuits which control multiple pixels (i.e., “at least two of the light-emitting diodes”), we are not persuaded the Examiner erred in rejecting claim 8.

Sixth Issue

Independent claim 19 recites the limitation “circuitry formed at least partially within the semiconductor substrate.” Appeal Br. 28. In rejecting claim 19, the Examiner finds this limitation taught by Cok. Final Act. 27 (citing Cok Figure 3 elements 16, 14 and 12; ¶ 64). Appellant argues the Examiner has erred because the circuitry shown in Cok is *on* the substrate, but not *within* the substrate. Appeal Br. 20. We agree.

Appellant’s Specification draws a distinction between circuitry implemented *on* a substrate and circuitry implemented *within* a substrate. For example, paragraph 37 states that display control circuitry “may be implemented using thin-film transistor circuitry implemented on substrate 24, and/or may be implemented using circuitry formed within substrate 24 (e.g., in a configuration in which substrate 24 is formed from a semiconductor substrate such as a silicon substrate).” Spec. ¶ 37.

The circuitry shown in Cok is positioned entirely on top of the substrate, but it is not embedded within the substrate. As such, we agree with Appellant that the Examiner has failed to show that the cited prior art teaches or suggests “circuitry formed at least partially within the

semiconductor substrate,” as recited in claim 19, and we do not sustain its rejection under 35 U.S.C. § 103.

Remaining Claims

Appellant does not present specific arguments for any remaining claims not discussed above. Accordingly, the remaining claims each stand or fall with their respective independent claims based on the analysis set forth above.

CONCLUSION

The Examiner’s rejection is affirmed-in-part.

More specifically:

We reverse the rejection of claim 8 under 35 U.S.C. § 112(a) as failing to comply with the written description requirement.

We affirm the rejection of claims 3 and 5 under 35 U.S.C. § 112(b) as being indefinite.

We affirm the rejection of claim 1 under 35 U.S.C. § 103 as being unpatentable over Lynch, Rogers, and Lau.

We affirm the rejection of claims 2 and 25 under 35 U.S.C. § 103 as being unpatentable over Lynch, Rogers, Lau, and Kim ’424.

We affirm the rejection of Claim 5 under 35 U.S.C. § 103 as being unpatentable over Lynch, Rogers, Lau, and Kahen.

We affirm the rejection of claim 6 stands under 35 U.S.C. § 103 as being unpatentable over Lynch, Rogers, Lau, Kahen, and Kim ’424.

We affirm the rejection of claim 26 under 35 U.S.C. § 103 as being unpatentable over Lynch, Rogers, Lau, Holman, and Handschy.

We affirm the rejection of claim 3 under 35 U.S.C. § 103 as being unpatentable over Lynch and Kahen.

We affirm the rejection of claim 4 under 35 U.S.C. § 103 as being unpatentable over Lynch, Kahen, and Kim '424.

We affirm the rejection of claim 8 under 35 U.S.C. § 103 as being unpatentable over Cok, Rogers, Hu, Kim '424, and Spinar.

We affirm the rejection of claim 12 under 35 U.S.C. § 103 as being unpatentable over Cok, Rogers, Hu, Kim '424, Spinar, and Lee.

We affirm the rejection of claims 13–17 under 35 U.S.C. § 103 as being unpatentable over Cok, Rogers, Hu, Kim '424, Spinar, Lee, and Miyamoto.

We affirm the rejection of claim 18 under 35 U.S.C. § 103 as being unpatentable over Cok, Rogers, Hu, Kim '424, Spinar, Lee, Miyamoto, and Ohba.

We affirm the rejection of claims 28 and 29 under 35 U.S.C. § 103 as being unpatentable over Cok, Rogers, Hu, Kim '424, Spiner, and He.

We reverse the rejection of claims 19 and 20 under 35 U.S.C. § 103 as being unpatentable over Cok, Hu, Kim '534, and Kim '758.

We reverse the rejection of claim 21 under 35 U.S.C. § 103 as being unpatentable over Cok, Hu, Kim '534, Kim '758, and Kim '424.

We reverse the rejection of claim 31 under 35 U.S.C. § 103 as being unpatentable over Cok, Hu, Kim '534, Kim '758, and Shirouzu.

DECISION SUMMARY

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
8	112(a)	written description		8
3, 5	112(b)	indefiniteness	3, 5	
1	103	Lynch, Rogers, Lau	1	
2, 25	103	Lynch, Rogers, Lau, Kim '424	2, 25	
5	103	Lynch, Rogers, Lau, Kahen	5	
6	103	Lynch, Rogers, Lau, Kahen, Kim '424	6	
26	103	Lynch, Rogers, Lau, Holman, Handschy	26	
3	103	Lynch, Kahen	3	
4	103	Lynch, Kahen, Kim '424	4	
8	103	Cok, Rogers, Hu, Kim '424, Spinar	8	
12	103	Cok, Rogers, Hu, Kim '424, Spinar, Lee	12	
13–17	103	Cok, Rogers, Hu, Kim '424, Spinar, Lee, Miyamoto	13–17	
18	103	Cok, Rogers, Hu, Kim '424, Spinar, Lee, Miyamoto, Ohba	18	
28, 29	103	Cok, Rogers, Hu, Kim '424, Spiner, He	28, 29	
19, 20	103	Cok, Hu, Kim '534, Kim '758		19, 20
21	103	Cok, Hu, Kim '534, Kim '758, Kim '424		21
31	103	Cok, Hu, Kim '534, Kim '758, Shirouzu		31
Overall Outcome			1–6, 8, 12–18, 25, 26, 28, 29	19–21, 31

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TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED-IN-PART