

HISTORY

In any historical review of radio the name of the General Electric Company plays an important part. Since the earliest discoveries of practical radio, the General Electric Company has taken an active part in promoting and developing the art. In 1912 there were only sixty shipboard radio stations and by 1915 the number had increased to almost 400. All of these were of the spark telegraph type and of limited range. The majority of these equipments were built by the Marconi Company, but lacked the vital element: The successful vacuum tube. The General Electric Company entered the radio field in 1913.

Among the early patents on the vacuum tube were those issued to DeForest in 1908 but it was Langmuir, of the General Electric Research Laboratory, who discovered the fundamental theory of electronic emission in 1913. The results of his work made the first reliable electronic tubes available in 1916. His work resulted in the formulation of the laws governing the flow of electrons in a vacuum. In 1913 E. H. Armstrong discovered the regenerative circuit which added greatly to the accumulating store of knowledge.

Patents

The large number and diversity of the patents involved in the early years caused the radio industry to be faced with a condition of self-strangulation. With the advent of the World War I, the Federal Government appealed to the larger companies to disregard patent rights and manufacture equipment needed for the conflict, and at the same time guaranteed protection from all infringement suits. The major companies were the General Electric Company, the Westinghouse Electric and Manufacturing Company, the Western Electric Company, the Marconi Company and the DeForest Company. This patent agreement ended with the termination of the World War.

Governmental Interest in Radio

The General Electric Company had been trying to find a more efficient type of radiation than the spark transmitter produced, and in 1915 E. F. W. Alexanderson announced the high frequency alternator. This was a rotating machine for the generation of high-frequency radio energy. A 50-kilowatt and 200-kilowatt alternator were subsequently installed and carried the bulk of the transatlantic radio traffic (one-way) in the period of 1918 to 1920. After the armistice it appeared that foreign interests already operating stations in the United States would get control of the radio communications if rights under the various patents held by the major companies were extended to them. This was especially true of the Alexanderson alternator patent.

Several governmental agencies became actively interested in the prospects of foreign communication control in the United States and the government accordingly suggested that rights be denied to the interested foreign operating and manufacturing companies and that some agreement be worked out among the patent holders to keep control in the United States.

The General Electric Company accordingly, upon the suggestions of the various personnel of the Navy Department, first acquired control of important United States patent rights held by foreign interests and effected a corporate organization of the Radio Corporation of America on October 17, 1919. In 1920, the Westinghouse Electric and Manufacturing Company acquired important Fessenden, Armstrong and other patent rights and caused a corporate organization of the International Radio Telegraph Company whose purpose was to protect the acquisitions of the Westinghouse Company in the radio field and to compete directly with the Radio Corporation of America.

Very soon after its organization the Radio Corporation of America obtained control over a majority of the radio communication stations in the United States and its influence was soon felt abroad.

Cross Licensing

It was literally impossible for any one company to manufacture complete radio equipment without infringing patents held by one of the major corporations. RCA accordingly, in 1920, made a cross licensing agreement with the American Telephone and Telegraph Company permitting free use of each other radio patents.

In 1920, the Westinghouse Company demonstrated the possibility of radio broadcasting. Voice had been transmitted by radio as early as 1906. However, the demonstration in Pittsburgh, conclusively indicated that a new era was at hand. In 1922, the General Electric Company founded its pioneer station, WGY.

With the advent of radio broadcasting and with public demand for receivers becoming acute, it was necessary to effect additional patent agreements to avoid infringement. In 1921 RCA acquired the patent rights of the International Radio and Telegraph Company from the Westinghouse interests, in exchange for a stock interest in Radio Corporation. This allowed the radio industry to produce satisfactory equipment substantially free from patent infringement. The radio industry then surged ahead with such momentum that it was impossible to produce radio equipment fast enough to keep up with the demand. All equipment sold by RCA was manufactured by the General Electric Company and the Westinghouse Electric and Manufacturing Company.

Litigation and Arbitration

During the period of 1922 to 1930 many companies infringed patent rights controlled by Radio Corporation and extensive litigation followed. This resulted in the sustaining of important RCA patents, and about 1927 the Radio Corporation started the policy of licensing all infringers who applied.

Government Investigation

As the radio market grew, additional manufacturing capacity was installed until the industry approached overexpansion. Early in 1930 the consent of the General Electric and Westinghouse to relinquish the rights of manufacturing and engineering radio appliances was announced so as to enable the Radio Corporation of America to manufacture all radio equipment

sold by it. In consideration for relinquishing these rights, the General Electric and Westinghouse Companies received issues of Radio Corporation of America's stock.

During the 1920's, there were numerous investigations into the corporate structure and management of the radio industry. Finally, in 1930, the Government brought an anti-trust suit, naming RCA, General Electric, Westinghouse and the American Telephone and Telegraph Company as defendants. The defendants categorically denied all charges and conferences between the Department of Justice and the defendants were arranged. There followed a long series of debates and conferences which resulted in the withdrawal of the General Electric Company and the Westinghouse Electric and Manufacturing Company from the RCA Corporate structure. The consent decree modified the license agreement, pledged General Electric and Westinghouse to divest themselves of RCA stock and to transfer certain real estate. Following the withdrawal of General Electric and Westinghouse from RCA, an Agreement A-1 stating rights, royalties, etc., was executed between the three companies.

Licensing Agreement

Agreement A-1 of 1932 provided General Electric and Westinghouse licensees to manufacture and sell radio apparatus and tubes in the home field and some additional fields, such as aircraft, police and power companies, but still excluded them from some of the broader applications in the radio-purpose field.

With the development of television and frequency-modulation, and more recently radar, the scope of the potential market for both apparatus and tubes became considerably enlarged, and dictated several modifications of existing patent license agreements.

Agreement Supplemental to Agreement A-1 (1939) and Third Agreement Supplemental to Agreement A-1 (1945) were entered into by General Electric-RCA-Westinghouse. A Supplemental Agreement between General Electric and American Telephone and Telegraph Company executed in 1941 and a second one a few years later produced additional rights for General Electric in the radio-telephone field. Licenses were also secured from Major E. H. Armstrong under his FM system patents, for all applications except public service. As a result of the foregoing agreement, General Electric now has patent licenses for radio apparatus and tubes, subject to certain royalty payments, for substantially all of the radio-purpose field except:

- (a) For public service communication by or between fixed stations located in the United States or Philippine Islands.
- (b) For commercial or professional use for producing photographic motion pictures or sound records for use with such pictures, or both, for showing directly or by television.

Federal Regulation

In the earliest days, the electromagnetic spectrum was under the purview of the Interstate Commerce Commission. For a short time in the early 30's, the Federal Radio Commission had cognizance. The Communications Act of 1934 established the Federal Communications Commission and vested them with the authority to regulate non-governmental radio transmissions and to issue licenses for radio stations. The Communications Common Carriers were brought under the authority of the FCC at this time.

The FCC was also charged with the apportionment of the radio spectrum - namely, "in the public interest, convenience and necessity". As the sun provides energy, the FCC provides for the spectrum allocations that have been the foundation for the growth of the nation's and General Electric's commercial radio businesses.

Company Interest in Receivers for the Public

In December 1929, the Company decided that the contributions of the General Electric Research Laboratories in radio engineering and broadcasting should have identification with the retail trade and the consuming public. The plans of the Company were already well under way for the development, manufacture, and sale of "Consumer Goods" for the home.

It was planned to organize and establish a radio section within the Merchandise Department (as the Housewares & Radio Division and the Major Appliance Division were known at that time) and to set up for the nation-wide wholesale and retail distribution and sale of radio receivers. The General Electric Company then had contractual agreements with the Radio Corporation of America covering the manufacture of radio receivers and arrangements were made with them to build the receivers. The first radio receiver bearing the G-E nameplate, consisting of four models, was offered to the public in 1930.

In 1935, it was decided that the General Electric Company would manufacture their own radios and, as a result, the engineering, manufacturing, sales and distribution of radio and television receivers were consolidated in the General Electric plant at Bridgeport, Connecticut.

Scope of Operations

Because of the continued expansion and diversification of the use of electronic devices, the Radio, Television and Electronic Department was created in October, 1941, and Dr. W. R. G. Baker, Vice President, was given full responsibility for engineering, manufacturing and sales. The Department was made up by transfer of the Receiver Division, Appliance and Merchandise Department and the Transmitter Division operations of the Apparatus Department. Radio tube plants of the Lamp Department were also added at a later date as was the Ken-Rad line of radio tubes obtained by purchase of the tube business of the Ken-Rad and Lamp Corporation.

The name was later changed to the Electronics Department, since electronics is a word that includes radio and television and more comprehensively denotes the activities of the organization.

The Development of CED from the Transmitter Division

It can be appreciated from the historical summary that General Electric was in and out of some phases of the radio business over the years since the formation of RCA. However, as far as the Commercial Equipment Department is concerned G.E. was never completely out of the business. In the beginning there were three logical divisions of the Radio Department: Transmitter, Receiver and Tube. The Commercial Equipment Department grew out of the Transmitter Division.

The history of the transmitter business is quite different from receivers, mainly for the reason that RCA manufacturing was unable to establish a competent engineering and manufacturing organization for this type of product for a considerable number of years. In the beginning, General Electric and Westinghouse built all transmitters for RCA communications, Radio-Marine and other operating branches of RCA. They also provided the transmitters for all broadcasting stations which were sold by RCA in competition with the AT&T, who had rights in this field, although they never had in the broadcast receiver field. During these years, the General Electric Company pioneered high power which eventually resulted in the installation of the 50-KW transmitter at WGY. This was followed by the installation of General Electric high power transmitters at numerous key broadcasting stations such as WEAJ, WTIC, WENR, KFI, KPO, KOA, WCAU, and others. Many other stations of various power ratings were equipped by General Electric for some years after the formation of RCA Manufacturing, but eventually they were in a position to handle such projects and this business was lost. However, as late as 1933 RCA lacked facilities for doing such a job as the 500 KW amplifier for WLW and had to have General Electric and Westinghouse do this job for them. It can be seen, therefore, that with respect to commercial transmitters G.E. did not lose so much ground that they had to start all over again when rights were regained.

Paralleling the activity in the Commercial Lines, the organization assigned to military radio made continued progress along a path which was not confused by patents, licenses, or anti-trust suits. In this field the General Electric Company dealt directly with the Government agencies and RCA was not involved. It was not long before all of the arcs on shore had been replaced by transmitters using electronic tubes, and in a few years all naval vessels had equipment employing electronic tubes. During the period between the two World Wars, there were many changes in the list of the companies working with the Army and Navy. Some started, but were later attracted by the commercial fields exclusively. Others dropped out because of severe financial losses. Some companies were in or out as convenient to them. During this period, only General Electric and one other company constantly maintained an organization for the development of military equipment and G.E. handled a much greater variety of projects and volume of business than the other.

A wide variety of General Electric military projects contributed to the great advancement to the art. The fact that a continued problem of replacement was carried on over the years is strongly indicative of the progress made. In many of these years, when Army and Navy appropriations were limited, a procurement could be justified only by the prospect of a major advancement. Certain General Electric designs became more or less

military standards. In high power transmitters for example up to World War II no company other than General Electric had supplied equipment for shore stations above 25 KW and the Navy has a considerable number of G.E. transmitters rated at 25 KW, 50 KW, 300 KW and 500 KW. The long range transmitter on every heavy bomber used in the last war was of General Electric design.

World War II Performance

Some years before the Second World War, the Government's program for communication equipment was intensified and continued on an expanded scale up to the time of Pearl Harbor. At this point, practically all communication designs were frozen and efforts were concentrated on mass production. The British and Germans had frozen their communication designs several years before and as a result our communication equipment was considerably advanced over theirs. The freezing of the communication designs released engineers in increasing numbers for the all-important job of radar, and the cessation of all commercial activities supplemented this group.

It was logical, because of the pre-eminence of General Electric in the military electronics field, for the various governmental agencies to look to our Company for the most complicated equipments. G.E. was not adverse to this attitude because it recognized its great responsibilities in the emergency. G.E. became the exclusive supplier of practically all of the high power ground and ship radar and about all of the radio countermeasures equipment used by all branches of the Armed Service. The countermeasures projects required the development of a unique line of magnetrons by the Research Laboratory. G.E. also contributed heavily in lower powered ship and airborne search and fire control equipment and produced the high power Loran system. Then in addition to the very heavy production load on the "frozen" radio designs there were developed several new communication equipments, two of which were procured in very large quantities.

General Electric's World War II performance in providing electronic equipment cannot be detailed in anything short of a book-length report. Obviously then it cannot be summarized adequately in a few words. In general, however, the magnitude of our contribution to victory--the number and variety of the radio and radar equipments delivered--was a very substantial factor in the nation's fortunate accomplishment of making faster and greater progress than our enemies in the utilization of electronics for warfare.

Post War

The greatest evidence of the importance of General Electric contributions is the fact that so many of its major projects survived the V-J Day cut-offs. Such jobs as the Cadillac, CPS-6, Mark 56 and others involved requirements which could be met only by development well in advance of the state of the art when the contracts were placed. In effect they were premised on the possibility of a much longer war. G.E. had a much greater percentage of such projects than any other company, perhaps more than all of them combined. It was quite logical that they should be continued after V-J Day even though quantity production might have to be

withheld for later consideration. These carry-over projects formed the base on which the present military load was built.

Prior to V-J Day the management group of the Electronics Department had given much thought to post-war planning. It had been decided to take complete advantage of the rights which had been restored to us and set up an organization and a plant to enable participation in all phases of the electronics business--except the two restricted fields previously mentioned. This would require more engineering personnel and more plant because it was already evident, by V-J Day at least, that G.E. would have to continue the commitment of a very large portion of the engineering organization and plant to military business.

The decision to operate on the broadest possible charter was a courageous one in many respects. It meant that in practically all the product lines which CED now carried, except military, G.E. would have to start from scratch in the face of established and very capable competition. The progress has been substantial since the decision was made. At present our Company is in the electronics business on a broad base. In some lines there has been very satisfactory progress. In others there is still much to do to achieve the objectives. It is anticipated that there will be continued activities in all commercial lines, and perhaps expanded ones in some, unless an expanded defense economy forces a curtailment.

Organization

The Electronics Division (changed from Department to Division in 1951) was a decentralized, integrated Division of the Company, under the direct supervision of a Vice President of the Company. It was a Division of the Appliance and Electronics Group which was one of the three major operating groups of the Company. The other two were: The Apparatus Group and The Industrial Products and Lamp Group.

The Electronics Division had full responsibility for the engineering, manufacturing and marketing of a long list of products. These items were classified as electronics products because they involved applications of the electronic tube. The Division had partial responsibility for certain other electronic products such as Carrier Current and Electronic Heating equipment where marketing considerations dictated a shared responsibility with other Divisions of the Company. Finally there was a group of electronic products produced by the Company for which the Electronics Division had substantially no responsibility.

Here is how the Electronics Division visualized its overall responsibilities:

Since the electron is electricity, it is evident that the science of the electron--that is electronics--must cut across every activity of our Company. How then may electronics be applied without confusion and conflict? The approach has been along the following lines:

1. Our Company, in order to retain its position of leadership, must stake a claim in every branch of the art.
2. Problems must be resolved to the advantage of General Electric. While individual departmental claims must be considered fairly, such interests are secondary.

With this as a platform, the problem worked out as follows:

The Electronics Division developed the market for electronic tubes. It sold the other Divisions on electronic principles and cooperated with them in tube applications.

In addition, the Electronics Division--on its own account--developed product lines exploiting electronics even when such lines were not normally within its scope. The product lines were turned over to some other Division where the best interests of the Company were served.

Whether another Division bought such assemblies from the Electronics Division or manufactured the electronics product, the Electronics Division produced the tubes.

The organization structure set up by the Electronics Division to discharge its responsibilities consisted of three Departments: Receiver, Tube and Commercial Equipment. Each of these operating Departments was under the direction of a Manager who reported directly to the Vice President and General Manager of the Division. Responsibility for entertainment or home radio and television receivers was allocated to the Receiver Department. The Tube Department had responsibility for all electronic tubes. All other products of the Division were the responsibility of the Commercial Equipment Department.

The Commercial Equipment Department was loosely subdivided in three major sections. These sections were definitely not decentralized since a common manufacturing section served all three. Two sections were served by the same Sales section.

In June of 1951, the Commercial Equipment Department was reorganized into the Commercial and Government Equipment Department. As these two businesses grew, it became necessary to divide them in 1953 so that there was once more a Commercial Equipment Department.

As the first steps of decentralization began to take effect, the Commercial Equipment Department became the Technical Products Department in 1955. It was at about this time that the growth curve for Communications Products sharply increased its slope. With such growth, recognition of the Communications Products Department came in October of 1956.

The general economic tempo and the pace of the communications industry was quickening. Volume of industry orders for mobile radio increased from \$42 millions in 1954 to \$58 millions in 1956. General Electric had introduced its PROGRESS LINE of vehicular products and had established a dual channel of distribution to challenge Motorola. The direct sales force was supplemented by a nation-wide network of franchises for manufacturers' representatives. Service station franchises also blanketed the nation.

An aggressive management team could foresee the growth opportunities ahead and it was decided to bring together at one location the several office and plant operations then existing in and around Syracuse and Utica, New York.

A site at Gainesville, Florida, was selected for CPD headquarters. Even though land had been acquired and construction was under way, a squeeze on Company investment funds cut the project short for this Department as well as for several other operations in the Company.

Shortly thereafter the facilities in Lynchburg, Virginia, which had been completed about two years prior and was occupied by the Rectifier Department, became available. This event occurred when these Rectifier operations were consolidated with other locations and CPD started a move to Lynchburg in 1958. Since then the original building in Lynchburg has had two major expansions -- in 1959-60 and in 1962-63.

Design work on TRANSISTORIZED PROGRESS LINE (TPL), started in Syracuse, was completed in Lynchburg and order volume began in late '58. The Business Radio Service was opened by the Federal Communications Commission and industry orders climbed up from \$88 millions in 1958 to \$128 millions in 1960. Channel splitting also contributed to this growth as it did again in 1961-63 and most recently in 1968-69.

In the early half of the '60's CPD captured microwave and multiplex (now known as MACS product section of Telecommunication Products Department, TPD) orders for Western Union's transcontinental communication system, Titan II's communication complex and Southern Railway's private communication system from Washington, D. C. to Atlanta and to New Orleans and Jacksonville, Florida.

Simultaneously the mobile radio business began a metamorphosis. A huge Navy order (exceeding \$1 million) was captured for TPL. Mobile telephone equipment was introduced in 1961 and orders far exceeded expectations. The Air Force began obtaining equipment for its bases under a leasing arrangement. Large orders (those in excess of \$100 thousand each) began coming in. In 1963, orders over \$100 thousand each accounted for just \$1,985,000 volume for MRD compared with \$10 million in the first 9 months of 1970. Even so, the attractiveness of mobile radio communications for small users' economy and competitiveness keeps orders of less than \$15,000 each at about 2/3's of our Department volume.

Introduction of products continued to broaden the line as a trend to portable and personal requirements was building. A fully transistorized portable was evolved into PORTAMOBIL (1964) and later into base stations. VOICE COMMANDER (1960), about the size of a Polaroid-Land camera was followed by a purchased design, POCKET-MATE (1967) while our own personal line was being readied. Our introductions of the PR (1969) and PE (1970) personal radios, as well as MESSAGE MATE I (1962) and II (1970), represent steps toward miniaturization and solid state concepts with integrated circuits and higher power transistors that will be continuing with an accelerated pace.

However, vehicular radio still commands the major portion of the market and our design of MASTR PROGRESS LINE was introduced in late 1964 followed by its companion line, EXECUTIVE, which was marketed beginning in 1966.

Recognizing the diversifying nature of customer demand for mobile radio, a Marketing Consulting firm was retained in 1967 to obtain organization recommendations. Out of that study there originated business classifications being used now. Local radio users were distinguished from major users and from specialty users. Characteristics of these different groups were noted as follows:

Local radio users include:

MANY, SMALL UNSOPHISTICATED USERS
SIMPLE SYSTEMS
MAINTENANCE PURCHASED
FAST DELIVERY
PRICE, FUNCTION ORIENTED

Major users include:

LARGE, SOPHISTICATED USERS
COMPLEX, INTEGRATED SYSTEMS
SELF-MAINTAINED
LONG-TERM CONTRACTS
SPECIFICATION, PERFORMANCE ORIENTED

Specialty users includes:

BELL SYSTEM
INDEPENDENT 'PHONE COMPANIES
WESTERN UNION
MESSAGE SERVICES
PAGING SERVICES

TRANSPORTATION

RAILROADS
METROPOLITAN TRANSIT SYSTEMS

MARINE COMMUNICATIONS

INLAND WATERWAYS TRANSPORTATION
PLEASURE CRAFT

AIRCRAFT COMMUNICATIONS

AIR-TO-GROUND COMMERCIAL CRAFT
EXECUTIVE AIRCRAFT
PRIVATE AIRCRAFT

Organization of CPD began to change when Mobile Radio and Power Line Carrier were separated as business sections. Then the Mobile Radio Department was established in 1969 and CSD (Communication Systems Division) was formed in 1970. The Division consists of the Mobile Radio Department and Telecommunication Products Department in Lynchburg along with the Communication and Control Devices Department in Waynesboro, Virginia.

Of course, the changes have not ended. The Company's communications business continues to grow heartily. Expectations for the future are for much greater business volume which will undoubtedly lead to more Departments, Divisions, and Groups.

Archivist Note: It is likely that this document was written by John McCormick.