## Donald Lewes Hings , P.Eng, M.B.E., C.M. Development of Walkie Talkie from 1930-1945

Material presented to the National Research Council of Canada, August 31,2001 by Guy L. Cramer (former research assistant and grandson of Donald L. Hings)



Donald Lewes Hings in 1992 with C-58 production model Walkie Talkie initially developed in 1937 as an emergency voice communications device for Geologists and pilots in British Columbia working for Consolidated Mining & Smelting Company of Canada Limited now known as "Cominco". As of this writing, Don is 93 years old and has contributed greatly in clarifying the facts and pictures below.



Donald Lewes Hings 1940 on loan to the Defense Department from his company during the War and working for the National Research Council of Canada as a Civilian. As his contributions to the War effort grew the Defense Department felt it necessary to mark his travel papers as Captain or Colonel to minimize his identity. The Canadian Government classified Hings Patents "Top Secret" throughout the World War II.

Few people in the world, let alone his own country of Canada realize the historical accomplishments in wireless communications by Donald Lewes Hings, leading to the walkie-talkie in World War II and long range, reliable, portable communications, which to this day still rely on circuits he designed in the 1930's. His portable radios were initially developed in 1930 for a large mining company he worked for called, Consolidated Mining & Smelting Company of Canada Limited, now known as "Cominco" of Trail, British Columbia, Canada. Don designed geophysics equipment for the company. He was challenged by the head of the company to design a real-time communications system so the company could communicate between mines, aircraft and locations throughout western Canada and the Far North. Hings first developed Light weight aircraft radios using Continental code that were used by the companies fleet of aircraft from 1930-1938. In 1938 Don added the ability of voice communications to the radio called the 10PC20. A year prior to the 10PC20 in 1937 Don also developed a portable emergency voice radio carried by the company aircraft that was to become the precursor to the Walkie-Talkie. The head of the Mining company later stated that he never expected Don to be successful with portable voice radio because to his knowledge, no one in the world had yet accomplished this feat. The trick according to Don was the special modulation he designed, "this was the key to everything" according to Don.

HINGS INSTALLING EQUIPMENT OF HIS NELSON, B.C JUNE 7, 1930. DESIGN AT

# HINGS BROADCASTS FROM PLANE, CODE PICKED UP, NELSON

P D P

Radio Test From Consolidated Plane Is Success

MESSAGE HEARD AS FAR, HARROP

First Test of Kind Ever in Kootenay; Will Try **Once** More

something new in radio management of the sense of the sense the sense of the sense of the sense of the the sense of the sense of the sense of the the sense of the sense of the sense of the the sense of the sense of the sense of the the sense of the sense of the sense of the the sense of the sense of the sense of the the sense of the sense of the sense of the the sense of the sense of the sense of the the sense of the sense of the sense of the sense of the the sense of the sense of the sense of the sense of the the sense of the sense of the sense of the sense of the the sense of the the sense of the sens

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with a point and a hard wright at the end. Mr. Harrison tuned in im-mediately from the start, and they talked back and forth, using the continental code, the messages coming in very dis-tinctly. But when the 'plane passed just beyond Harrop com-munication was lost and only picked up again about the seme place on the return trip of the plane. Mr. Hinch found the messages coming in very loudly when passing over Neison, and was not hindered by the rear of the motor in the least. Gradually, though, as they flew up the lake the messages became faint-er and fainter, and then he lost the other station, due to the battery giving out. The station call was VESBH.

station call was VESBH. They were sending and receiving on the 80 band metre, short wave. During the trip Filot McFhee main-tained a speed of between 75 and 80 miles an hour. Mr. Hings hopes to be able to make a second attempt in the bear future, when with the aid of a few adjustments he expects a per-fect result. He was highly pleased with the day's success, thoug's he declared he can see now where he could have done several things differently had it not been for the mixing of his first airplans tide

Trautman, Publicty Man for C. P. R. for 20 Years Is Dead This article form June 7, 1930 refers to the new Airplane 2-way Radio using continental code (not voice) to communicate between the ground and air. Note, the end of the article refers to not only this historic moment in communications history but also the test was also Hings first flight in an airplane!



HINGS INSTALLING EQUIPMENT OF HIS NELSON, B.C JUNE 7, 1030. DESIGN AT

coming flight to Canada, were categorically denied tought by Premier Ramsay MacDonald.

**Captured British** Indian Officer Has Brother in Alberta

REGINA, June 8-Captain J. C. Prere, the British officer, who with his wife and another officer, was kidnepped last Wednesday by hos-tile tribesmen on the northwest frontier of Inspector E. C. Frere, of the Royal Canadian Mounted police, stationed at Jaspor, Alberta, according to a telegram received here from the latter. It was re-ported in despatches Saturday-how-ever, that all three captives had been subsequently unharmed.

The first portable 2-way voice radio developed by Hings in 1937, the "Light Aircraft Emergency Set" was only 12 pounds, battery included, range approx. 130 Miles, painted yellow and water tight when the cover over the dials was locked on with two quick release latches on either side. Made buoyant for people near water in case the plane had to drop the radio into the water while still flying. Fold down antenna included in case. Capable of 2 frequencies, one for the company "Cominco" and the other for the "Canadian Army Signal Corps". Could be carried while transmitting and receiving voice.



LIGHT AIRCRAFT EMERGENCY SET



12 LES. COMPLETE SEALED, BOUYANT.

December 7, 1938; The 10PC20 Airplane Radio developed for Cominco pilots. Using the same technology for the Light Aircraft Emergency Set, made voice communication in small aircraft feasible of long transmission distances. This set was also capable of transmitting code and voice, as were most of the units Hings developed.



Later photo of 10PC20 with cover on. The smoking pipe was included for size reference.







He stated that the date of Dec 7, 1938 for the 10PC20 airplane voice radio was a year after developed the portable emergency voice radio (1937) for the pilots and geologists in case of crash or other problems, it could float in the water as the container was water tight and painted yellow in case the pilots needed to drop it into a lake. The size was very similar to the C-58 production model 6" x 7" x 13" with a fold down antenna. When asked about the range of this emergency portable radio he laughed and told a story where someone claimed the battery wasn't working out in the field so he went out and transmitted to the Canadian Army Signal Corps (one of two frequencies the radio had was locked into Canadian Army Signal Corps the other frequency was direct to their company, Consolidated Mining & Smelting Company of Canada Limited, now called Cominco). Range in this case was determined to be 130 miles.

His Special form of Modulating was nicknamed "Ever Expanding" modulation by his research team and would give a 20 db gain on voice due to the expanding carrier wave. Something the other radios from the allies could not duplicate.

In 1939 Donald L. Hings approached his company about taking out a patent for the technology he developed for the portable 2-way voice radios, they told him that they were a mining company and not interested in Patents for communications. They were happy to allow him to patent the device he had developed. In September of 1939 Hings traveled to Spokane, Washington across the B.C. boarder, as this was the closest city with an authorized Patent Attorney. After a day of teaching electronics to the Patent Attorney, Hings walked back to his Hotel only to hear that Canada had just declared war: Canadian Parliament declared war September 10, 1939, just one week after Britain.

## 1940

## RADIO DYNAMICS LIMITED

WM. THOMSON. JR., SECRETARY D. L. HINGS, CHIEF ENGINEER

> P. O. Box 172. TRAIL, B. C.,

#### DEVELOPMENT OF RADIO DYNAMICS LIMITED.

Radio research leading to the establishment of Radio Dynamics Limited commenced in the spring of 1930 when aircraft equipment was constructed and installed for two-way plane-to-ground testing in the mountainous regions of British Columbia. As a result of these tests there was founded a new aircraft radio and point-to-point communication system that extends over a greater part of Canada.

After ten years of operation and development of such equipment as carrier systems, portable units, remote controlled apparatus, aircraft radio and broadcast installations it was found necessary to form a development company consisting principally of experienced engineers whose developments could be grouped, arranged and filed for patenting. Radio Dynamics Limited, or 'Radyne', now represents

a progressive patent holding and research developing company that has been fortunate in uncovering several entirely new and basic developments. The resulting devices have been thoroughly tested and proven in Canada's north as testing grounds. The accompanying data sheet shows some of the more outstanding achievements of this company.

June 1940.

### RADIO DYNAMICS LIMITED

WM. THOMSON, JR., SECRETARY D. L. HINGE, CHIEF ENGINEER

> P. O. Box 172. TRAIL, B. C.,

RESEARCH ACHIEVEMENTS BY RADYNE

- A. POINT-TO-POINT COMMUNICATION EQUIPMENT.
  - Multiplex C.W. transmitters without synchronization.
  - 2. High speed C.W. transmission with complete zero-signal break-in facilities.

#### B. AIRCRAFT TRANSMITTING EQUIPMENT.

- 1. Multi-frequency crystal control with electronic selection of frequencies thus permitting complete remote control with the omission of all make-and-break contacts, relays, and moving parts in the transmitter. This is accomplished with less tubes for a given output than in a conventional single frequency transmitter.
- 2. Exceptional wide crystal operated frequency range, extending from 400 to 10,000 kc/s.
- Modulation of the carrier wave exceeding normal 100% having extended positive peaks.
- C. PORTABLE DRY BATTERY TRANSMITTING EQUIPMENT.
  - New high efficiency modulation system permitting exceptional compactness.
  - Electronic voice control which affords minimum battery drain.
- D. CONVOX EQUIPMENT.
  - Speech garbling equipment suitable for portable use.
  - This system may be applied to all speech transmission apparatus.

15 June, 1940

Mr. D. L. Hings, Box 494 Rossland, B.C.

Dear Mr. Hings:

Your communication of 11 May addressed to Mr. W. K. Esling, in which you submitted a proposal and specifications for a new type of aircraft radio transmitter for consideration by the Inventions Board, has been received and has been placed before our technical officers. It is desired to thank you for this evidence of your interest in Canada's war effort.

Yours faithfully,

HCKNOLILEDGEMENT OF DATA ON INVENTIONS BY GOVERNMENT

(Sgd) S. J. Cook, decrebary Inventions Board.

SJC:EPW

Copy to W/C Lawrence



The three pictures above are the first model (Pack Set) developed for the War in 1940 (based on the small mobile emergency radio developed for Cominco). The paratroopers ruined it in an obstacle course, which brought about the tougher C-17.

The next page shows the distance trials by the Canadian Army Signal Corps on the Pack Set pictured above.

Results of 10 Meter Pack Set Tests Rockeliffe July 10, 1940 # 17 Highway 10 16 Position Distance Signal Strength Remarks 3/8 mile 5/8 31. " .. -7 4 5 " 

RESULTS OF FIELD TRIALS GIVEN HINGS BY SIGNAL CORPS AFTER V DEMONSTRATION.



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1940 Vancouver Sun article on 10PC20 and war effort (Picture added by Hings later).



## 1941



C18 Prototype Capacitive Tuned Signal Corps Experimental Model, 1941

First use of Walkie Talkie Name 1941: Don's quote ...''We also took two more C 18 sets to an enlistment drive in downtown Toronto where a Soldier walked about with a C 18 strapped to his uniform. A News Reporter asked him, ''What does it do?'' He replied, ''Well you can talk with it, while you walk with it''. So the reporter wrote in his newspaper there was a new invention on display, a ''Walkie Talkie'' and the name remained from then on.''

## 1942



The letter below refers to Don's patent and the engineers saying that his circuit shouldn't work even though he had working models showing that the circuit did work, this confusion over the circuit didn't end even after the war.

His Special form of Modulating was nicknamed "Ever Expanding" modulation by his research team and would give a 20 db gain on voice due to the expanding carrier wave. Something the other radios from the allies could not duplicate.

November 9, 1942 Woodling and Krost Cleveland, Ohio

Mr. William P. Hahn Electronic Laboratories, Inc. 122 West New York Street Indianapolis, Indiana

> In Re: Applicant; Donald L, Hings Serial No. 412,708 Filed: September 29, 1941 For: RADIO SIGNALLING SYSTEM (Further identified as Case I)

Dear Mr. Hahn:

We are enclosing herewith a copy of the Patent Office action for the above entitled case. This is responsive to the amendment filed May 19, 1942 by Mr. O. W. Lee who was the patent attorney for Mr. Hings before we took over Mr. Hings' rights.

When I was in Ottawa Mr. Hings and I discussed this application and we were both of the opinion that the best way to take care of the prosecution of this case would be for Mr. Hings and me to go to Richmond and interview the Examiner. However, before going to Richmond, we thought it would be a good plan to wait until we get the Office action on the Hings No. 2 case because the two cases are interrelated.

It is true that the expression "thermionic reactance" has no recognized meaning in the art, but it is clearly apparent that the action which takes place in the No. 1 and No. 2 inventions is entirely new and patentable provided the proper words can be found to express the invention. Engineers have examined the circuits for the Nos. 1 and 2 inventions and seem to disagree as to what actually takes place in the circuit, and some have gone so far as to say that the invention won't work, when in fact it does work.

Probably the best definition of Mr. Hings' invention which is characterized as "thermionic reactance" is found in Claim 13 of his United States application for the No. 2 invention which reads:

> "An electrical system for operating a thermionic tube to render the tube highly efficient comprising, in combination, resonant output means energized by the tube, frequency input means for energizing the tube, means for operating the said thermionic tube to produce a misalignment of the peak voltages between the output means and input means to render the tube highly efficient."

Mr. Hahn

#### Woodling and Krost Cleveland, Ohio

November 9, 1942

This claim upon being found allowable will have to be transferred to the No. 1 case. In other words, when I prepared the No. 2 case, I drafted broad claims which would likewise read upon the No. 1 case as well as the No.2case. This is the reason that I want to hold up the preparation of an amendment upon the No. 1 case and the trip to Richmond until I receive the Office action on the No. 2 case, at which time I will advise you.

Very truly yours,

podling and frost



COPY

NATIONAL RESEARCH COUNCIL Canada de Montesart

> Ottawa, April 10, 1942.

Office of the President.

Mr. S. G. Blaylock. President and Managing Director, The Cons. Mining & Smelting Co. of Canada, Ltd., The Cons. Milling 2 215 St. James St. West, Montreal, P.Q.

you han Hings was getting along.

Dear Mr. Blaylock:

In your letter of 8 April you mentioned Mr. Hings and I would just like to tell you that he has done extraordinarily well here and has developed some very ingenious, practical and useful equipment for the Army Signals Corps.

Yours sincerely.

"C.J.Mackenzie"

Acting President.

cc:D.Hings





C-43 Vehicle transmitter Don Working on prototype. (photo 1942)



1942 Canadian Soldier Pictured with C-58 Mark I



Canadian Signal Corps Radio Group, Don Hings far left

# Signals Corps Sees Phone Demonstration

A demonstration of the new No. 58 Communication Set (Canadian) by Brigadier H. E. Tabor, was a feature of the get-together dinner held by officers of the Royal Canadian Corps of Signals Thursday night at the Chateau Laurier. The brigadier explained the construction and use of the set, a special telephone development for use in the field.

Present at the gathering were, Brigadier P. E. Earnshaw, Brigadier E. G. Weeks, Brigadier Tabor, Colonel R. A. H. Galbraith, Colonel C. Sandford, Lieut. Colonel R. H. Huestis, Lieut. Col. K. G. McCullagh, Major A. W. Y. De Brissey, Major J. H. W. Currie, Major G. A. McClennan and Major T. A. T. Legge.

The dinner committee was comprised of the following, Major I. H. McDowell, chairman; Lieut. J. J. Donnelly, secretary; Major I. Neary, Major Legge and Major W. E. Bailley.

Among the guests were Don Hings and Jack Watson, civilian personnel working in signal development; Major C. L. Roach, of the staff of technical services, Royal Canadian Ordnance Corps, and several Signals officers from Toronto and Montreal.

During the evening discussion took place of problems of signals equipment production, after which the officers enjoyed a social period.



CANADIAN HANDIE-TALKIE 1943

The C-27 Handie-Talkie developed by Hings pictured here in January 1943. This is what most people think of as a walkie-talkie. This model had the receiver within the earphone so if the enemy were in close proximity they wouldn't hear any transmissions and give away the operators position.



VEHICLE TRANSMITTER USED IN EUROPE



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vices, and duced. Our tank arsenal now is ts costing producing self-propelling gun mounts, and will shortly go into production on the M-4 tank.

"This type now is standard for the United States, British and i, calculate Canadian armies."

A dynameter industry, a ceramic wind de- insulation industry, and a crystal and finally industry had been developed in Canada to meet demands of the radio industry. Canada had become a major source of supply for the United Nations in this field.

> Canadian invention was responsible for seven major developments in the production of signal equipment, ranging from a tiny "talkie-walkie" radio set which one man could operate as easily as a cradle phone, to a super - highpower field wireless station with a radius of more than 100 miles. These products of Canadian design had so impressed other Allied Nations that orders had been placed for tens of millions of dollars worth.

His department's main purchasing branch had placed orders totalling \$2,500,000,000, with one of its buying duties 50,000 battle dress a week and 5,000,000 pair of footwear a year.

This branch now had taken over, under arrangement with the United States, the purchase of food for thousands of men working on the Alaska highway.

The Minister said 1943 production of timber would show "another serious decline". During the past few months, non-essential exports had been eliminated, civilian consumption curtailed and military specifications revised. No program direct military programs now were being delayed by lack of 400-gone lumber, except where climatic had been conditions made hauling imposedule and sible. Commitments to Britain, verted to the other Dominions and the United States for military lumber were being met in full.

Britain and the rest of the Emthe end pire were almost entirely dependn tanks." ent on Canada for lumber imports been pro- for direct war uses,

INGLIGUADULI, THIS ... ness interests on the board and consideration of those interests was also necessary.

#### Cuban Navy Vessel Sinks German Sub

HAVANA, June 11.43 (AP) -Cuba announced tonight that a patrol vessel of the Cuban subchaser fleet had sunk an enemy submarine in battle off the Cuban north coast, in the Atlantic, a few days ago.







TWO-WAY RADIO EQUIPMENT maintained contact between headquarters and forces in the field as Canadian troops toughened up for battles to come, in largescale manoeuvres over 200 square miles of Alberta wilderness. Signalman H. Martin, Toronto, sends a message over "walkie-talkie" set.

C58 FROM REGULAR PRODUCTION

1943-45

## D-day events

Another interesting story is that Don was told of D-day before it happened and had become important enough in the war effort that the Canadian Defence Department dressed him as a Colonel when he accompanied the Minister of Defence to England just before D-day as they didn't want the Germans knowing he was there, of course Don was never part of the Military but because of this event the Canadian Signal Corps recognize Don as an honorary member (this membership is limited to military service personal) Don received this honour a few years ago when the signal corps confirmed his (honorary) Colonel status during the war. Don was involved in many other technologies during the War.

"The British Army was so impressed with the radios Hings developed that they took most of the Canadian sets for D-Day and gave them to the British troops and gave the Canadians the lower quality British Models. This upset Don quite a lot as he feels that many extra Canadians lost their lives that day due to this turn of events as the Canadians had experience and training with the longer range, lighter, much longer battery life, more durable, and clearer signal the C-58 provided."

"The British also traded armour before D-day with the Canadians as the Radios within the Armour (also Hings) were much better than the British models. Many Canadian crews unfamiliar with the British Armour became stuck on the beaches and strafed while the British quickly forced into land with the better Canadian equipment."

## Post War:

One interesting story, a solar storm after the war eliminated all communication between Alaska and the rest of the United States, panic of sneak attack set in within the U.S. Military. Don had the giant communications antenna at Cominco in Trail B.C. at his disposal and had them tip it on its side so as to utilize the low ionosphere reflection. This allowed the U.S. Military open communication with Alaska for the three day solar storm with Cominco as the go between.

"After the war the someone asked Don to make an antenna to receive a Low Frequency signal from New Jersey that the U.S. Military was transmitting at 100 Kc/s (a very long wavelength). He first tried a copper wire about a mile long (didn't work). So he made an special loop antenna (small and compact) that picked up 100% of the signal from New Jersey. The man that meet with Hings went back to the U.S. and Don received a call from the Pentagon offering him bags of money. Don went to the Pentagon and upon Don's presentation the U.S. had the Canadian military create the Mid Canada Line using the new antenna design which was the precursor to the DEW Line. It didn't work and they had to contact Don to fix the problem, it turns out they changed his antenna design (and Don had to excite their antenna with his special modulation to receive the signal). This special modulation that was the key to the miniaturization of the 10PC20 and Walkie Talkie and later to the Early Warning NORAD (North American Aerospace Defence Command) depended on into the 1980's."

The Walkie-Talkie is not one patent but a combination of patents he put together. His patents used for the DEW line technology (Doppler Radar) consisted of more than six separate patents such as the Discharge Wave Generator and a separate patent for the Pulse Reception System.

#### COMPARATIVE DATA ON WW II INFANTRY PACK RADIOS

	CANADIAN	BRITISH	US ARMY	GERMAN
AVAILABLE	1942	1941	1944	1940
NODEL	C-58 MK1	18 MK1	SCR 609	STAG-RF.1
PACK-SET WT.	20 LBS	34 LBS	40 LBS	38 LBS
2-WAY RANGE	5+ MILES	5+ MILES	5+ MILES	5+ MILES
BATTERY LIFE (3 RCV-1 SND)	40-90 HRS	8-12 HRS	8-12 HRS	8-20 HRS
SIZE	6"x7"x13"	8"x10"x16"	6"x10"x20"	8"x10"x14"
TUNABLE CHNLS	300	200	200	100
OPERATIONAL	ALL WEATHER WATER SEALED SHOCK MOUNTED	WEATHER RESISTANT FABRIC COV.	WEATHER AND SHOCK RESISTANT	WEATHER SEALED RUGGED
OPTIONAL	DRY OR STORAGE BATTERIES	DRY BATT.	DRY OR RE- Chargeable	DRY OR DYNAMO

#### Donald Lewes Hings, P.Eng, M.B.E., C.M.

#### Awards and Life Memberships



C.M. Member of the Order of Canada (picture to left) (awarded August 16, 2001) M.B.E. Member of the British Empire (picture to right), awarded for outstanding contribution in radio communications during World War II. A.P.E.B.C. Association of Professional Engineers of B.C. A.P.E.O. Association of Professional Engineers of Ontario. A.G.U.



American Geophysical Union.

## **Don Hings Patents**

Radio Signaling System Canadian Case #1 –Woodling and Krost Canadian filed Oct 7, 1940 Serial No. 477,147 Patent No. 466,457 (Walkie -Talkie) July 11, 1950

Radio Signaling System American Filed Sept 29, 1941 Case #1 –Woodling and Krost Serial No. 412,708 Patent No. 2,395,049 (Walkie-Talkie) Feb 19, 1946

Radio Frequency System American filed June 22, 1942 Serial No. 447,890 Patent No. 2,415,427 (Walkie -Talkie) Feb. 11, 1947

Radio Frequency System Canadian filed June 13, 1942 Serial No. 493,455 Patent No. 414,084 (Walkie -Talkie) July 27, 1943

Radio Frequency Generating & Modulating Systems Australian Patent No. 127,105

Radio Amplifier American filed Aug. 8, 1942 Serial No. 454,083 Patent No. 2,416,831 March 4, 1947

Radio Amplifier

Canadian Serial No. 494,965 Patent No. 425,624 Feb 20, 1945 Radio Noise Rejector Circuit American filed August 21, 1942 Serial No.455,629 Patent No. 2.438.501 March 30, 1948 Radio Noise Rejector Circuit Canadian Filed August 20, 1942 Serial No. 495,380 Patent No. 470,109 Dec. 19, 1950 Battery American Filed Dec. 8, 1942 Serial No. 468,181 Patent No. 2,429,515 Oct. 21, 1947 Battery Canadian filed Dec. 4, 1942 Serial No. 497,884 Patent No. 452,931 Nov. 30, 1948 Radio Signaling Circuit American Filed March 27, 1943 Serial No. 480,766 Patent No. 2,447,701 August 24, 1948 Radio Signaling Circuit Canadian filed March 22, 1943 Serial No. 500,923 Patent No. 469,640 Nov. 28, 1950 Antenna American filed May 3, 1944 Serial No. 533,862 Patent No. 2,400,551 May 21, 1946 Antenna Canadian filed April 24, 1944 Serial No. 513,399 Patent No. 447.509 March 30, 1948 Oscillator Control Circuit American filed May 3, 1944 Serial No. 533,861 Patent No. 2,439,890 April 20, 1948

Oscillator Control Circuit Canadian filed April 24, 1944 Serial No. 513,398 Patent No. 460,834 Nov. 8, 1949

Multiple Transmitter Units American filed May 3, 1944 Serial No. 533,860 Patent No. 2,443,389 June 15, 1948

Multiple Transmitter Units Canadian filed April 25, 1944 Serial No. 513,428 Patent No. 467,980 Sept. 12, 1950

Discharge Wave Generator American filed Aug. 6, 1945 Serial No. 609,259 Patent No. 2,468,754 May 3, 1949

Discharge Wave Generator Canadian filed July 20, 1945 Serial No. 529,289 Patent No. 472,738 April 10, 1951

Pulse Reception System American filed Aug. 6, 1945 Serial No. 609,260 Patent No. 2,532,667 Dec. 5, 1950

Pulse Reception System Canadian filed July 20, 1945 Serial No. 529,293 Patent No. 475,586 July, 31, 1951

High Speed Pulse Reception System American filed Aug. 6, 1945 Serial No. 609,261 Patent No. 2,532,450 Dec. 5, 1950

High Speed Pulse Reception System Canadian filed July 20, 1945 Serial No. 529,291 Patent No. 484,804 July 25, 1952

Wave Inverter American filed Aug. 6, 1945 Serial No. 609,262 Patent No. 2,545,232 March 13, 1951

Wave Inverter Canadian filed July 20, 1945 Serial No. 529,296 Patent No. 513,616 June 14, 1955 Amplified Wave Inverter American filed Aug. 6, 1945 Serial No. 609,263 Patent No. 2,537, 760 Jan. 9, 1951

Amplified Wave Inverter Canadian Serial No. 529,288 Patent No. 476,974 Sept. 18, 1951

Detector Fed Automatic Volume Control American filed Aug. 6, 1945 Serial No. 609,264 Patent No. 2,540,483 Feb. 6, 1951

Detector Fed Automatic Volume Control Canadian filed July 20, 1945 Serial No. 529,290 Patent No. 473,530 May 15, 1951

Inverter Amplifier and Automatic Limiter American filed Aug. 6, 1945 Serial No. 609,265 Patent No. 2,586,230 Feb. 19, 1952

Inverter Amplifier and Automatic Limiter Canadian filed July 20, 1945 Serial No. 529,292 Patent No. 597,689 Nov. 17, 1953

Tetrahedral Reflector American filed Aug. 6, 1945 Serial No. 609,266 Abandoned

Tetrahedral Reflector Canadian filed July 20, 1945 Serial No. 529,295

Wind Impeller American filed Aug. 23, 1945 Serial No. 612,262 Patent No. 2,542,522 Feb. 20, 1951

Wind Impeller Canadian filed July 20, 1945 Serial No. 529,297 Patent No. 441,791 June 3, 1947

Selective Amplifier American filed Aug. 6, 1945 Serial No. 609,267 Patent No. 2,533,802 Dec. 12, 1950

Selective Amplifier Canadian filed July 20, 1945 Serial No. 529,294 Patent No. 471,706 Feb. 27, 1951

Phonograph Record Changer American filed Aug. 23, 1945 Serial No. 612,235 Patent No. 2,537,752 Jan. 9, 1951

Phonograph Record Changer Canadian Serial No. 529,287 Patent No. 476,637 Sept. 4,, 1951

Audio Controlled Limiter American filed Aug. 27,1945 Serial No. 612,923 Patent No. 2,533,803 Dec. 12, 1950

Audio Controlled Limiter Canadian filed Aug. 13, 1945 Serial No. 530,235 Patent No. 513,617 June 14, 1955

Remote Control Radio Frequency Relay American filed March 12, 1946 Serial No. 653,734 Abandoned

Remote Control Radio Frequency Relay Canadian filed March 2, 1946 Serial No. 538,550 Patent No. 477,378 Oct. 2, 1951

Radio Frequency Inverter Relay Circuit American filed March 20, 1946 Serial No. 655,692 Patent No. 2,532,451 Dec. 5, 1950

Radio Frequency Inverter Relay Circuit Canadian filed March 7, 1946 Serial No. 538,774 Patent No. 478,639 Nov. 20, 1951

Electrical Musical Instrument American filed March 20, 1946 Serial No. 655,691 Patent No. 2,492,919 Dec. 27, 1949

**Electrical Musical Instrument** 

Canadian filed March 7, 1946 Serial No. 538,775 Patent No. 467,981 Sept. 12, 1950

Demodulation System American filed Sept. 6, 1947 Serial No. 772,509 Patent No. 2,621,291 Dec. 9, 1952

Demodulation System Canadian filed Aug. 30, 1952 Serial No. 635,764 Patent No. 511,329 March 29, 1955

Noise Neutralizing Pulse Detector American filed March 22, 1948 Serial No. 16,155 Patent No. 2,621,287 Dec. 9 1952

Noise Neutralizing Pulse Detector Canadian filed August 30, 1952 Serial No. 635,765 Patent No. 507,488 November 23, 1954

Noise Neutralizing Demodulator American filed April 6, 1948 Serial No. 19,247 Patent No. 2,621,288 Dec 9, 1952

Noise Neutralizing Demodulator Canadian filed Dec. 2, 1942 Serial No. 639,699 Patent No. 510,866 March 15, 1955

Directional Antenna American filed April 10, 1953 Serial No. 347,871 Patent No. 2,886,813 May 12, 1959

Directional Antenna Canadian Serial No. Patent No. 593,796 March 8, 1960

Directional Antenna Array American filed April 10, 1953 Serial No. 347,872 Patent No. 2,875,438 Feb. 24 1959

Directional Antenna Array Canadian Serial No. Patent No. 587,477 Nov. 24, 1959

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The following patent was invented by both Donald L Hings and Donald P Hings.

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