HISTORY OF THE AUTOTUNE

This document contains the text of a speech written and delivered by Art Collins at a meeting of the Collins Radio Technical Association (CRTA) meeting on May 2, 1944. The speech was typed and Art underlined certain phrases and words with a pencil – presumably to emphasize these points.

Since Ted asked me to tell this group something about the early history of the Autotune I have been having quite a bit of fun making up some notes covering my recollections of the past six or seven years dealing with this subject. I will not attempt to give you dates and I may have my facts out of chronological order.

Our first multi-frequency transmitters made use of separate r-f sections complete with tubes and circuits for each channel and employed a common power supply and common audio systems. We made up several of these sets providing operation on three or four frequencies. Each channel had a power of about 100 Watts and the construction was of the relay rack type. We sold these sets to Braniff and American Airways, to the Standard Oil Company of Venezuela and to a few other customers. They were very practical and satisfactory sets and a number of them are still in use today after eight or nine years service. At that time Western Electric and RCA placed on the market some multi-frequency transmitters in which they used common r-f tubes but switched different sets of tuned circuits in order to change frequencies. RCA built some four channel sets and Western Electric built a ten channel set. These transmitters were only moderately successful. RCA and Western Electric at that time did not have very much competition in the high frequency transmitter field and were inclined to be a little bit careless as a result in executing their designs. As soon as the airlines began to extend their operations in this country they found that they had a real need for some really reliable multi-frequency transmitters with as many as ten channels. One day after I had been visiting Frank Dyer in Dallas and while I was flying back home, I decided that a new approach to this problem was needed and that if somebody could build an extremely reliable set there would be a large market for it. The idea of building a continuously tunable transmitter and shifting frequency by actually mechanically tuning the circuit appealed to me and on my way back I made some mental notes as to how the job could be done.

I have asked several of my friends who are responsible for various inventions and new ideas as to what particular environment they have found to be most conducive to original thought. I have noticed that in thinking about problems and attempting to find a new solution for them that the answer usually comes to me while I am either flying or riding along somewhere. Other people tell me that they get ideas while shaving and in various other particularly congenial surroundings. So far I have never had anyone tell me that they were able to get an intelligent idea on a golf course. I personally am still experimenting with this procedure, however, results have been entirely negligible but I haven't given up hope.

When the decision was made to go ahead with the mechanical tuning idea it seemed apparent that it would be necessary to really do a good job of building a precise and reliable mechanism and that the amount of work involved would be such that the design should be more or less universally applicable to any kind of a transmitter. At that time the Collins Radio Company was very poorly equipped in its facilities and experience to undertake a program of this kind. The only machine tool which we possessed was a broken-down 16" South Bend Lathe. This lathe is still in our shop

having been rebuilt three or four times and I believe it is referred to disparagingly as the "old gun lathe". It never did qualify as an accurate tool. It was obvious, therefore, that we needed some new equipment and probably some new talent before we could get very far with this new project. I went over to Ohio State and hired Pete Morison, a little Scotchman, then an assistant professor in the Mechanical Engineering Department. Pete looked to me like the sort of fellow who could do a nice job of building gadgets. He talked one of his students, another Scotchman, by the name of Bob Cochran, into coming over to Cedar Rapids with him, and then I sent Pete to Chicago to really splurge himself buying some machine tools. Pete spent one thousand dollars for a secondhand Brown & Sharpe Vertical Milling Machine. This mill was in reasonably good condition after Pete got through lining it up. He spent the other $500 we possessed at that time for tools, cutters, collets, etc., and for a South Bend work shop lathe. This equipment was set up in the basement of the building at 621 First Avenue which is not the Troy Laundry and we were all ready to go into the Autotune business. Poor Bob Cochran went back to Ohio State for an operation and just as he was ready to leave the hospital he died from an embolism, so we had to carry on without his help.

Although I had some reasonably concise ideas as to how an Autotune unit should be built, at no time did I have very much to do with the actual engineering of any of the models of the Autotune. I found that there have always been several of you people who have been in a position to do a very good job of engineering this type of equipment. Bob Samuelson, who is now Chief Engineer for Hallicrafters, did quite a bit of the detail layout work on the first models and he was assisted by Don Holmes in laying out the relay control circuits. Bob Davis, John Giacoletto, Roy Olson and several others of you have had a great deal to do with engineering of later models.

The first model of the Autotune looked quite a bit different from the present models which you are familiar with. It used stop rings clamped in somewhat the same way as the present model but instead of using pawls it employed a lead screw which moved a dog up and down parallel to the main shaft into position to engage one of the ten stop rings. The lead screws were driven separately by one motor and the tuning shafts were driven by another motor though a disc clutch. This version of the Autotune had several things wrong with it which we were not able to overcome in that form. First of all the motor driving the lead screw had to stop very accurately in order that the dog would engage a single stop ring properly. We had a lot of difficulty getting a motor and control system which would position itself without over-shooting or hunting. Numerous schemes were tried to reduce this trouble and we finally got fairly good results. The other trouble with the first model of the Autotune was the disc clutch which was subject to considerable variation in torque depending upon condition of the clutch surfaces. We never did get those disc clutches working very satisfactorily, but we soon got around that problem by substituting overrunning coil springs for clutches. Quite a few transmitters were built using the lead screw arrangement and coil springs in place of clutches. The most successful models were the 17D's which were 100 Watt aircraft transmitters built for Braniff Airways. The 17D's proved after going through the headache stage to be quite reliable sets. They have been used successfully by Braniff up until the last year or so. The 17D's were the first high powered set used in an airplane having a power something over 100 Watts and they were the first ten-channel aircraft transmitters. I believe they were also one of the first transmitters to receive CAA type approval. The 17D was not particularly dainty, it weighed 60 to 70 pounds and was built in a rather crude but substantial fashion. One of the 17D's went through Braniff's only bad crack-up and although the airplane was completely washed out and the 17D was thrown several hundred feet clear of the wreck, it was found to be in operating condition after a broken tube was replaced.

In thinking back over the history of the Autotune, I have been touched by a feeling of appreciation of the part played by our customers in fostering this development. Some of our customers played the part of sponsor consciously, others couldn't help themselves. Old Bill Beakes of Tropical Radio Telegraph bought the first Autotune set along with a group of other transmitters they were buying. I am sure that Bill realized that the damn thing wouldn't work and he more or less wrote off its price, some $1500 or $2000, as a contribution to the advance of science. Frank Dyer of Braniff recently made the remark to me that he felt sure that he had bought the first model of every piece of equipment we had ever built. I think that statement is almost literally true. Frank is an incurable optimist and he also has a knack of making things work. I would say that Braniff had made a very real contribution to the development of Autotune equipment. They were placing some orders at a time when orders were urgently needed in order to keep going. Jim Flynn of American Airlines was another hardy pioneer. After we began to get the bugs out of the Autotune he came along with an order for $100,000 worth of aircraft transmitters which were to be of the new design which was still just a glint in our eye. $100,000 in those days was a lot of money. Roy Olson built this set for Jim and it became our 17F which was really a good set in that it embodied a type of Autotune which is substantially the same as our present model.

I am getting ahead of my story a little bit. The turning point in the Autotune history came with the set we sold to TWA. Some years ago TWA seemed to be long on boards of directors and creditors and short on imagination. I don't know how they managed to screw up their nerve to buy anything so questionable as an Autotune set, but Howard Morgan and Jack Franklin finally took the leap and ordered a ten-channel ground station equipment to be installed in Kansas City on an experimental basis. This set was to be complete with all sorts of bells and whistles and automatic gadgets which it was decided were essential to airline ground station equipment which would be standard throughout their system. At this stage of the game we were still building the two motor lead screw type of Autotune. We had, however, graduated from the friction clutches to the over-running springs. I think everything that possibly could go wrong with a piece of radio equipment went wrong with that set in Kansas City. I have always had a suspicion that one of the troubles was that the TWA transmitter received the helpful attention of too many engineers and not enough Ford mechanics. In any event, after the TWA set had blown up for about the fourth time, Myron Smith, Frank Davis, and myself were driving down to Kansas City in the middle of the night and I decided while we were sailing along through the Missouri brush that there ought to be some easier way of doing the Autotune job than using two motors, which had to stay out of each other's way. Myron and Frank and I talked the problem over and after we got back to Cedar Rapids we started the gang out to build the type of Autotune which has proved to be most successful. A single motor was used to rotate the tuning shaft and also to rotate a cam actuating pawls to engage the stop rings. Another feature which was introduced at this time was the type of clutch we are now employing which has a torque which is substantially independent of changes in the condition of the clutch surfaces.

The Autotune has proved to be a very important factor in the development of our Company. At various times I have tried to analyze as accurately as possible why this is so and I have come to this conclusion: As an invention the Autotune is not an outstandingly brilliant idea; in fact it is a very garden variety sort of idea. It makes use of more or less obvious means of performing its function. I don't think anyone could truthfully describe it as being the result of any "flash of genius". There have been too many headaches connected with it to fall in that category if there is such a thing. The important lesson to be learned from the Autotune, as I see it, is that either through

luck or good judgment we accurately defined the problem and we also set a sufficiently high goal to shoot for in respect to standard of performance and reliability. There have been other tuning devices, several of which are really more ingenious than the Autotune. Some of the push button tuning mechanisms on car radios for instance are really extremely cleaver. However, they have all been developed for a specific purpose and in no case has the designer undertaken to find a full answer to the whole problem of precise tuning. What we set out to do when we undertook the Autotune project was to develop an automatic tuning system which would be to radio communications what automatic dial switching is to telephone communications. It was a type of mechanism which is ultimately capable of extreme precision and we insisted on building the units to the best possible standard of design and workmanship. I think if we had been satisfied with designing and building a simpler and perhaps smarter device which would have been suitable for a particular application but which would not have been capable of use on a transmitter requiring a large number of tuning controls, even more than was needed on some of our earlier sets, and also which was capable of even greater accuracy than we had need for at the time, we would not have established the reputation we have in this particular field. Therefore, I believe that if we are to take a lesson from our experience with the Autotune in setting future Company policies, and also possibly in serving as a guide to individuals who are working on their particular projects, I think we can find support for the principle of employing methods which are capable of giving performance greater than is necessary for the needs of the moment. To illustrate this point in relation to the Autotune, I might refer to Ted Hunter's new oscillators. The idea of tuning high stability oscillators was only a vague possibility at the time the Autotune work was started because we didn't have any very stable oscillators at that time. However, the Autotune arrangement chosen was capable of very close accuracy and now that Ted has come along with some really good oscillators we have a tuning mechanism to serve as a complementary and necessary device capable of giving an overall system with substantially crystal standards of frequency resetability.

Some of the recent developments in respect to our Autotune patent situation may be of interest to you. We have, of course, applied for and received patents on all the various versions of the Autotune and now have a considerable number of applications pending on some of the recent improvements. We also have made applications on numerous alternative schemes which we did not intend to build but which we wished to have covered in order to afford more complete patent protection for our work. One of the early Autotune sets we sold went to the French affiliate of I. T. & T. Somehow this set found its way into Holland, and apparently started the Philips Company of Eindhoven working along similar lines. Before the war some of the Philips publications showed illustrations of experimental transmitters with quick shift devices which appeared to be copied from this set. Philips filed patent applications on their work and some of their claims interfered with claims in our patents. These applications were filed in this country and RCA through their exchange of patent rights under their agreement with Philips had a certain interest in these patent applications. Last year RCA brought an interference action against our patents under the Philips applications. After several preliminary hearings and extended discussions with RCA we were able to show RCA that our dates were substantially prior to the dates which might be established due to Philips' work, and RCA gave us a concession of priority. This concession on the part of RCA and Philips substantially enhances our patent position so that at the present time we have no serious challenge to our Autotune patents. Of course, we may expect increased activity in this field and if we are to continue in the lead, we will have to continue our present policy of intensive development work.

The most recent history of the Autotune as of the last three or four years is no doubt familiar to most of you. Although the airlines were the first important customers, military applications were kept in mind from the beginning. The Army was not very receptive to the idea at first, although they later became quite interested. The Navy, however, took the lead in sponsoring the application of the Autotune quick shift idea to military equipment. A couple of Navy pilots, Roy Jackson and Ham Dow, who were radio amateurs on the side and had been doing a good deal of flying on commercial airlines and had seen commercial airline equipment, landed in Cedar Rapids on two or three occasions and looked over the equipment we had been building for the airlines. Apparently they were in a position to make some recommendations to the Bureau of Ships because when we approached the Navy Design Section with a proposal to build some quick shift ground stations transmitters for the Navy bases we had little difficulty in enlisting the Navy support and we were granted several substantial contracts, in spite of the fact that at the time the Navy was severely limited as to the amount of money it could spend for communications equipment. Later on we undertook a development program directed towards producing an Autotune aircraft transmitter for scout and patrol planes. This development job eventually grew to be the ATC. The Army has followed the lead of the Navy and has now adopted the ATC to completely replace the existing liaison sets. The eventual combined requirements of the Army and Navy for Autotune ATC's are so large that we have granted to the Navy Department a free license for the duration under our patents to permit the Army and Navy to have additional quantities of equipment made by other manufacturers to be an exact copy of our design.

Since Dick May has joined our organization he has been given general responsibility for Autotune development and he has set himself down to make more or less of a career of this work – at least until such time as he can devote his effort to some even more promising project. Dick has combined a large amount of ingenuity with the careful and scientific approach and has been getting results far beyond anything I imagined when I started out on this work years ago. In fact, I find myself considerably at a loss every time I drop into Dick's lab in trying to keep abreast of the fine points of his work. Dick's latest Autotune units are much smaller, more easily adjusted, more accurate and more reliable than anything we have had before now.

At this point I would like to take a back seat and let Dick do something which would be very difficult for me to do – explain how the Autotune unit works.

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