STANFORD UNIVERSITY
Stanford, California

Department W. W. Hansen Labs of Physics, Microwave Laboratory No. S74-09

Hansen Lab Docket M.L. 316

RECORD OF INVENTION

1. Title Electronic Device for Converting Written Music to Audible Sound

2. Inventor C. F. Quate Position Professor

   Address 25835 Estacada Drive, Los Altos Hills, California 94022

3. Co-inventor -------- Position -------

   Address --------

4. Sponsor None Contract or Grant None

5. Witnesses H. J. Shaw

6. History — Details — Dates

   (a) Conception The system was conceived while considering various systems for improving upon the methods for reading music. Jan. 10, 1974

   (b) Notes See Notebook M.L. #2272, pages 10-11.

   (c) Construction None

   (d) Tests None

   (e) Use An electronic system for the aid and improvement of the teaching of music.

7. Disclosures

   (a) Oral H. J. Shaw (January 15, 1974)

   (b) Publications None

   (c) Other M.L. Notebook entry #2272, pages 9-10

8. Invention Disclosure

Tt is evident to me that one can assemble existing components into a system which can serve the purpose of converting written music into audible sound. The reading can be taken from the Optacon and used to convert a musical note into an electrical signal. The timing of the reading of a given note can be regulated by an electronic metronome. The electrical signal can be used to drive the tone generator - a solid state device now produced by Motorola. The output of the tone generator can be used to drive a conventional loudspeaker - to produce the audible output.

9. Attachments

Inventor C. F. Quate Co-inventor -------

Read and understood by H. J. Shaw Paul Fine Date January 16, 1974

DATE: March 4, 1974

TO : Invention Disclosure Files

FROM : NR

SUBJECT: Meeting of Calvin F. Quate and Niels J. Reimers of February 28, 1974

We agreed there was a need to develop additional patent attorney strength for Microwave Laboratories patent matters. I will investigate potential candidates and review their capabilities with CFQ.

S74-06 WAVEFORM GENERATION WITH NON-LINEAR ACOUSTIC
Realization of this invention may require advances in silicon niobate technology. Invention uses convolver. Decision to file.

S74-07 PULSE GENERATION WITH SAW
Similar to 74-06, but of more significance. Decision to file. Gallium arsenide may be better than silicon for storage. Fairchild, BTL, Intel, and other companies researching in this area. NR to investigate with companies prior to filing decision.

S74-09 ELECTRONIC DEVICE FOR CONVERTING WRITTEN MUSIC TO AUDIBLE SOUND
NR to present to Yamaha on occasion of their next visit.

S74-10 ACOUSTIC READOUT FOR MAGNETIC BUBBLES
NR to follow up on progress of development in early fall 1974.

S74-11 ACOUSTIC READOUT OF PATTERNS AS EMBOSSED ON PLASTIC TAPE
NR to check for RCA reference which may be noted on pages 17 and 18 of Microwave Lab notebook #22-72. Re-evaluation for filing later.

S74-12 PRINTING WITH FOCUSED ACOUSTIC BEAMS
NR will check evaluation of Dick Sweet and recontact CQ.

S74-13 READOUT DEVICE FOR PIEZOELECTRIC TAPE.
NR to follow up with CQ in early fall.

S73-14 AN INEXPENSIVE DISPLAY PANEL
Decision to file but after more critical inventions. NR may present to Xerox.

S74-15 A NEW FORM FOR AN INTERNAL COMBUSTION ENGINE
NR to discuss this invention with M. Chodorow.

S74-16 NEW CONFIGURATION FOR SUPERCONDUCTING UNDERGROUND CABLE
Agreed to defer filing decision and review later this year.

S74-17 SCANNING AND DISPLAY OF OPTICAL IMAGES THROUGH COUPLING OF GUIDED OPTICAL WAVES AND ACOUSTIC SURFACE WAVES
Decision to file. This invention, along with 74-18, 74-19, 74-21 will be placed with a single patent attorney.

S74-18 OPTICAL FILTER WITH GUIDED WAVES
NR to obtain evaluation from Steve Harris.

S74-19 OPTICAL SCANNER VIA ACOUSTO-OPTIC INTERACTIONS
NR to obtain evaluation from Steve Harris

S74-20 SCANNING OF ACOUSTIC BEAMS
Decision to defer until late summer.

S74-21 ACOUSTO-OPTIC FILTER
To be combined with 74-17, 18, 19.

S74-22 MULTIPLEXING OF OPTICAL BEAMS VIA ACOUSTIC INTERACTION
?

S74-23 VISUAL DISPLAY FOR ELECTRONIC STRINGED INSTRUMENTS
NR to present to Yamaha on occasion of next visit.

S74-24 FREQUENCY DIVIDER
NR to check with Chodorow before development decision. Student, Tom Grudkowski, may implement the concept.

cc: C. F. Quate

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June 5, 1974

Mr. Yasunori Mochida
Director
Advanced Development Div.
Nippon Gakki Co., Ltd.
YAMAHA
10-1, Nakazawa-Cho
P. O. Box 1
Hamamatsu, Japan

Dear Mr. Mochida:

You will recall our last communication of May 23, 1974 with respect to the FM sound system work of Dr. John Chowning regarding which we are awaiting a reply from you. This letter is not concerned with that subject, but to obtain your opinion of the following inventions.

It has become evident to an applied physics professor that a system utilizing existing technology can be assembled for the purpose of converting written music into audible sound. What we do not know is if there are similar systems now in existence or whether, indeed, there might be a market for such a system, if developed.

I also would like to obtain your opinion regarding another music related invention. This relates to a visual display of electronic stringed instruments which would allow a student to learn more rapidly than is now possible. I should first explain that the University now has the electronic stringed instruments made by Max Mathews of the Bell Telephone Laboratories. The system contemplated here would be to produce a visual display of the notes played by the student which can be compared with the printed notes, so that the student could readily identify whether he was "on key" or not.

When you have an opportunity, could you let me have your opinion regarding the above inventions? Thank you for any consideration and we look forward to hearing from you. Incidentally, Dr. Chowning will be on campus (from Berlin) the week of June 22 for conferences.

Very truly yours,

Niels J. Reimers
Manager, Technology Licensing

NJR:jp

bcc: C. F. Quate

July 30, 1974

Calvin Gate

Niels Reimers

Dear Cal:

You will recall my writing Yamaha about your ideas regarding converting written music into audible sound and the visual display of musical notes as played by a music student. Attached is a copy of Yamaha's response which will be of interest to you. I am also sending a copy of this attachment to John Chowning and Leland Smith as they are also interested in this subject:

cc: J. M. Chowning, w/attachment
L. C. Smith, w/attachment

Regarding the computer music system:

1. Conversion of written music into audible sound

It is believed the idea of automatic performance of the music manuscript has been experimentaly implemented at the various places.

We consider MUSIC V of Max Mathew, most well-known among all, is too bulky and rather inconvenient to manage for an unskilled user.

Ashton, now the professor of the Computer Science Department at Brhygum Young University, implemented the similar system with the use of an electronic organ and PDP-8 mini-computer.

It was capable of;

1) Interpreting a sort of music language in which most music notations used in the music manuscript are somehow expressed in alphabet or special characters.

2) Converting the above text to the performance data that is fed to the interface between the organ and the mini-computer, so that the on-off switching of the electronic parts in the organ is manipulated in such a way that expected performance is obtained.

3) Real time handling of the above function.

The detail of his work is described in his doctoral dessertation, "Electronics, Music and Computers", 1972, Utah University.

We think there is a strong possibility to yield the commercially feasible computer controlled instrument that is capable of digital recording of the human performance or written music and reproducing it as exactly it was played or with some artistic modification, and hopefully providing some useful informatin for the educational or compositional purposes. We emphasize, however, it should be simple to operate, compact in size, and low in the production cost to be commercially feasible.

YAMAHA has already developed, with an initial instruction provided by Prof. Ashton, the similar version with the use of PDP-11 mini-computer and electronic organ.

Its functions are as following:

1) Digital recording of the performance information onto the disk.

2) Reproduction of the stored information into the electronic organ.

3) Conversion of the music manuscript into the performance information.

4) Modification of the performance data in terms of tempo change, transposition, and tone coloring.

5) Real time display of the performance on CRT in the form as close to the usual music notation as possible.

As for the written music conversion, we enclose YAMAHA version of the program manual. It is mostly compatible to Ashton's rule, but interpreted by our PDP-11/1Ø mini-computer. Also enclosed is an example of visual display of the performance. This is done strictly on real time basis. Please notice there are some "H" marks which indicate those are now being played but do not know the length of the notes until they are completed.

Again toward the commercially feasible system, we are now replacing the mini-computer with so-called one chip CPU (like Intel 8Ø8Ø), TTL logics of the interface with the LSI devices, and expensive disk drive with some cheap bulk storage devices.

2. Electronic stringed instruments and visual display

Although we have no knowledge about Mathews' electronic stringed instrument, your system seems to be understanding to fulfill the educational need.

As a matter of fact, we developed the similar system as already explained above. If our opinion regarding this matter were to be about marketability, again it would become a question of cost and size.

It is also our opinion that such a display must be made on the real time, must have the same format as the written manuscript, must not be too cumbersome in editing, if required, to get it close to the written form; and there would be a dilemma we now fall between the visual format, convenience, and the size and cost of the system.