August 4, 1952

Mr. D. M. Ward
La Jolla, Calif

Dear Mr. Ward:

In response to your request for a chronological resume of our efforts and experience in the fields of mechanical and electronic design as well as design for production and the actual production both at the bench and in a supervisory capacity, we submit herewith.

We would like to point out that the history may seem rather disconnected and that the activities would indicate a pattern in which no continuous thread of endeavor seems to appear. This is largely due to the fact that it has been necessary - at all times - to seize the opportunities as they appeared and it has seemed that the design facility has not been restricted to any particular phase.

The dates included are approximate. There are many more items that could be listed, but which are either obscured in the obscurity of the past or considered to be insignificant in this aspect.

1919. Our first legitimate design to be patented and produced involved a water-injection carbureter. Having observed the improved performance of the internal combustion engine under high humidity conditions, the attempt to reproduce this condition resulted in the design of a special carbureter which produced a water fog which was super-heated and injected into the manifold. The results were very gratifying, and extreme mileage appeared in actual road tests. A company was formed, patents applied for, and prototypes built by the writer. Internal friction between the members of the company caused its ultimate dissolution. We understand that a similar method is now being used in connection with the combustion engine, but our patents have long expired.

1920. Rotary Combustion Engine. The turbine part of this engine did not involve anything particularly new nor useful; however, the method of producing the driving pressure seemed to have possibilities. It consisted of a strong enclosed cylinder equippped with a rotating fuel injection valve. The original starting combustion within the cylinder was produced the ignition of volatile gasses. Rotation of the injection valve presented fuel oil to the high-pressure interior resulting in combustion and pressure. The pressure from the cylinder was to be used as steam might be, to rotate the turbine. A patent was applied for this device, but it was never manufactured due to lack of facilities and finances.

Between the year of approximately 1920 and 1922 some other devices were designed, and I believe that patent applications were made. However, nothing was done with them and we cannot remember too clearly just what was involved.

1923. Having become interested in the aviation activity about this time we cast around for some legitimate activity which could produce an income, and it appeared that aerial photography and mosaic mapping were most attractive applications. With facilities being unavailable

it was necessary to design and construct a photographic camera for this purpose. A dark room was set up and considerable activity was enjoyed in the business. The only interesting thing about it as applying to this history is the design of a rectifying projector. In those days of aviation, it was practically impossible to keep the plane in a perfectly horizontal position, resulting in mosaics that had considerable perspective. The automatic rectifying projector was designed. There was not sufficient market for the device to warrant manufacture and we do not remember whether patent application was made or not. However, as far as we know, a similar device has never appeared on the market, and we do believe that it has possibilities.

1923-24 From this photographic activity it was an easy step into the field of motion pictures and a new laboratory was built to produce advertising film, so-called 'trailers' as used in the theatre to announce coming attractions, and animated educational films. Every piece of equipment in this laboratory was designed and constructed by the writer and included ultra-high speed printers, projection printers, automatic animation devices, continuous developers, etc. The business was fair and promising, but the rumble of the coming depression could be heard and a steady decline of business made it necessary to close down. Conditions made it undesirable to consider the possible production of laboratory equipment for the market.

About this same time we designed an electrically amplified guitar. It was a simple device but functioned very well, consisting of a magnetic pick-up on the neck of the instrument. Some stir was created by its appearance, but, again, business conditions did not permit the backing which would be necessary to produce such an item, and it was shelved.

1925. About this time we moved to Seattle, Washington. Activities in the field of design were greatly restricted. With the sound motion picture coming into prominence a contact was acquired under which we designed and built a sound-on-film recording system for a laboratory in Seattle. This unit was completed and used commercially.

1926. The next activity in Seattle was with the Electrophone Corporation. This organization had sold stock in a wire recording device which - as yet - had been impractical commercially. As chief engineer, we designed and personally built the parts of a new instrument, which included complete transcription and intercommunication facilities. This company was also the victim of the coming depression, and was unable to continue salary payments, and it was necessary to sever the connections.

The dates around this time are somewhat confused in our memory. We do recollect that things were very rough in the design field, and for a while we remember building radio transmitting equipment for some large organization in that city.

1931. About this time, and being pressed into the necessity of making a living in any possible way, we secured a connection with a radio station and played a guitar, having learned to do so in the previous experiments with the amplified guitar. This was fairly successful, and we received offers for stage appearances. The guitar is a very weak instrument from the standpoint of volume, and remembering the old model of amplified instrument, we constructed another for the sole purpose of use, realizing that the inherent design was too elementary for production or manufacture. The instrument created

a great deal of interest among the musicians and theatrical people of the area, and, at the insistence of a hotel man in the city, we set to work to design a practical model. This resulted in the production of an instrument with a magnetic array set under the strings, and, by means of variable permeability resulting from the motion of the steel strings, a completely practical instrument was built. This was taken to Los Angeles, and elaborate patent applications prepared. The company eventually removed this person from the organization, but the instrument was produced, and, as you know, many thousands are now in use. As far as we know, our patent was the first in this field.

1933. At the same time and in Seattle, Washington, we worked on the design of an electrical organ which consisted of toothed wheel rotating before magnetic cores. The models were very successful, and an attorney in Seattle came into the picture. Patent application were prepared, and, as far as we know, actual patent procedure started. At the same time a design for an air-horn was completed which consisted of a mechanically operated vane in the air stream. This same attorney was preparing application of patents for this also. In the midst of things, a serious set-back in his financial affairs made it necessary to drop all operations, and the writer moved to Los Angeles with the electrical guiter device.

1932-33 After the failure to realize any returns from the transfer of rights on the electrical guitar, we next secured a connection to design and construct a dual-table transcription recorder for the R. U. McIntosh Company for the production of radio serial plays. This device was completed and put into commercial use, but, again, financial failure of the company closed the operation.

1934. After the earthquakes of 1933 we moved the family to Spokane, Washington. There being little activity here in the field of design work, we opened a small factory and produced intercommunicating systems of our own design. One of these in particular was interesting, and consisted of an integrating relay system which reduced the system wiring to an absolute minimum and provided great flexibility. For some time there was an interest shown by a large organization in the east, but due to lack of enthusiasm on our part in view of the many past financial failures no effort was made to put it out commercially. Several systems were installed and are possibly still in use.

One interesting design of this timewwas that of a large radio program and intercommunicating system at the University of Idaho. The design factors of the circuit were such that complete coverage to approximately 600 outlets was secured from a simple radio receiver without additional amplification. This, of course, had little commercial application, and was never pursued.

An intercommunicationsystem involving the use of radio frequency wired carrier was also designed at this time.

We were subsequently approached by a casket manufacturer of Spokane, and told that there was a large market for reproducing equipment to be used in funeral homes if all extraneous noise and all mechanical detection could be removed from the sound system. With this in view, we designed a completely new automatic record changing system, involving an automatic volume control circuit. In connection with the casket manufacturer, patent application was made and patent issued for the automatic volumce control circuit. A large number of these units were made and sold.

The business in Spokane continued until about 1940, one other instrument being designed and produced. This was a combination grid-dip meter, signal generator, heterodyne wave-meter, and modulated oscillator. It was produced under the title 'Type B Handset' and a considerable number was made and sold to various governmental agencies. Many of these instruments are yet in use.

1940. At this time, we moved to Pullman, Washington, the home of the Washington State College as it looked very promising for a radio repair station. Such was a shop was opened, and very fine activity enjoyed. The only interesting here is a slight activity in the design of farm freezer equipment.

1941. At the insistence of an offical of the Washington State College, the writer moved to Seattle and went into the employ of the Boeing Aircraft Company. The first activity here was in the instrument shop where special equipment was designed and produced by the writer for the testing of instruments and other test equipment. Some interesting designs resulted and were used to test various electrical, electronic andbombing equipment. After finishing this work, the writer transferred to the engineering department of the Boeing Company.

In the eingineering department there was not too much design activity except in one matter upon which we collaborated and which seemed successful. This was the method of preventing windshield fog by refrigeration of imbedded bars. We do not know if this was every produced or not.

After being with Boeing about one year, the writer transferred to the Massachussetts Insitute of Technology as a research associate.

1942. At the M.I.T., our first activities were to present the design for a proximity projectile. We next designed and built a marker generator for the calibration of indicators. Our next activity was in the design and building of simulation equipment for the training of personnel in the use of radar.

At this time, we also designed a method of submarine detection which was eventually taken over the the underwater laboratory of Harvard. Whether it was completed or produced we do not know.

About ayear later, we were approached by a representative of the Bendix-Westinghouse company who were in serious situation on the design and production of compressed air-head sound systems for the government. Deciding that the possibilty of production might be more worth while at the Bendix organization, we transferred to Elyria, Ohio, and went into their employ as Chief Electronic Engineer. In this capacity, we designed improved methods of production for the airh head, designed several new types of air-head, and also designed complete air base systems using the air-head sound. After completion of these designs, we returned with the family to Spokane again due to ill health of the children in the Ohio area.

1944. Upon returning to Spokane we became involved with the Pacific Electronics in the matter of research design on a drone project they had with the Naval Research Laboratory. Considerable design work was done on this project, and we also composed the training and instruction books for the project. We next became involved in the design of a Sonar system, and was placed in charge as Chief Engineer of the organization.

The next design for the Pacific Electronics was that of a secondary frequency standard involving tri-crystal circuits. This project was completed and delivered to the government agency.

As nearly as we remember, the next activity was that of the drive-in theatre in Seattle. This theatre had first been put into operation with a large loud speaker covering the area. The neighboring homes protested, and the owner was required to close down. Due to the unavailability of plugs, jacks and other devices, it was impossible to change the system over the individual speaker system, and we received the contract to design something to relieve the situation. This resulted in the production of split transformer units which permitted the theatre to reopen and function. It is not known whether the Pacific Electronics or the theatre owner applied for patent on this device, but it was planned to do so. We had no interest in the item, realizing that the required equipment would be available at some future date, and there would be no demand for the design.

At this time, we produced an abstract design for a remote speaking device to be used in the car at the drive-in theatre and which included the facility for producing sound without amplification from the modulated infra-red source which was part of the design. This was not produced.

As engineer at the Pacific Electronics, we produced several types of small receivers as well as record playing equipment, and designed a very simple slug-tuning device which may or may not have been patented by the company.

We eventually left the Pacfic Electronics and opened our own small business here, and the only design activity was the design of a special slotted line indicator for the Naval Research Laboratory under sub-contract from the Pacific Electronics.

All of the above, together with the many embryo designs which have been passed on to you in the past constitutes a fairly complete picture of our background. There being no engineering activity in this area, we have opened and are now operating a laboratory for the repair of the transit, the level, the microscope and various mechanical and electrical scientific apparatus, recently taking on the pH meter, the titrator and the spectrophotometer. At one time we were the repair station for the Simpson Electrical company, and repaired various types of electrical meters. We have dropped this activity, however due to lack of business, and are concentrating on the activities listed above.

We trust that this is what you wanted, and will be glad to fill in wherever possible. It is very difficult to remember back over the many years and we may have forgotten some important things just as we may have included so insignificant items.

Sincerely,