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# Music Engineers. The Remarkable Career of Winston E. Kock, Electronic Organ Designer and NASA Chief of Electronics

### Introduction: Kock the Novelist

"This is not just the usual boy-meets-girl, boy-loses-girl, boy finds girl story. Told in the first person *Love's Warm Sun* is a tale written with such warmth and insight that it is difficult to believe that it is not autobiographical. Wayne Kirk has created an old-fashioned love story that holds interest without having to resort to the more explicit titillation of present-day writing. When George White and Jan Matthews meet, he is just beginning his career as a research engineer. She is an attractive young woman, from a good family, with an excellent singing voice and an aptitude to play to the piano. They get along well and enjoy each other's company. George's work is time-consuming and he makes inroads in his research and is promoted within the company. He travels a great deal, but always counts on Jan's being there when he returns.

One day he comes home from a trip to find she has left for Europe without leaving an address. Their reunion, when he finally finds her, and her reason for disappearing are movingly told. Mr. Kirk has included songs, which he has composed, in his book. They add to the lyricism of *Love's Warm Sun*.[1]>

This is the blurb of a book published in 1982. The author is nobody else but Winston E. Kock (1909 –1982), writing under the pseudonym of Wayne Kirk. He was a remarkable electronics engineer about whom relatively little is known. He was a man of many talents and distinguished himself in electronics. In what follows I will concentrate on his achievements in music technology and on his ideas on creativity.

### Student Years

Winston Kock was born in 1909. His parents encouraged him to take piano lessons at an early age – he started at the age of four – and to play tunes for guests at his parent's parties. They found a good teacher for him from the Cincinnati Conservatory of Music. When he was a high school senior he could play from memory a full evening's recital.[2]

Fig. 1. Winston E. Kock playing an experimental model of his first organ-type electronic instrument. (This and the following illustrations are from Winston E. Kock's *The Creative Engineer.)*

At college young Winston was encouraged to also compose music which he did fairly well. He began studying organ and soon secured a position as church organist and choir director in a small church. At the University of Cincinnati he studied electrical engineering and, at the Cincinnati College of Music, piano and organ. In the early 1930s Kock built an electronic organ as partial fulfillment of his degree in electrical engineering.

In the electric organ, one electric source can, different from the conventional organ, produce different timbres or tone colors. This is because the electronic vibrations of the tone generator are passed through electric circuits which modify the tone color of that electrical source when it is finally transformed into an acoustic tone by the loudspeaker. In the early days of electronic organ development this significant advantage posed a problem, because the use of standard radio tubes as tone sources meant that about 70 tubes, plus all the associated circuits, were required. This involved considerable expense. Therefore the early experimental organ that Kock constructed used tiny neon tubes as tone sources which were inexpensive compared to vacuum tubes.[3]

But there was another advantage, namely that, through the use of formants, many tone colors were obtainable with only one tube. Formants were first intensively investigated by Karl Willy Wagner at the Berlin Institute of Technology in the late 1920s. A formant can be defined as a frequency range with particularly strong harmonics (overtones). The graph representing the relationship between amplification and frequency is usually called the 'formant characteristic'. To give an example: The body of a violin converts the almost inaudible sound of the strings by a process of resonance and radiation into a much louder

sound. In doing so, it imposes its own formant on the sound; different frequency components in the string vibrations are enhanced by different amounts and so the timbre is changed. In electrical musical instruments, electrical resonant circuits can produce, electrically, the musical instrument resonances contained in true orchestral instrument sounds.[4] In 1935 Kock filed a patent application describing the use of formant circuits in an electronic organ.

But there were also serious problems with this organ, especially pitch maintenance. The frequency of oscillations depends on several factors; changes in any of these will affect the pitch so that retuning becomes necessary. Bringing the 70 or so neon-tubes oscillators into proper pitch was a complicated matter.

In his master' degree thesis Kock tackled the problem of pitch stabilization. He tried to learn more about the neon-tube oscillator properties, that is about intermittent glow discharge. To solve the pitch stabilization problem, an inductance can be added to the standard intermittent glow discharge circuit. By this, Kock hoped that a resonance effect could be introduced in which the resonant frequency was determined by the original capacitance and the newly introduced inductance. In 1932 Kock received his electrical engineering diploma and in 1933 his Master of Science degree.[5]

**Kock and Vierling in Berlin**

In the spring of 1933, after finishing his studies in Cincinnati, Kock became exchange fellow at the Technical University of Berlin. He had heard of Karl Willy Wagner's work and wanted to conduct doctoral research with him at the Heinrich Hertz Institute. Kock's counterpart as an exchange student from Berlin to Cincinnati was Sigismund von Braun, Wernher von Braun's eldest brother. In Berlin Kock wrote a Ph. D. thesis on oscillations in inductive glow discharge circuits and, with Oskar Vierling, another student of Wagner's, designed an improved electronic organ on the formant principle.[6]

Oskar Vierling (1904 –1986), Kock's collaborator on the Kock-Vierling organ, had studied electrical engineering at an engineering school and in 1925 joined the Laboratory of the German Research Institute for Telegraphy headed by Karl Willy Wagner. In 1928 he followed Wagner as his assistant to the newly founded 'Institute for Vibration Research' conducting acoustic research and designing electrified pianos and electronic organs. Together with the Nobel Laureate Walter Nernst he in 1931 designed the <Neo-Bechstein piano>, an

electrostatic piano and from 1928 to 1935 developed his <Electrochord> for the piano manufacturer Förster.[7] The National Socialist <Strength through Joy> organization sponsored Vierling's <Strength through Joy Organ> which was played at the Olympic Games in Berlin in 1936. This enlarged and improved version of the Kock-Vierling model created a sensation as did his electrically generated bell sounds which he presented at the National Socialist Party Rally in Nuremberg a year later.[8] Fascination by technology, electricity and electronics, surprising effects, glorious sounds, this was food for the masses and much appreciated by the party propagandists. Vierling's mentor Karl Willy Wagner must have watched his former assistant's success with very mixed feelings, having himself been forced to resign from his directorate of the Heinrich Hertz Institute in 1936. There is an irony in the fact that Kock, who played a significant role in the US War effort during World War II, contributed, although unintentionally, to enhancing Nazi propaganda efforts.

## Becoming NASA Chief of Electronics

Returning from Berlin, Kock went to Bangalore, India, for a year where he conducted research in tone colour and the acoustics of music instruments at the Indian Institute of Music. His trip to India was financed by the Baldwin Piano Company in Cincinnati. Back in the United States he in 1936 became research director of that firm. During his time at Baldwin and based on his research in Berlin he designed an improved electronic organ which was patented in 1941. Obviously, times of war were not conducive to building and marketing electronic musical instruments, therefore the production of the first Baldwin electronic organ had to wait until 1946.[9]

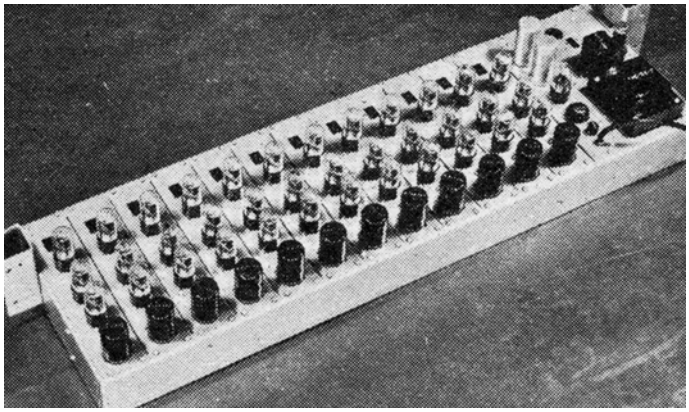

Fig. 2. The electronic generator of the first commercial model of Kock's electronic organ.

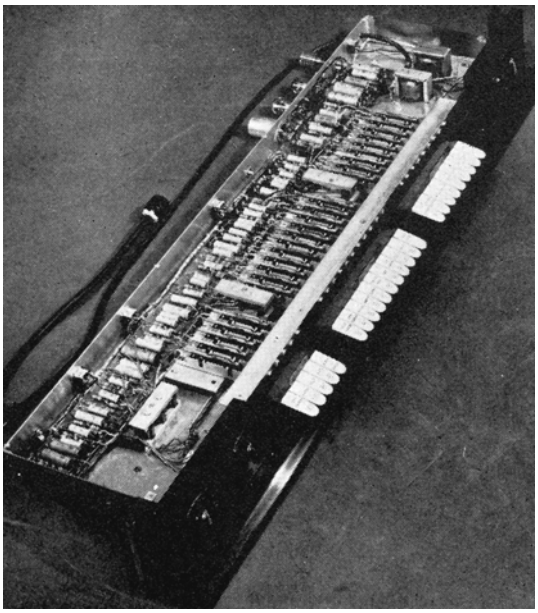

Fig. 3. The tone – modifying electronic circuits of this model.

In the Baldwin organ neon tubes were replaced by radio tubes called <double triodes>, single tubes equivalent to two radio tubes. This procedure reduced the number of tubes to a comparatively modest 37, thereby permitting much greater pitch stability than had been possible with neon tubes. In journals like *The American Organist* the Baldwin organ was favorably received.

Fig. 4. The assembled electronic organ.

Shortly after the United States entered World War II Kock left Baldwin. In 1942 he joined the Bell Telephone Laboratories to pursue military research mainly on fire control radar for the Navy. He excelled in the field of microwave antennae and when the war was over applied his research findings to transcontinental microwave radio relays for telephone and TV

transmission. In 1951 Kock became Director of Acoustics Research at Bell and in 1955 Director of Audio and Video Research. At that time he worked on band compression for voice transmission and initiated the development of a picture-phone for use over telephone lines. Limited commercial service of this device started in 1964. During his years at Bell Kock was also engaged in underwater sound projects.

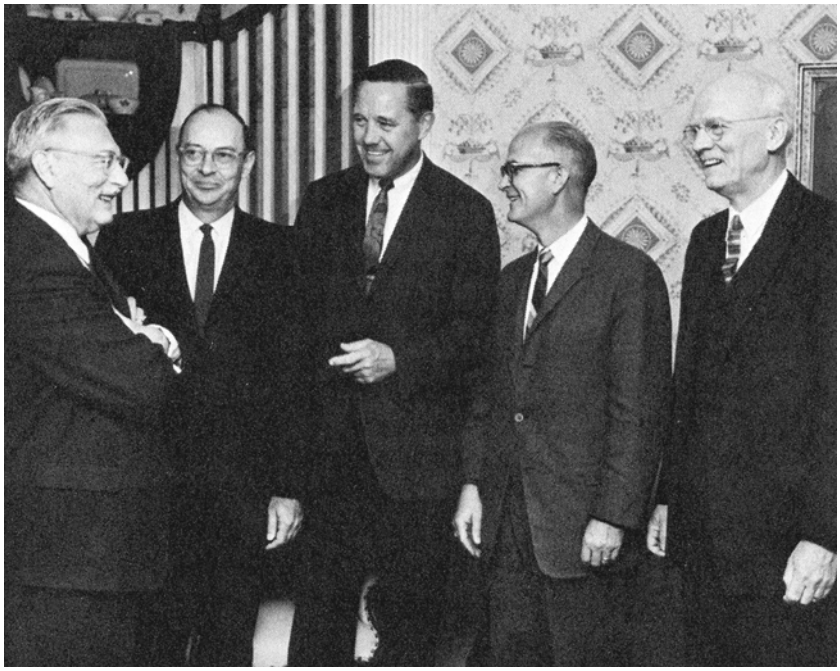

Fig. 5. A group photo taken at Kock's Ann Arbor home. Left to right: Nobel Prize winners Peter Debye and John Bardeen, Winston E. Kock, Nobel Prize winner William Shockley, and Ralph Sawyer, Vice-President for Research at the University of Michigan.

Mainly due to his interests in submarine detection he left Bell in 1956 and joined the Bendix Corporation. Bendix was a pioneer in sonar research and strong in developing torpedo and undersea missile control systems. In 1958 he became director and general manager of the Bendix Research Laboratory Division and was made Vice-President of Research in 1962. During his time at Bendix he participated in the development of an anti-submarine device called <dunked sonar>, in which helicopters lowered the sonar listening unit into the sea to spot enemy submarines.[10]

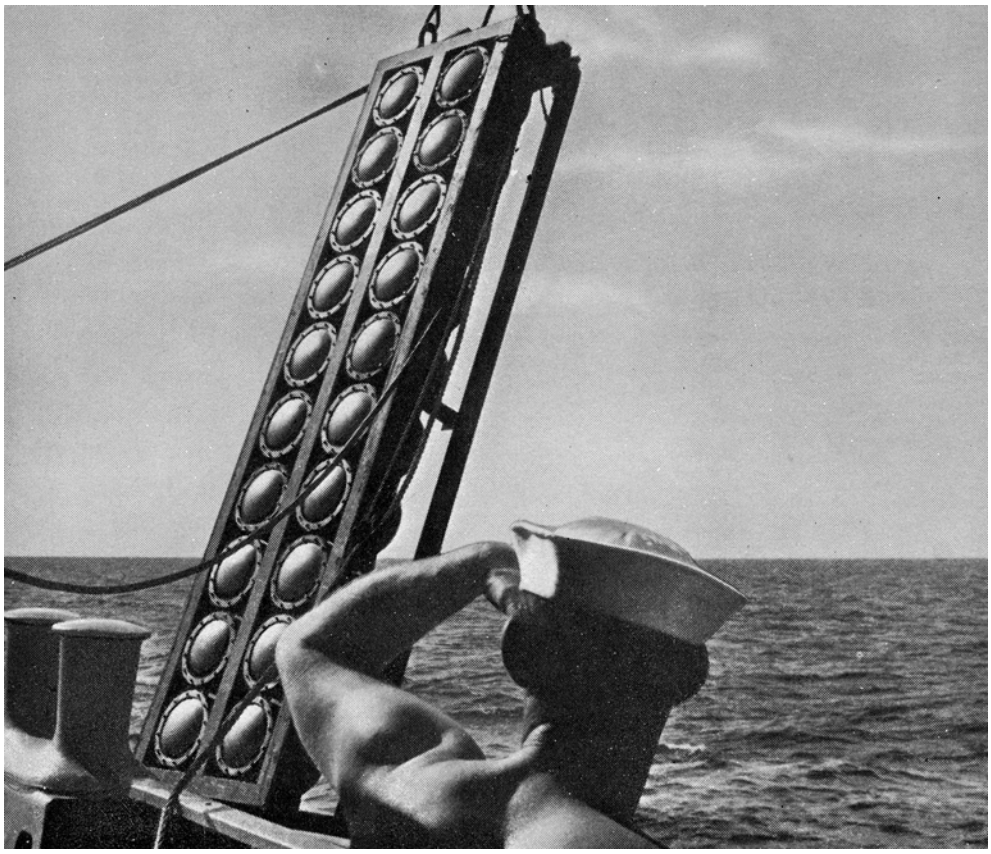

Fig.6. <Dunked Sonar>.

Kock was also involved in radar, laser and holography and the design of a control-rod drive mechanism for nuclear reactors in nuclear powered submarines. When NASA founded its Engineering Research Centre in Cambridge, M. A., Kock was asked to take a leave from Bendix to became the Center's first director, guiding research on aeronautical and space electronics. In 1966 he returned to Bendix and concentrated on research on acoustic holography, a field in which he became internationally known. After his retirement from Bendix in 1971 Kock accepted the position of director of the renowned Herman Schneider Laboratory, the Basic and Applied Science Laboratory at the University of Cincinnati.[11]

**Kock on Creativity**

In 1978 Plenum Press published his book <The Creative Engineer. The Art of Inventing>. Kock seems to have been familiar with the most important publications in that field. In line with researchers like Koestler, Martindale or Guilford he pointed out that a creative, innovative person values or should value interdisciplinary work. <The more the world makes up specialists, the more we should strive to become generalists> was his advice.[12] According to him, the most important features of creative persons are the non-acceptance of stock

answers and the production of associative ideas, transferring a new concept from one field to another, breaking the pattern of the familiar.

What activities are particularly useful for fostering creativity? Obviously, for a person like Kock music-making and especially composing are relevant. But there are others, for example chess. Kock pointed out that several eminent scientists like Turing, Wiener or Shannon championed chess as an ideal proving ground for research.[13] Chess problem composing is particularly important. Kock was a superb chess player himself. But also, and coming back to my quotation from Kock's book at the beginning: Literature, writing short stories, novels and poems should be valued highly. Closely linked to chess problem composing is the writing of mystery novels. But other fields of literature are useful too: Kock mentions that many science and engineering innovators moved into the field of science fiction writing, e.g. Arthur C. Clarke, who pioneered in suggesting a communication satellite, or Bell Lab's inventor John R. Pierce, who, *inter alia*, was, together with Rudolph Kompfner, responsible for the microwave amplifier, the <travelling-wave> tube. Authors of cartoons and humorous columns should also not be forgotten. They have to come up with novel ideas and the unexpected all the time if they are to maintain a following.[14]

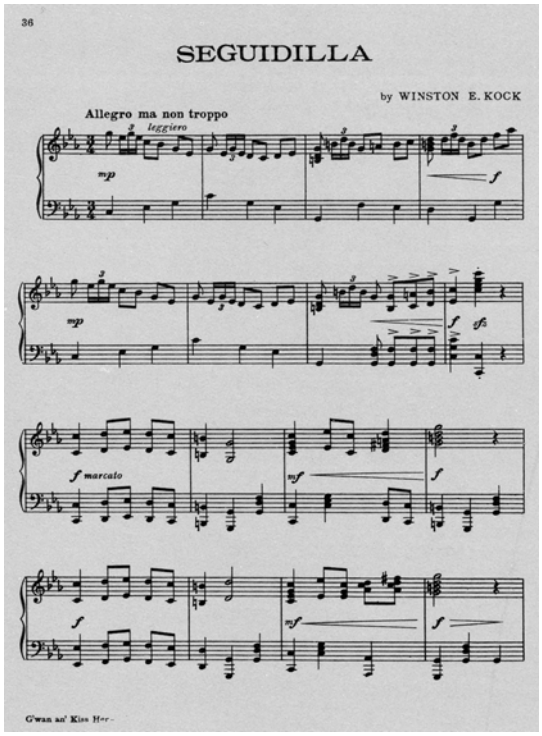

Fig. 7. A Seguidilla composed by Kock in 1931.

## Conclusion

<From electronic organ designer to NASA chief of electronics> could be a popularised abstract of Kock's professional life. But a phrase like this might be misleading. It could insinuate that there was a spectacular development from something relatively simple – designing an electronic organ – to a prestigious high tech appointment, one of the most distinguished an electronic engineer in the United States could get. It has to be pointed out, however, that both fields, electronic organ design and NASA research, can be described as <high tech>; designing electronic organs in the late 1920s and early 1930s was no less demanding than NASA electronics in the 1960s.[15]

My other general point regards creativity: Although one does not have to be a musician – or a painter, sculptor, novelist – in order to do pathbreaking physics or engineering research, some artistic talent probably helps. Besides: For work of this kind, not so much economic demand push seems to be the driving force but the desire to create something new, <intrinsic motivation> as some psychologists say.[16]

In conclusion it can be said that we need more and in - depths studies - in this short article I have just scratched the surface - of these <artist engineers> in order to find out more about the relationship between artistic and scientific creativity. Kock has provided some hints in that direction and cognitive psychologists have offered interesting insights. But much more research needs to be done.

Notes

[1] Wayne Kirk (Winston E. Kock) *Love's Warm Sun. The Story of a Bright Young Engineer and a Beautiful Young Girl*, New York 1982.
[2] Winston E. Kock, *The Creative Engineer. The Art of Inventing*, New York 1978.
[3] Kock, *op.cit.*, 37.
[4] Charles Taylor, 'Formant', in: *The new Grove dictionary of music and musicians*, Stanley Sadie. - Reprinted ... in paperback ed. - New York [u.a.] : Grove [u.a.] (1995), 710-711.
[5] Kock, *op.cit.*,
[6] Hans-Joachim Braun, <Strange Bedfellows. The Relationship between Music Technology and Military Technology in the first Half of the Twentieth Century> in Bernd Enders and Joachim Stange-Elbe (eds.) *Global Village, Global Brain, Global Music*. KlangArt-Kongress 1999, Osnabrück 2003, 144.
[7] Wolfgang Voigt, <Oskar Vierling, ein Wegbereiter der Elektroakustik für den Musikinstrumentenbau>, in: *Das Musikinstrument* vol. 37, No 1/2, 1988, 214-221, No. 2/3,172-176.
[8] Fred K. Prieberg, *Musik in NS-Staat*, Frankfurt am Main 1982, 141.
[9] Kock, *op. cit.*, 53-55.
[10] Kock, *op.cit.*, 168.
[11] Winston E. Kock, *American Men and Women of Science. Physical and Biological Sciences*, vol. 4, New York, London, 15th ed. 1982, 403.
[12] Winston E. Kock, *The Creative Engineer. The Art of Inventing*, New York 1978,
[13] Kock, *op.cit.*, 114.
[14] Kock, *op.cit.*, 119.
[15] Braun, <Stange Bedfellows>, 151.
[16] Braun, *op. cit.*, 151.