THE BLILEY ELECTRIC COMPANY

THE EARLY YEARS 1930-1955

By Charles A. Bliley, K3NAU

Contents

Welcome...

This booklet contains a brief history of the first 25 years of the Bliley Electric Company of Erie, Pennsylvania, U.S.A. The company was then a manufacturer of frequency control and selective devices based on crystal technologies.

This PDF file is based on the booklet I authored and was published in 1982 by the Bliley Electric Company in association with the Antique Wireless Association. It contains all of the material from this booklet and some additional photographs from my scrapbook. Every effort has been made to guarantee accuracy. Nothing has been deleted from the original publication.

Overall, the content of this booklet is based on patent drawings, magazine articles, newspaper clippings, personal notes and letters, and audiotaped interviews with retired employees:

- Isabelle Bliley Kaiser, W3KPE (Deceased)—Chairwoman of the Board 1954-1997
- George Wright—V.P. Sales (Deceased)
- John Wolfskill, W3QKT—V.P. Engineering (Deceased)
- John Pinar, W3DKL—Supervisor, Calibration Dept.
- Robert Johnson—Personnel Manager
- Richard Shreve, W3PIX—Production Supervisor

Special thanks is given to the Antique Wireless Association (AWA) for its support of the original publication and to AWA members Joel Ross and Lou Vermond for their personal interest and encouragement.

This publication is dedicated to the loving memories of my father, Frank Dawson Bliley, and my mother, Isabelle Bliley Kaiser.

Thank you for your interest in my father's work and that of the many fine people that have dedicated their working lives to the Bliley Electric Company.

Charles A. Bliley

K3NAU

October 5, 2001

From 1938 Ham radio convention program

A YOUNG MAN AND HIS HOBBY

The story of Bliley Electric is, furthermore, the story of a man and those he chose for his friends and business associates. The founder of the company, Frank Dawson Bliley, a lawyer's son, was born in Erie, Pennsylvania, on April 29, 1906. Dawson, as his friends called him, received his first amateur radio license in September 1920 at age 14 and operated under the call sign of 8AGR. The station consisted of two antennas (L&T), a crystal receiver, a single Audion tube receiver, and a 1 kW spark transmitter, which he bought for $14.00. An amateur radio diary indicates his crystal set outperformed his Audion tube receiver, at least at the first.

In the Fall of 1920, Dawson moved with his parents to Boulder, Colorado, for the betterment of his father's health. He operated from Boulder under the call sign 9AXT with a rebuilt version of his Audion receiver and an A.C. powered 1/2 kW spark transmitter. His new antenna was a 58´ long cage "L" with the horizontal element made of five wires (two aluminum and three copper) spread apart at each end with bicycle wheel rims. A note in his log says the bedsprings were part of the ground system and the house lights flickered because of the high current demand of his spark transmitter.

Boulder did not help Dawson's father's health sufficiently, so after a couple of years they moved back to Erie, Pennsylvania. In Dawson's high school years, he acquired an interest in radio circuit design and in the propagation of the "new shortwaves". Armed with an experimental license under the call of 8XC, he cooperated with the Naval Research Laboratory station NKF and experimental amateur radio station 1XAM on a project analyzing propagation during various times of the day on frequencies up to 30 MHz. In these 1924 tests Dawson used an experimental self-oscillated single stage

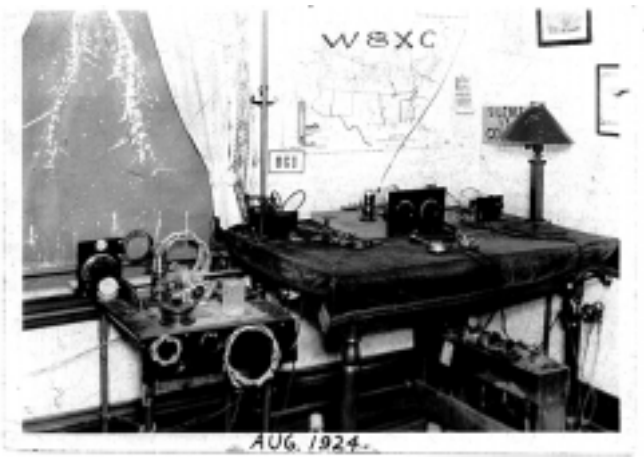


Figure 1. 1924 Experimental Station 8XC

Figure 2. Station 8GU

transmitter which he later described in the June 1924 *Radio* magazine. (Figure 1)

Spurred on by the success of these tests, he attempted a transcontinental contact in 1925 with 6AJF on 56 MHz. In spite of a new parabolic antenna at 6AJF and a daily schedule, the tests were a failure. Even so, Dawson's quest for an understanding of VHF/UHF propagation would be with him always. From what is now known about the nature of propagation above 30 MHz, we would consider a successful contact over such a long distance unpredictable.

Dawson followed up his teenage interest in radio communications by attending Pratt Institute. He graduated from Pratt in New York City, NY in 1929 with a degree in Electrical Engineering. When in college he pur-

chased a steel saw and used it in conjunction with a Carborundum slurry for slicing quartz crystal in the basement of his parent's home. He experimented with cutting and grinding crystals for his own transmitter and for those of his friends. After some success, amateur radio operators prom beyond Erie began asking him to make crystals for their equipment and Dawson was swamped with "orders" for crystals.

BORN OF THE DEPRESSION

The expectations and thrill that Dawson felt in June 1929 at his graduation were shattered by October when the stock market crashed. The depression that followed offered little hope for the future. Here he sat eager to apply what he had learned from experiences spanning the years of spark transmitters, the development of self-excited oscillators, and finally the development of the crystal as a practical frequency controlling device: yet, there was little hope for anything to do except tinker in his basement. With financial help and encouragement from his father, Dawson decided to turn his hobby into a vocation and start manufacturing crystals commercially. Thus, early in 1930 Bliley Electric Company was founded in a basement on West 9th Street in Erie, Pennsylvania.

It really was not much of a business at first, yet Dawson convinced Robert Schlaudecker (a ham friend) and, soon after, Winfield Riblet to join him in his basement factory making coarsely ground crystals for the amateur radio market. Dawson's mother complained so often about the traffic in and out of the house and the noise, they decided to box the diamond saw into a room ten feet square. The project helped the acoustics, but they soon ran out of space.

In 1931 Winfield Riblet asked George Wright, an old high school friend of Dawson, if he were interested in joining the group on West 9th Street. George, who had been working on the nearly completed Pulaski Expressway in New Jersey as a civil engineer, decided to accept the job offer. George started working on the crystal cutting machine, but later Dawson decided his gift of gab and pleasant personality would make him better suited to be a salesman for Bliley's. George's success led him to become Chief of Sales and Advertising until 1955. He then spent the balance of his fortuity years of service with Bliley's as its President.

THE PARTNERSHIP

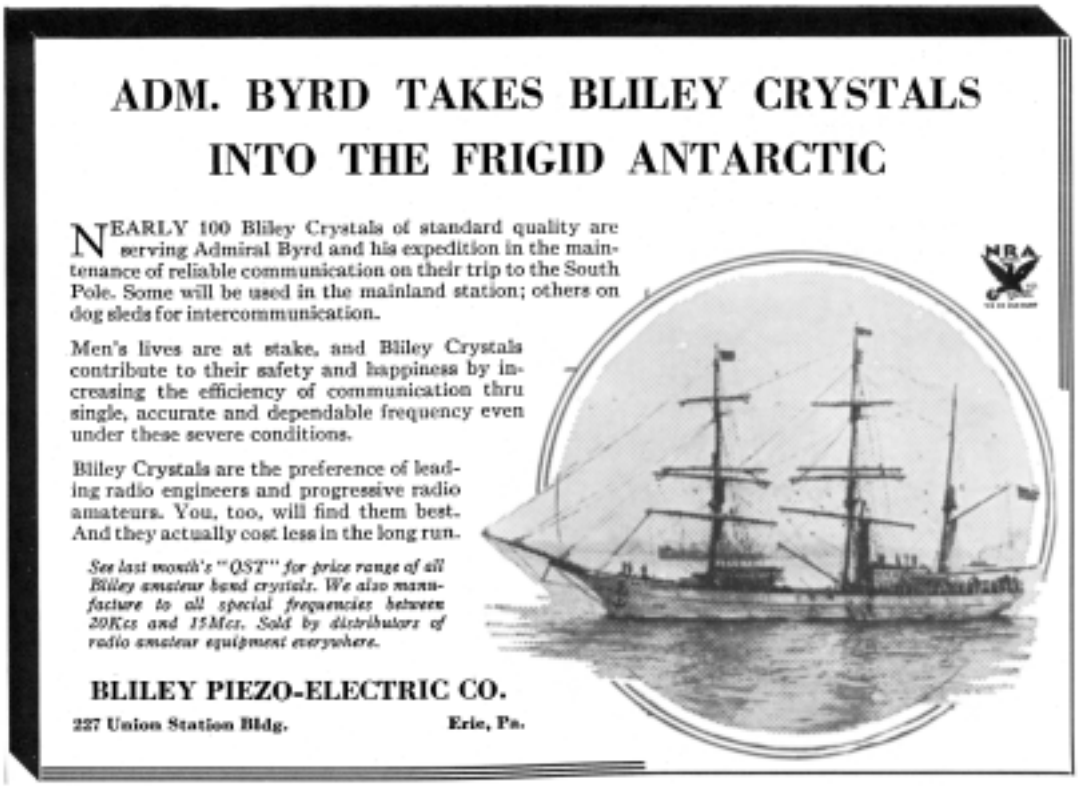
Also in 1931, Dawson approached a local optometrist, Dr. Conrad H. Collman for some help in the lapping process common to both their fields. Dr. Collman had the advantage of motor-driven lapers, which interested Dawson. The two men made an agreement that Bliley's could rent the use of the machines, but the Bliley crew soon was spending more time in Collman's laboratory than expected. Seeing an opportunity for mutual benefit, Dr. Collman suggested that his son Charles Collman (Figure 3), a mechanical engineer, and Dawson form a partnership. Dawson agreed, and the new Bliley Piezo-Electric Company moved into Collman's laboratory on the second floor of Erie's Masonic Temple Building on West 10th Street. Two rooms were now set up with an office for the expanding business.

Figure 3. Charles Collman (L) and Frank Dawson Bliley (R), Circa 1938

All things considered, 1932 was a good year for Bliley's. The first big orders followed Jim Lamb's "single signal" filter design (featuring Bliley crystals) in QST magazine, and there was also a significant increase in the number of orders from commercial and broadcast markets. This was the start of an enduring positive growth pattern that would require Bliley's to move again to new facilities in 1933, this time to the new Union Station Building in the center of Erie, a location next to the railroad lines. Later, as the company grew in these facilities, the soot and vibration from the coal fired steam engines rumbling through the station presented constant problems and a threat of possible contamination of the crystal units under calibration.

In 1933 Bliley crystals were taken to the Antarctic with Admiral Byrd for his radio transmitters. The crystals were "standard" units given to Byrd as sort of an apology for Dawson's refusal to go along as his radio operator. The use of the crystals, and Byrd's advertised endorsement, certainly did not hurt the young company's pride and image. (Figure 4)

The first big government contract in peacetime was supplying oscillator crystals for a Navy transmitter built by National Electric Supply. The technology of crystal manufacturing in 1935 did not allow close correlation of circuit parameters, so George Wright and Bob Schlaudecker traveled to Washington, D.C., to set up a temporary manufacturing facility at National Electric Supply. Unfortunately, crystal technology would not allow units to be reliably transferred from one transmitter to another. The team's mission was to do the final grinding and calibration of each crystal unit to match an associated transmitter.



ADM. BYRD TAKES BLILEY CRYSTALS INTO THE FRIGID ANTARCTIC

NEARLY 100 Bliley Crystals of standard quality are serving Admiral Byrd and his expedition in the maintenance of reliable communication on their trip to the South Pole. Some will be used in the mainland station; others on dog sleds for intercommunication.

Men's lives are at stake, and Bliley Crystals contribute to their safety and happiness by increasing the efficiency of communication thru single, accurate and dependable frequency even under these severe conditions.

Bliley Crystals are the preference of leading radio engineers and progressive radio amateurs. You, too, will find them best. And they actually cost less in the long run.

See last month's "QST" for price range of all Bliley amateur band crystals. We also manufacture to all special frequencies between 20Kcs and 15Mcs. Sold by distributors of radio amateur equipment everywhere.

BLILEY PIEZO-ELECTRIC CO.

227 Union Station Bldg. Erie, Pa.

Figure 4. Byrd Advertisement in QST Magazine

DISCOVERIES AND NEW TECHNOLOGIES

Bliley's made patentable improvements in the four big engineering problems of the thirties, specifically: crystal manufacturing technology, temperature stability, aging effects, and frequency limitations. These improvements and resultant patents gave Bliley's a competitive edge over many companies, and helped establish Bliley's as a trend setter in the industry for years to come.

One of the key persons in this period of development was John Wolfskill. He was introduced to Bliley's at the 1933 World's Fair where Dawson and George Wright went on a lark to set up a display. John was doing research work at the Bell Telephone Laboratories at the time, but realized his low position on the seniority list meant he was

likely to lose his job eventually as a consequence of the depression. Having specialized in piezoelectric phenomena in engineering school, and knowing radio amateurs were becoming keenly interested in crystal techniques, John submitted an article to QST magazine for publication in December 1934 on quartz crystal fundamentals.

Shortly after its publication John wrote to Dawson Bliley asking if he were interested in hiring him. Dawson was impressed with John's article and, to John's delight, he invited him to come to Erie for an interview in March 1935. John accepted Dawson's subsequent job offer and increased Bliley's employment to twelve. Shortly after John came to Bliley's, he convinced Dawson to order an "inexpensive" test oscillator for his laboratory work on crystal characteristics. Wolfskill knew a need existed to push higher the upper frequency range of crystal oscillators. He decided to work on getting a crystal to oscillate reliably above 9 or 10 MHz, then considered the highest operable frequency on a fundamental mode. Using a technique from his low frequency Bell Laboratories experiences, John placed a headphone at the end of a quarterwave transmission line (resonant at the crystal frequency) in series with a 5 MHz range crystal plugged into the test oscillator. As the test oscillator's feedback circuit was tuned to each odd harmonic of the test crystal, a "click" was heard in the headphone. This click was the result of a surge of current created when the crystal and the oscillator feedback circuit reached a harmonic resonance. Feeling that he was on to something, John transferred the crystal to an oscillator designed with a tank circuit tuned to the third harmonic of the crystal. He was successful in getting the oscillator to drive a dummy load test lamp to full brilliancy. This became the birth of the overtone crystal. Work now began to perfect the crystal which would later be sold as a Bliley type HF2. This new crystal would allow radio amateurs to build single stage high output level oscillators with confidence. When the overtone crystal patent application was filed the patent office reported the Radio Corporation of America was contesting the application. Bliley's won the suit, and John Wolfskill won a promotion to Chief Engineer.

Figure 5. John Wolfskill at Work in the Engineering Lab

May 9, 1939. J. M. WOLFSKILL 2,157,808

PIEZOELECTRIC CRYSTAL

Filed Aug. 27, 1935

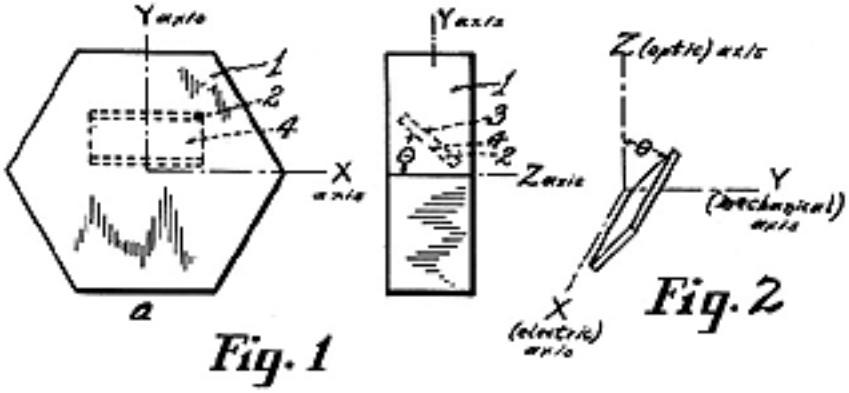


Fig. 1

Fig. 2

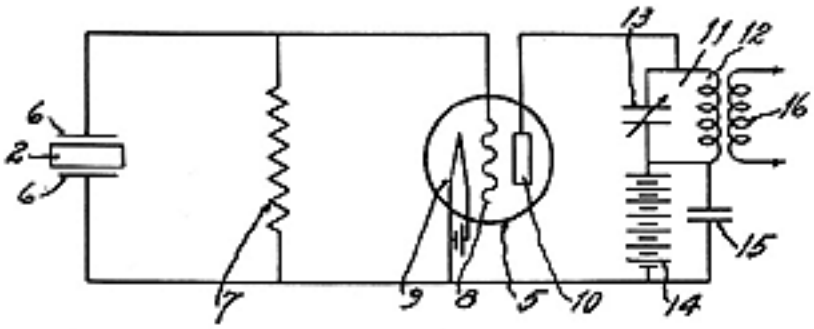


Fig. 3

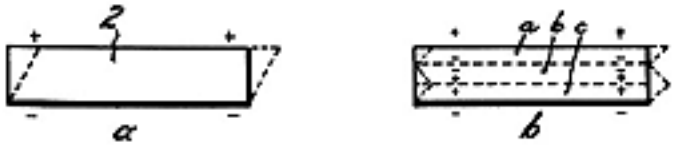


Fig. 4

Inventor

JOHN M. WOLFSKILL

By

Overtone Crystal Patent Illustration

Figure 6. Detail from Overtone Crystal (HF2) Patent

NEW PRODUCTS FOR RADIO AMATEURS

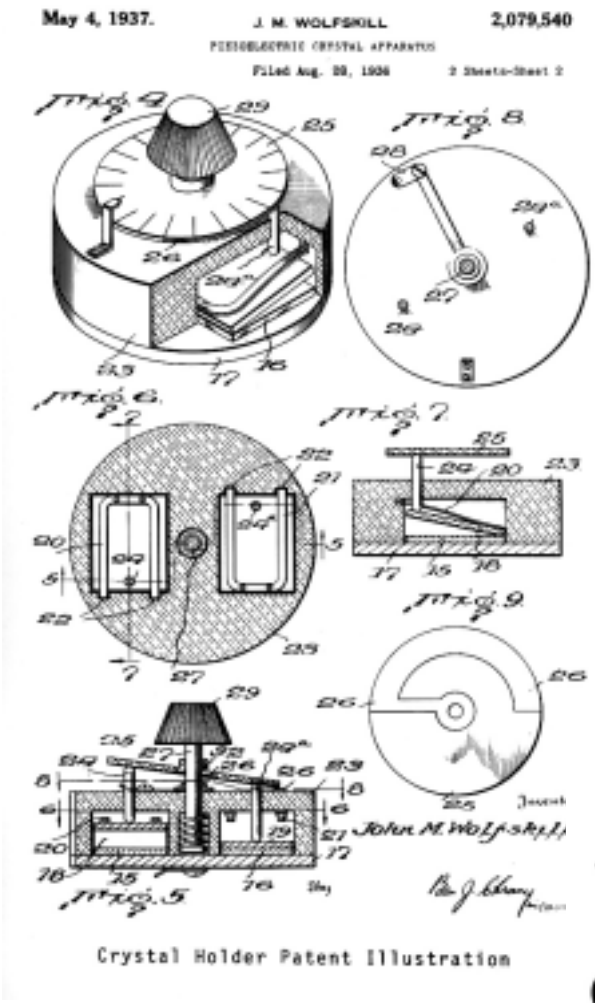
Following the successful development of a variable frequency crystal for the broadcast industry, Bliley's introduced an improved variable crystal for the amateur radio market called the VF1. John Wolfskill's engineering excellence now made it possible for amateurs to vary the fundamental frequency of a crystal up to 6 kHz. Using the variable crystal technique, Wolfskill built a quad network of crystals controlled by a rotating common shaft which could shift each crystal in succession for a total spread of 24 kHz. This arrangement became the heart of a patented, but unsold, series of frequency synthesizers covering a wide frequency range.

Immediately preceding the introduction of the variable crystal to the amateur market, Bliley's conducted a market ; survey of radio amateurs in 1936. Four hundred and eighty questionnaires were circulated with an outstanding return of 62%. By 1982 standards, with the average amateur responding that he owned five crystals and planned to purchase no more than one a year, the amateurs could hardly be considered a lucrative market. Even so, Bliley's did a good business with amateurs and knew that many of them were engaged in using or recommending crystals for commercial applications. In these early years Bliley's also considered the commercial and broadcast markets as valuable sources of business and developed a broad base of products to support them.

During the mid-thirties so many people were looking to this small company for technical information regarding crystal oscillator techniques that a booklet "Frequency Control with Quartz Crystals", Engineering Bulletin E6, was printed, twice in 1938 and four additional times between then and 1943. The booklet was a practical guide to crystal selection and circuit design. It struck such a responsive chord in both amateur and commercial circles that the book remained popular with engineers for more than two decades.

Selling anything during the depression was difficult, but Bliley Electric succeeded in selling many units through a network of dealers who received crystal units on consignment. This policy, coupled with heavy advertising in amateur radio magazines, helped make Bliley's a popular "standard of quality" among the amateurs. Bliley's continued to advertise for amateur radio trade until the end of World War II when the amateur radio market changed due to competition and new technologies. Relatively high stability variable frequency oscillators made crystals less desirable.

Figure 7. Dawson testing his 5 Meter transceiver in his brand new 1937 sedan!


May 4, 1937. J. M. WOLFSKILL 2,079,540

PIEZOELECTRIC CRYSTAL APPARATUS

Filed Aug. 28, 1936 2 Sheets-Sheet 2

Fig. 4. Fig. 8.

Fig. 6. Fig. 7.

Fig. 9.

Fig. 5.

John M. Wolfskill

Crystal Holder Patent Illustration

Figure 8.
VF1 Patent Illustration
(To the left)

Figure 9. VF1
Advertisement in QST Magazine
(To the right)

DAWSON'S FAMILY AND VHF ACTIVITIES

In 1940 Dawson with his new wife Isabelle, his former secretary, moved into a new home on the south side of Erie on top of a ridge overlooking the city. He chose the site as a beautiful compromise between convenience to the plant and his amateur radio interests. This new homestead had a 13' x 15' "radio room" on the third floor and a partially hidden staircase giving access to the flat "widow's walk" above. From his rooftop perch he erected experimental VHF antennas rotatable by hand using a mast extended into the radio room. Many contacts were made with Canada, which is twenty five miles away and can be seen with the naked eye on a clear day. With the addition of a 65' freestanding utility pole for permanent antennas, Dawson's VHFer's paradise was complete. Unfortunately, the war years followed all too quickly after they moved in, prohibiting him from taking full advantage of his new location.

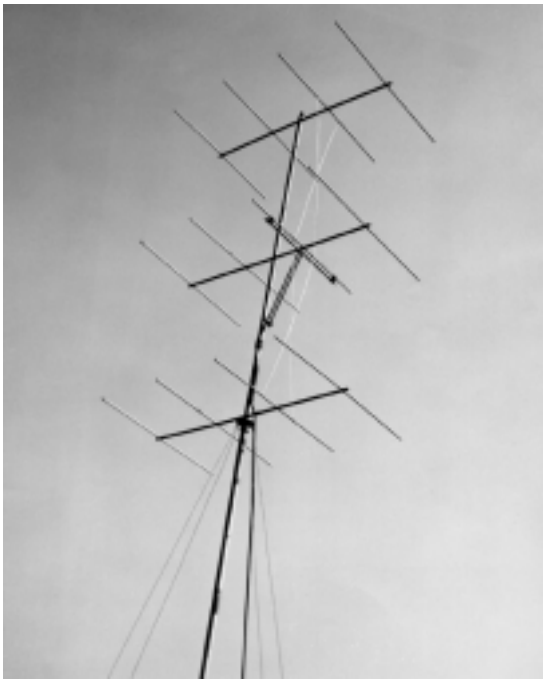


Figure 10. W3GV's 2M Array, Located above the roof of family house.

Figure 11. W3GV's VHF Station in the Third-Floor Radio Room, Circa 1952

(The hand-rotated antenna mast passed through a desktop map. A mast-mounted pointer indicated the antenna's direction.)

Like so many hams restricted during the war years, Dawson remained "active" on VHF through the War Emergency Radio Service serving the local Civil Defense. Dawson was a radio aid officer and his wife was an active W.E.R.S. member who obtained her amateur radio license after the war. Dawson encouraged her so she could help as a radio operator in his antenna and propagation experiments. After the war he offered free crystals to anyone contacting him on the newly assigned two-meter (144 MHz) amateur band as an enticement to use these frequencies.

THE SECOND WORLD WAR

As the years of World War II approached, Bliley Electric was well established in the marketplace and employment approached forty. As a result, Bliley's became a key member of a corps of crystal manufacturers called upon to support the war effort. With upcoming government guaranteed contracts and federal loans, Bliley's quickly expanded and filled the entire second floor of the Union Station Building. Eventually, a federally funded second manufacturing facility was built on West 12th Street and incorporated under the name of Bliley Manufacturing Corporation. This was dedicated solely to the manufacture of products for government defense contracts.

Most industries had problems finding qualified people required to meet the new demands of war, and Bliley Electric was no better off. Robert Johnson was hired to coordinate a grandiose project to train hundreds of people (mostly recent female high school graduates and housewives) to fill the specialized job openings. Bob designed courses of study taught to Bliley trainees in a special short program at Erie Technical High School. This project, paralleling many other industries' programs, gave Bliley the initial group of employees needed to handle the war effort. Even with this help, request for higher levels of production demanded improvements in crystal production technology.

The single largest bottleneck in the production cycle was the calibration of crystal units. John Pinar, Supervisor of Calibration, devised a scheme whereby one frequency measuring station could serve six to eight final grinding stations, each equipped with its own oscillator. Because an operator spent only one in every five minutes actually testing the crystal in an oscillator, one measuring station with a single qualified person was all that was needed to check the calibration of a crystal unit and relay the results back to the grinder. Thus, an efficient division of labor was developed.

Figure 12. 1938 Employees of Bliley Electric Company

The offices and manufacturing areas were located on the second floor of the Union Station Building next to the Nickel Plate Railroad Tracks. The location provided for efficient transfers of heavy crystal stock from the train to the slicing department. The Union Station was the company’s home from 1932 to 1962.

THE SECRET "X-LAP" PROCESS

John Wolfskill developed a new technique for doing the final calibration. In order to mislead competitors should they hear of the new process, it was referred to as "X-LAP". This process, more correctly described as "etch-to-frequency", gave Bliley Electric a distinctive, high quality, competitive product and a production advantage over the rest of the government contract crystal manufacturers.

X-Lap included an entire sequence of operations starting by sampling one of a large group of crystal blanks in one batch and measuring its frequency. Next, the sample crystal blank was placed in an acid etch bath for a fixed period of time, perhaps a minute. The blank was measured for frequency shift versus time. This data was entered onto a slide rule type calculator, and the time to etch the entire batch to within ten kilohertz, or so, would be shown on the scale. The final step was to etch each crystal unit on to frequency, rather than use the older time-consuming hand grinding technique. The X-LAP process meant that a single inexperienced operator could learn to accurately calibrate crystal units in a reasonably short time. There were other significant benefits which were not expected but later proved invaluable. The entire process was a closely guarded company trade secret for several years.

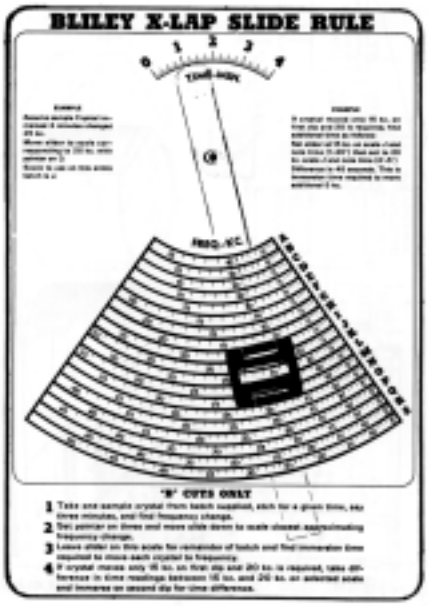


Figure 13. X-Lap Slide Rule Used in the Calibration Department

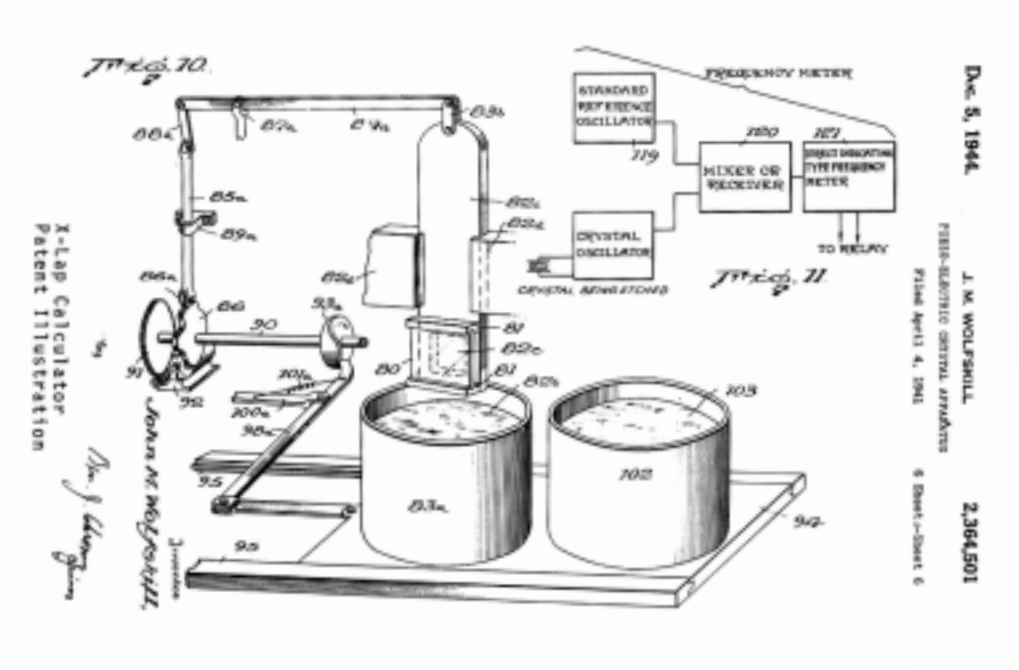


Figure 14. X-Lap Patent Detail Showing Batch Processing

A TEST OF PATRIOTISM

As the U.S.A. was gearing up for war, many thousands of crystals were ordered by the Army Signal Corps from numerous companies, but Bliley crystals proved to be the most reliable after many months of dead storage. Many competitive units showed signs of premature aging, a lack of activity, or erratic frequency shifts. As a result of Bliley's superior performance, the Signal Corps asked Bliley's for some explanation regarding Bliley's performance. Not eager to give up its trade secret, Bliley's initially refused to divulge the details, but did agree to conduct tours of the plant for top military brass only after they signed an oath of secrecy regarding what they would learn of the "X-LAP" process. The officers were delighted with the simplicity of the procedure, and demanded Bliley's offer the "formula" to the other crystal manufacturers having government contracts. (By the war's end there were over two hundred manufacturers of crystals in the U.S.A.) Giving in to political and patriotic pressures, Bliley's divulged the process to anyone who was interested, giving tours of the plant to many of their competitors.

Even though Bliley's was later given the patent for the process and it was written into military specifications for crystal units, Bliley's lost a significant competitive advantage for which they never received proper compensation. In effect, the process's use during the war became so basic to the manufacturing of crystals that any attempt to control it would be futile. The war years, however, were good to Bliley's. The circumstances presented opportunities to do research on new and improved products. On several occasions during the war, the company was honored by receiving the Army/Navy "E" award for production efficiency and contributions to the war effort.

THE POSTWAR YEARS: YEARS OF UNCERTAINTIES

With the news of victory in Japan most war contracts were immediately terminated, and Bliley's was not spared. Suddenly the employment dropped from a peak of 1,300 to less than 100. Now Bliley's had to compete with many of the two hundred or so crystal manufacturers to whom they had fed technology during the war. Most of the war created competitors faced similar problems and folded in short order, not having established civilian customers to call on once again.

Within Bliley's engineering department, work was going on to push wartime prototype projects into finished products, ready for manufacture and sale. Dawson Bliley and Charles Collman now had to pour wartime profits back into the company in order to keep it alive until new orders and hard-to-get materials came in. These months brewed many uncertainties and encouraged some key members of the management team to consider leaving the company and forming a company of their own. Feeding the fuel of this fire were Charles Collman's attempts to persuade Dawson to manufacture Collman's pet interest, an electric shaver, and convert Bliley's primarily into a manufacturer of consumer goods. The two men disagreed on the future of the company and its direction. They decided to dissolve the corporation. Dawson bought out Collman's interests, and once again Bliley's was a privately owned business with renewed dedication to establishing itself as a viable competitor in the electronics marketplace. The dissension in the ranks of the management disappeared, and the core remained intact. The key to future success appeared to be diversification of the product line and obtaining more commercial business.

REDEDICATION AND NEW PRODUCTS: 1945-1950

In the years following the war, Bliley's looked to the ship-to-shore, amateur and broadcast radio, and government markets for sales. For a while, Bliley's even attempted to enter the test equipment market in the infant television repair industry. Unfortunately, the product, a test oscillator/signal generator, was too well made and not competitively priced. The competition produced a functionally equivalent model built with surplus crystals and employing frequency synthesis. The competitor's circuit was technically inferior but functionally adequate. In the amateur radio and marine markets, Texas Crystal (and a few others) became keen competitors using reground war surplus crystals, selling them at a lower price than Bliley's. Even so, Bliley's decided to remain a producer of first-quality products, with customers eventually putting quality before price.

One interesting development after the war was a request from Western Electric/ Bell Telephone Laboratories asking for use of John Wolfskill's patented design of a low frequency "resonant pin" crystal holder. Western Electric had free use of the patent during the war and now wanted to maintain the status quo. The result of the months of negotiations which followed, was an agreement to allow free use of all of each other's patents. This agreement was the first step in a long and enduring relationship between the two companies which still exists today.

Just prior to the Korean War, Bliley's manufactured crystals for the Wurlitzer Corporation for use in their carrier-current jukebox remote control system. Dozens of crystals were required for each installation, with the total crystals produced by Bliley's numbering in the hundreds of thousands before the contract ended.

The years of the late forties and early fifties saw many new products incorporating electronics added to the product line. Crystal ovens and packaged high stability oscillators turned out to be the new "meat-n-potatoes" products for Bliley's without affecting their standards of quality. New contracts from both the government and private sectors gave Bliley's solvency and stability.

From 1950 to 1953, the Korean War brought a short boom to Bliley's business, but it was small compared to the magnitude of the World War II level of activity. The years of employment levels exceeding 1,300 were over, but the company was alive and well as it approached 1955, the year marking its twenty fifth anniversary.

Figure 15. CCO-1C TV/Radio Test Bench Test Oscillator Advertisement

1955 MANAGEMENT TEAM

Frank Dawson Bliley
Founder and President

George Wright
V.P. Sales

John Wolfskill
V.P. Engineering

Joseph Haller
Production Manager

Donald Stout
Treasurer

THE SILVER ANNIVERSARY: CELEBRATION AND DESPAIR

The twenty fifth year for Bliley Electric Company was one for celebration a celebration of years of achievement in development and quality, but the joy soon turned to despair. In May 1955, the founder, Dawson Bliley (49), suffered a fatal heart attack while vacationing in Florida. His passing marked the end of the first twenty five years for Bliley Electric. Thanks to a solid foundation in the electronics field, and a good management team, the company was able to continue manufacturing the quality products for which it had become famous.

The Bliley Electric Company is still a successful and growing business in Erie, Pennsylvania after 68 years in operation. The once important amateur radio business has been replaced by the needs of the commercial communications and computer industry.

CCO—MODEL 1C Range 150 to 6000 Kc

The Bliley CCO-1C . . . crystal controlled oscillator is a crystal controlled test equipment for radio service technicians. Each signal is directly controlled by an individual crystal operating at the desired frequency.

Low temperature coefficient crystals, stable to within ±0.1%, provide:—

DIRECT CRYSTAL CONTROL, with instant selection of the five most commonly used intermediate frequencies—175 kc, 262 kc, 370 kc, 455 kc and 465 kc.

DIRECT CRYSTAL CONTROL at 200 kc for r-f alignment.

DIRECT CRYSTAL CONTROL at 1000 kc for short wave alignment.

There is an external socket for addition of special frequencies, a three position modulation selector and a five step attenuator with vernier output control from 0 to 7 volts.

The standard CCO-1C unit operates on 110 volts a-c or d-c. Special units can be supplied for operation on 220 volts. Special units are also available with crystals at any specified frequency in the range 150 to 6000 kc.

Figure 16. CCO-1C TV/Radio Test Bench Test Oscillator Advertisement

POSTSCRIPT: 1998—THE COMPANY IS SOLD

Bliley Electric Company Acquired By Local Attorney *(Official Press Release)*

October 12, 1998 -- Erie, PA

Bliley Electric Company, an international custom electronics manufacturer, and its wholly-owned subsidiary, Sunburst Electronics, were acquired on October 9, 1998 by local business attorney Roger W. Richards. Bliley Electric Company, which continues to employ approximately 200 people in Erie County, will preserve its nearly 70 year tradition of providing unique quality products to the electronics industry.

Attorney Richards has appointed John T. Johnson president of Bliley Electric Company, and David A. Christopher president of Sunburst Electronics. Johnson has been employed with the company for over 18 years and has served as treasurer since 1983. Christopher has been associated with Sunburst for seven years and previously served as vice-president of operations.

"Although our dedication to quality and service behind the Bliley name will not change, the approach to improving our overall business philosophy will," said Johnson. "Our immediate goals include development of innovative low-profile crystal packages with surface mountable technology, and the expansion of our oscillator line to include a surface mountable product family - some of which will feature low power consumption."

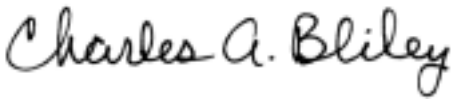
A family-owned business since 1930, Bliley Electric Company is recognized throughout the electronics industry as a major supplier of components for computer, telecommunications, space, aerospace, and a continuing number of defense applications. Sunburst Electronics, the local leader in subcontract printed circuit board and wire harness assembly, will continue its dedication to servicing the regions' top industrial manufacturers.

Personal Comment

As a result of the sale of the company, no member of the Bliley family continues to have any financial or employment interest in the company. Dawson and Isabelle Bliley's two eldest sons—Richard D. Bliley (President) and David M. Bliley (V.P. of Sales)—officially "retired" from the company as the ownership changed hands. The sale of the company was done with the knowledge and approval of my mother, Isabelle Bliley Kaiser, prior to her death in March of 1997.

The contents of the paper form of this booklet were translated into electronic format and posted on the Internet in September 1997 as a memorial to my father and mother. In October of 2001, an expanded site for the company's history was created and posted on www.Bliley.net.

Thank you for your interest in the work of my father and the many fine people that worked with him at the Bliley Electric Company.



October 5, 2001


BLILEY
QUARTZ
CRYSTALS