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<https://doi.org/10.4224/21273431>

*Report (National Research Council of Canada. Radio and Electrical Engineering Division : ERA); no. ERA-225, 1952-04*

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NATIONAL RESEARCH COUNCIL OF CANADA  
RADIO AND ELECTRICAL ENGINEERING DIVISION

ANALYZED



PROGRESS REPORT  
FOR  
JANUARY - MARCH 1952

OTTAWA  
APRIL 1952

National Research Council of Canada  
Radio and Electrical Engineering Division

PROGRESS REPORT

JANUARY - MARCH, 1952

Comments or inquiries regarding subjects appearing in this report  
should be addressed to the Radio and Electrical Engineering Document Office,  
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## PROGRESS REPORT

JANUARY - MARCH, 1952

### I

## AIDS TO NAVIGATION

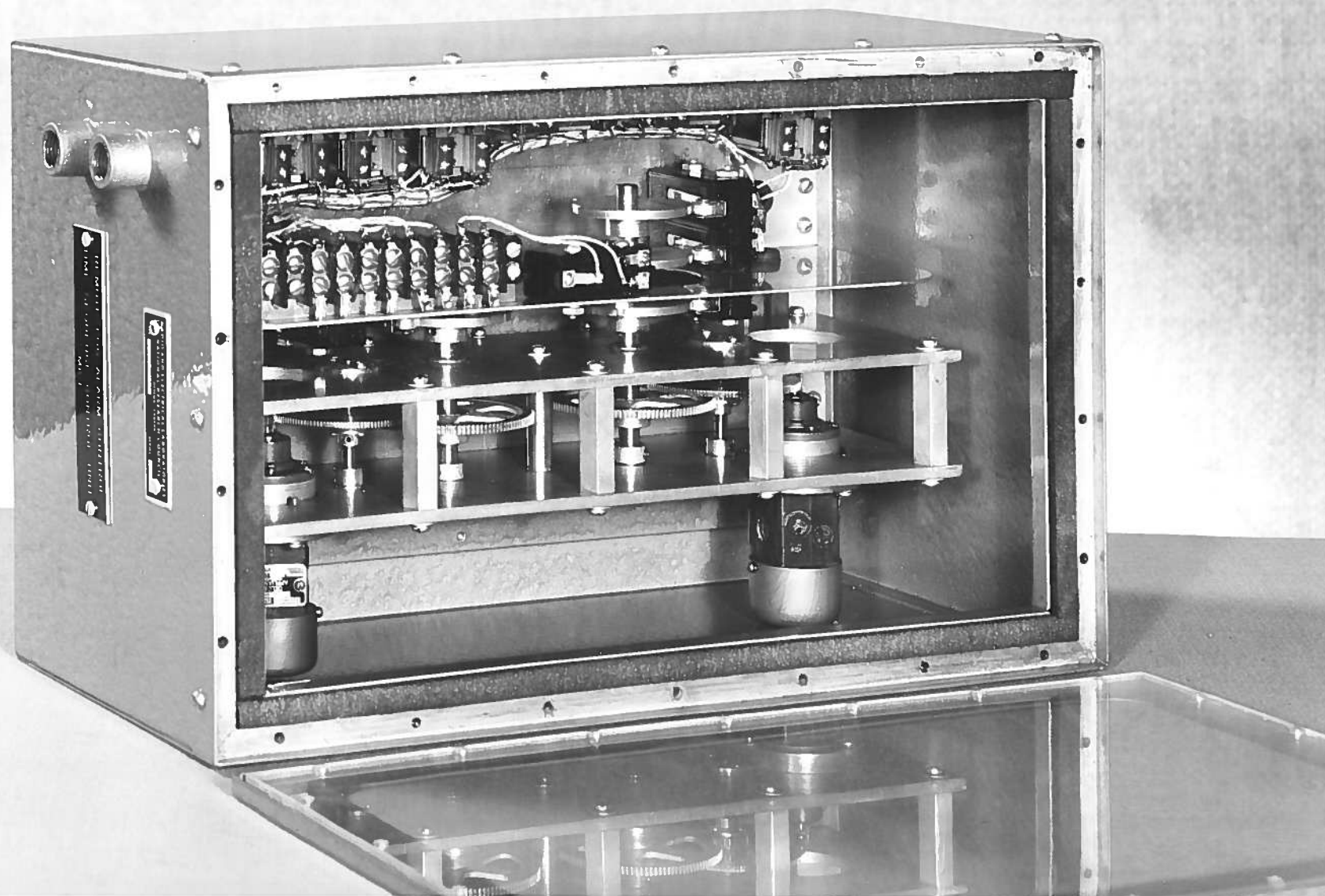
### REMOTE FOG-ALARM CONTROL

In the previous issue of this report the major requirements for the remote control system were outlined, and the equipment which had been designed to meet these requirements was described.

An additional requirement placed on the system is to provide remote-control selection of a small radio transmitter (as well as the two fog-alarm engines), in order that the operator may have a means of "listening in" whenever he wishes to monitor operation of the fog-alarm station.

It was found that this function could be provided very readily by a minor modification of the "time sequence control unit" requiring only the addition of a third, timed transmission at the transmitter. The period of operation of the first motor, necessary to start the second timing motor, was increased from ten seconds to twenty seconds. At the beginning of the eleventh second after a transmission has been received, the remote "listening" transmitter is turned on through a small timing unit which turns it off again after a few minutes operation. If the microwave signal from the control point is turned off before the beginning of the twentieth second only the radio transmitter will be turned on and no engine will be started, or stopped, as the case may be. Thus, the only modification of the microwave transmitter at the control point is the addition of a timer which will turn the transmitter off in this period of ten to twenty seconds. The timers for engine selection are advanced by ten seconds and operation remains as before.

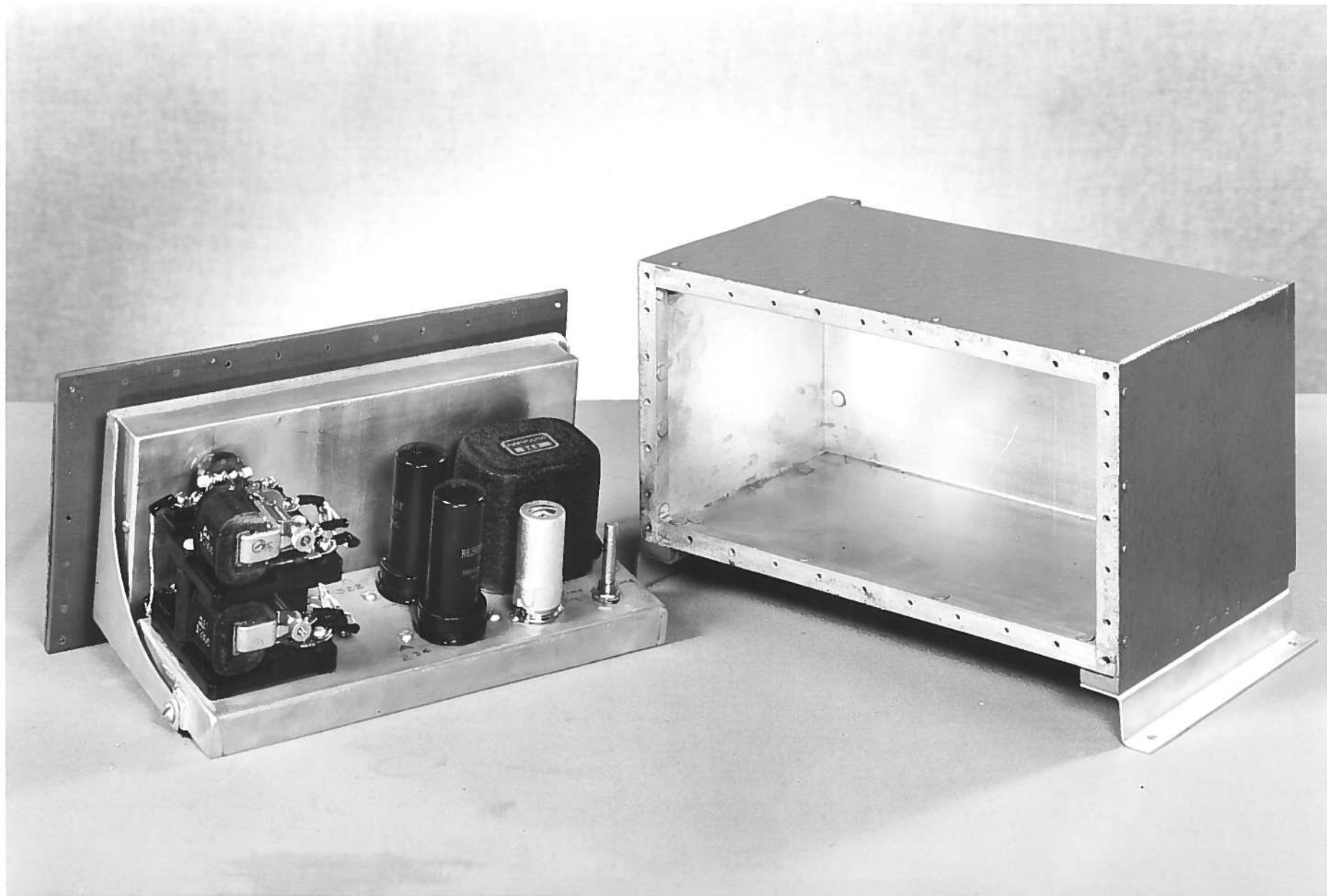
It is thus possible to start or stop either engine, with the "listening" transmitter coming on each time, or to start the "listening" transmitter at any time without interrupting either engine. In order to achieve the same flexibility of control with the resonant reed relay method it would be necessary to add a third control channel. At present the most convenient way of achieving this is to add a third resonant reed relay at the receiving end and a third pulse recurrence frequency in the control transmitter.



REMOTE FOG-ALARM CONTROL  
TIME SEQUENCE CONTROL UNIT



REMOTE FOG-ALARM CONTROL  
TRANSMITTER CONTROL UNIT



REMOTE FOG-ALARM CONTROL  
RECEIVER AND WATERTIGHT CASE



REMOTE FOG-ALARM CONTROL  
TOP AND INTERIOR VIEWS OF RECEIVER

Construction of all units has been completed, and they have been tested, with the exception of the Time Sequence Control Unit (see photograph). The transmitter has been designed so that it can be used with either the "time sequence" or "resonant reed relay" method of engine selection. The transmitter switch on the Transmitter Control Unit (see photograph), which allows selection of the desired engine, will select not only the proper pulse recurrence frequency but the right length of time for transmission as well. This will make it possible to test both receiving systems with the same transmitter.

The original experimental receiver employed a cathode-coupled Kipp relay stage, using two Type CK512AX pentodes. The presence of the cathode resistor made it necessary to provide this stage with a separate shielded filament supply, with relatively low capacity to ground. A new circuit using screen coupling in the Kipp relay eliminates the need for a separate filament battery. The general features of the Receiver Unit are illustrated in the accompanying photographs.

#### MICROWAVE LIGHTHOUSE

A 3.2-centimeter beacon has been installed in the lighthouse on the West Pier of the breakwater at Port Dover on Lake Erie for the Ontario Fisherman's Co-operative. The transmitter consists of a Type 1N-27 Marconi modulator and standard power supply. A pulse recurrence oscillator chassis has been added to trigger the modulator at 1000 cycles. The transmitter output is coupled to a horizontally polarized slotted waveguide antenna.

Two antennas were built for experimental trials — one with a 5-degree vertical pattern and the other with a 10-degree vertical pattern. Each has a 135-degree horizontal beam width to half-voltage. The 5-degree antenna was used for the Port Dover installation during the initial trial, and, as its performance was satisfactory, it was not necessary to use the 10-degree antenna. It was protected from the weather by a Lucite tube with a thickness of 0.030".

Five beacon receivers were distributed for circulation on the 34 vessels fishing out of Port Dover.

A report received from Captain E. Misner of the Ontario Fisherman's Co-operative states that the accuracy with which they can approach the harbour entrance is very reassuring, and a great relief to them when returning from their nets in foggy weather.

### ANOMALOUS PROPAGATION OVER WATER

The initial analysis of the 1951 data has been completed and some interesting results are evident, although these will not be considered conclusive until verified by further data to be obtained this year.

During the portion of the year when temperatures are normally above 50° F, there is some super-refraction over Lake Ontario more than 50 per cent of the time. Low level ducts (inversions at 50 to 60 feet) are apparent for days at a time during the summer months. The sharp boundaries of these ducts are marked by a 50 to 60 per cent decrease in signal strength for an increase of 20 feet in antenna height. The ducts are most prevalent from late afternoon until early morning hours. There were occasions when the strength and height of these inversions were constant for several days. The formation and fading of the ducts appears to be a function of a change in the index of refraction, but not of the actual value of the index. This would appear to eliminate the possibility of forecasting inversions by index of refraction measurements.

### NAVIGATIONAL AND DOCKING RADAR

#### Receivers

The input stage, consisting of a grounded-cathode Type 6AK5 stage followed by a grounded-grid Type 6J6 stage, has been replaced with a new low-noise twin triode tube (Type 6BQ7). Use of this tube has the advantage of saving space on the receiver chassis as well as improving the overall stability. To date no noise figure measurements have been obtained, but an indication may be had from the fact that the noise-voltage input to the video amplifier is 1.3 volts rms, as measured on a Hewlett-Packard 410A vacuum-tube voltmeter.

The second-detector stage was found to introduce undesirable detuning effects which varied as a function of the input signal level. This was caused by non-linearity of the crystal diode used as the second detector. It has been found that by replacing the series diode with a voltage-doubling circuit the detuning effect can be decreased, and, at the same time, the signal of the cathode follower succeeding the second detector can be increased.

Tests on the performance of the radar on "fast sweep" (short range) indicated that the clutter observed from zero range

to about 50 yards, with the transmitting channel terminated in a flat load, was associated with local oscillator tuning. By wiring in low pass filters in the supply cable at the socket of the local oscillator, considerable reduction in center spot (modulator pulse) size has been achieved. Further improvement was obtained by sealing the choke-flange waveguide connections with lead gaskets.

#### UNDERWATER TELEVISION

A research project has been initiated using this equipment to study the spawning habits of lake trout in their natural environment. The program will be carried out jointly by the Canadian Wildlife Service of the National Parks Branch and the National Research Council.

The existing underwater television equipment is being modified for this purpose. Design of a 500-foot length of cable for the submersible camera has commenced. The cable will have zero buoyancy, and will be wound on a spool provided with a rotary electrical contactor so that the equipment may be operated as the cable unreels from the drum. Alterations are also being made to the forward-reverse motor and to the water screw. A one-quarter horsepower motor will drive the screw, which will be provided with flues for raising the submersible camera while propelling it forward. This should allow the counter-buoyant chain to be raised free of the bottom to prevent stirring up sedimentary mud when the underwater apparatus is moved about. These changes are expected to improve the performance and manoeuvrability of the underwater camera considerably.

#### SHORAN AIDS TO AERIAL SURVEY

The special signal generator described in the previous issue of this report has been used to measure Shoran operational signal levels. Although the number of flights made was inadequate to establish the outside limits of the signal-level variations, data obtained to date, including that from a report recently made available, have provided sufficient information to establish a reasonably reliable figure for signal-level variations.

The possibility of serious errors resulting from drifts in the components of AGC systems, and certain fundamental operational weaknesses of peak AGC operation, prompted an examination of other means to reduce delay variations with signal intensity changes. The measured characteristics of experimental logarithmic receivers showed larger delay discrepancies than those of linear receivers, and other systems appeared even more complicated than a peak AGC system.

In describing the results of trials conducted under very close supervision, the report previously mentioned quoted serious errors resulting from maladjustments in tuning various Shoran components. Considerable effort has been directed toward the provision of power and frequency measuring equipment for use by the RCAF during operations.

## II

### ELECTRON-TUBE RESEARCH

#### INTRODUCTION

Two travelling-wave-tube detectors have been constructed during the period under review. The first tube became gassy before radio-frequency tests could be made, and the second tube developed a heater short soon after evacuation. The gun assembly has been redesigned, and a third tube is nearing completion.

A study of the detection effect at a potential minimum has led to the possibility of developing broad-band microwave detectors or converters. The detection effect was first observed in gas discharge tubes, and later in vacuum diodes. A theory of this effect, based on an hypothesis of retarding field detection at the potential minimum, has been prepared. The minimum detectable power observed with very crude experimental arrangements is about 15 db worse than that with the best crystal detector.

A circuit has been developed to measure gas current in commercial tubes. The circuit differentiates against leakage currents due to other causes. It will be used for determination of the "gas current integral" and to correlate this integral with tube life and cathode resistance.

Further work is continuing on the effect of residual contaminants on tube life. A report on this subject has been prepared and will be published shortly.

Life tests of interface resistance are continuing on some commercial-type tubes.

Owing to the considerable interest shown in the first model of the low-voltage regulated power supply (described in ERA-187), a second model has been developed with long-term stability and reduced output impedance.

### TRAVELLING-WAVE DETECTOR

The cathode design of this tube has been altered to increase the thermal efficiency, and the mechanical design of the helix assembly has been improved. The ceramic supporting the gun structure is now satisfactory.

The two tubes constructed were tested under d-c conditions before failure occurred. Satisfactory beam focussing was obtained.

### MICROWAVE DETECTION AT A POTENTIAL MINIMUM

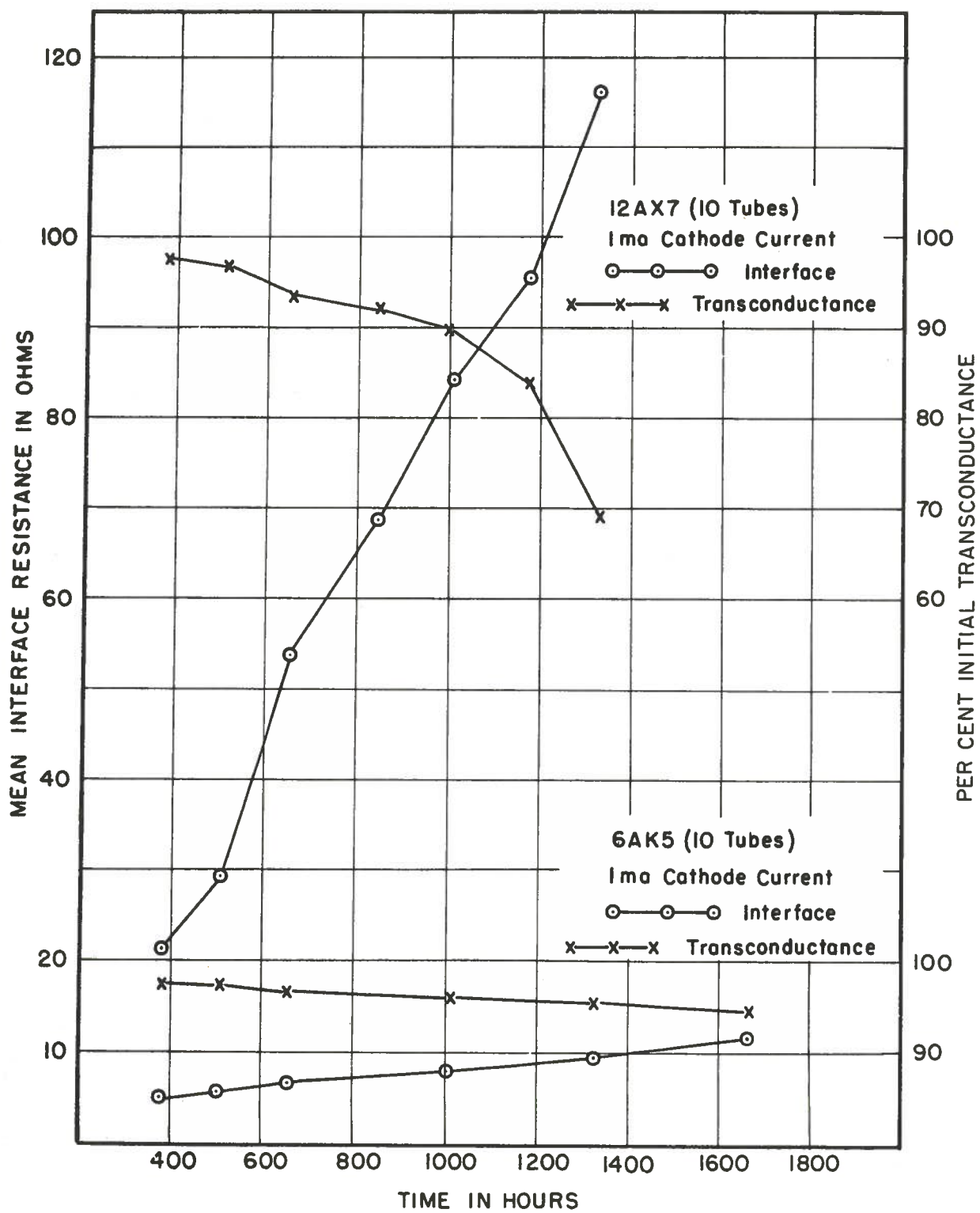
Detection of microwave energy was observed in gas discharge tubes; further investigation showed a similar effect in vacuum tubes. The detection phenomena are not dependent on the curvature of the static I-V characteristics. It is postulated that detection occurs at the potential minimum. A theoretical study has been made of the energy interchange between the radio-frequency wave and the electrons in the cathode potential minimum region, and of the retarding field detection at the potential minimum.

Further work is necessary to determine the ultimate sensitivity of this type of detector. Preliminary measurements at a three-centimeter wavelength with very crude experimental arrangements have shown a sensitivity only 15 db worse than that of the best available crystal detector.

### CONTAMINANTS IN VACUUM TUBES

A circuit for measuring gas current has been developed, which employs a modulated electron stream. The cathode current of the tube under test is magnetically modulated at a frequency of 60 cps. The current to the negative grid consists of the modulated ion current (in phase with the electron tube current modulation) and other components due to capacitive and space-charge coupling which are shifted in phase. A phase-sensitive detector is used to differentiate against the out-of-phase components. The use of a modulated system removes the error due to leakage currents.

The design of a magnetic resonance mass spectrometer is proceeding. Since this device can be constructed in a small volume it is ideally suited to the investigation of residual gases in electron tubes.



INTERFACE GROWTH AND EFFECT ON TRANSCONDUCTANCE

### OXIDE-CATHODE INTERFACE TESTS

Life tests of interface resistance on Types 6AK5 and 12AX7 tubes are proceeding. The accompanying figure shows the result obtained in the first 1500 hours. Interface resistance and capacitance is determined by the interface bridge described in previous reports. A report on the interface bridge has been prepared and will be issued as ERA-213.

### LOW-VOLTAGE POWER SUPPLY

An improved design of the previous stabilized supply has been developed.

The following characteristics of the new supply are pertinent:

Output voltage = 0.75 to 23 volts  
Maximum regulated current = 1.5 amperes at 1 volt,  
200 milliamperes at 21 volts  
Internal Impedance = 0.005 ohms

Output voltage constant to  $\pm 0.005$  volt for line fluctuations from 90 to 117 volts

Maximum drift after six hours warm-up is  $\pm 0.002$  volt.

This supply is described in Report ERA-221.

### PROCESSING EQUIPMENT

A bench with a transparent plastic enclosure has been constructed for tube assembly. The enclosure is pressurized with filtered air and prevents dust from reaching tube parts during final assembly.

## III

### DIELECTRIC RESEARCH

#### DIELECTRIC STRENGTH OF PURE LIQUIDS

The first part of the period under review was spent in testing several of the liquids mentioned in the previous issue of this report, using different types of electrode surface (nickel and aluminum). Results with nickel showed considerable scatter,

possibly due to defects in the plating. Aluminum electrodes gave the smallest scatter so far obtained. Breakdown values continue to be higher than any published in the literature. A letter summarizing recent results has been accepted for publication by the Journal of Chemical Physics.

The breakdown strength of n-hexane was determined while irradiating the gap with a gamma-ray source capable of producing four ion pairs per microsecond in the volume of liquid in which breakdown normally takes place. There was no noticeable difference between the results of these tests and those obtained previously.

#### DIELECTRIC STRENGTH OF TRANSFORMER OIL

In the early part of the period under review the microscope used for gap measurement was required for another project so that breakdown strength measurements could not be made. The time was spent in constructing a saw-tooth generator, of the saturated diode type, capable of generating pulses rising to 45 kilovolts in 10 microseconds, approximately. The rate of rise could be decreased to practically any desired value. A rise time of 60 microseconds was tentatively chosen, as this should be long enough to make the effect of time delay in the breakdown process negligible and short enough to prevent many particles from being drawn into the gap.

An improved arrangement for observing the gap from two directions at right angles has been constructed. Two high-power microscopes, which will be available shortly, will be used for accurate measurement of the arc position.

#### REVERSE CHARACTERISTICS OF CRYSTAL RECTIFIERS

An apparatus for determining the reverse characteristics of rectifiers under pulse conditions over a range of temperatures has been constructed and several units tested. The barrier height calculated from the test results is about 0.4 eV. This is of the order of that predicted theoretically when the presence of holes near the metal point is taken into account.

Studies of silicon and germanium ingots prepared by the NRC Division of Applied Chemistry have commenced.

#### IV

#### ELECTROMEDICAL RESEARCH

#### CARDIAC DEFIBRILLATION AND STIMULATION

The electromedical work during the period under review has centered on further investigation of electric shock treatment of ventricular fibrillation. The experiments in defibrillation have suggested that there are two phases of fibrillation. The first phase seems to degenerate very rapidly to a second irreversible stage, unless arrested by electric shock or other means. The deterioration is due in part to the muscle working ineffectually against the pressure of the blood in the ventricles.

The usual treatment of ventricular fibrillation is to force oxygen into the lungs, open the chest pericardial sac as quickly as possible and massage the heart to maintain circulation, and then attack the fibrillation with electric shock and drugs. It may be that the delay in applying the shock current allows degeneration to irreversible fibrillation. In recent tests at the Banting Institute it was observed that a single application of current before massage often stopped the fibrillation, resulting either in resumption of natural beats, or in standstill, usually overcome by pacemaker stimulation or massage.

The success of these first shocks in arresting fibrillation suggested the feasibility of intracardiac defibrillation with closed chest. In tests on medium-size dogs, the heart was catheterized and the countershock was applied across the electrodes within the right auricle as close to the ventricle as possible. Some success was achieved by this method, but the necessary high current caused burning of tissue surrounding the electrodes. However, when the two electrode rings on the catheter tip were paralleled and a shock applied from them to a large electrode on the chest over the apex of the heart, the ventricles could be defibrillated with less current and greater reliability. The procedure was repeated several times without difficulty. Further tests are necessary to evaluate the new procedure.

In conjunction with the defibrillation tests, the pacemaker stimulator was used to restore natural beats from standstill. In one instance where the auricles were observed to be in fibrillation, the artificial pulses inhibited the fibrillation and controlled the heart in the range from 80 to 140 per cent of its normal rate.

V

RADIO ASTRONOMY

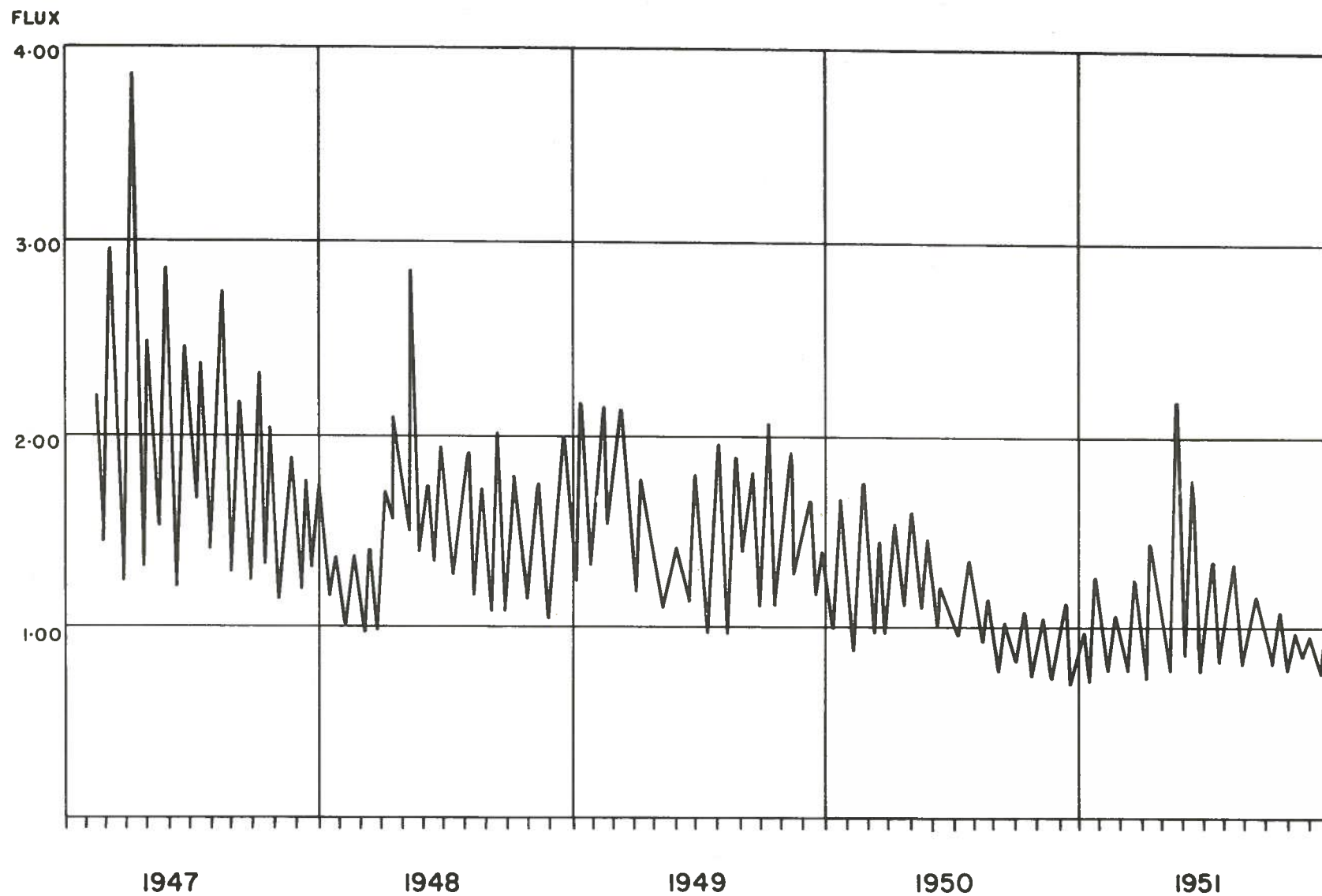
SOLAR NOISE OBSERVATIONS

Since 1947, the intensity of radio waves or "radio noise" emitted from the sun has been measured regularly at a wavelength of 10.7 centimeters with a four-foot paraboloidal reflector and a very sensitive receiver. Throughout the day the intensity remains constant, except for the rare occurrence of the sudden increase of noise which accompanies the appearance of solar disturbances known as "flares". Over longer periods of time, one notices that the daily intensities are usually greater than some minimum value, which occurs when the sun is relatively free from spots. This minimum value represents the intensity of radio noise from the whole spotless solar disk, and increases in intensity above the base line are attributed to radio emission from sunspots. Peak values are present when a large sunspot group faces the earth, and usually reappear 27 days later after the sun has made one revolution. The distinctive recurrent 27-day peak and minimum values have been plotted from 1947, a year of maximum sunspot intensity, to 1951, a year of low solar activity (see accompanying figure). During this period of declining solar activity, the curve of radio noise shows a decline, both in sunspot emission (amplitude of the fluctuations) and in the quiet solar level (lower boundary of the fluctuations).

Observations with the 150-foot array have been temporarily discontinued owing to mechanical troubles brought on by winter conditions. These will be remedied when milder weather returns. In order to investigate the effect of a gap which occurred between the horn and the waveguide owing to differential expansion and contraction with temperature, radiation patterns in the vertical plane were taken on a short mock-up section of the long waveguide array. The effect of the gap, for the particular horn configuration, proved to increase the antenna gain slightly, rather than decrease it, as expected. A new narrow band intermediate-frequency amplifier (0.75 megacycle at 30 megacycles) has been constructed for the purpose of narrowing the effective beam width of the array.

A 10-foot paraboloidal reflector has been mounted at the Radio Astronomy Observatory at Goth Hill. Some component units of the radiometer to be mounted directly behind the reflector are being constructed. Further construction and wiring are under way.

Experiments have commenced on a novel circuit for frequency conversion.



10.7 - CENTIMETER SOLAR NOISE OBSERVATIONS 1947-1951

VI

RADIO ENGINEERING

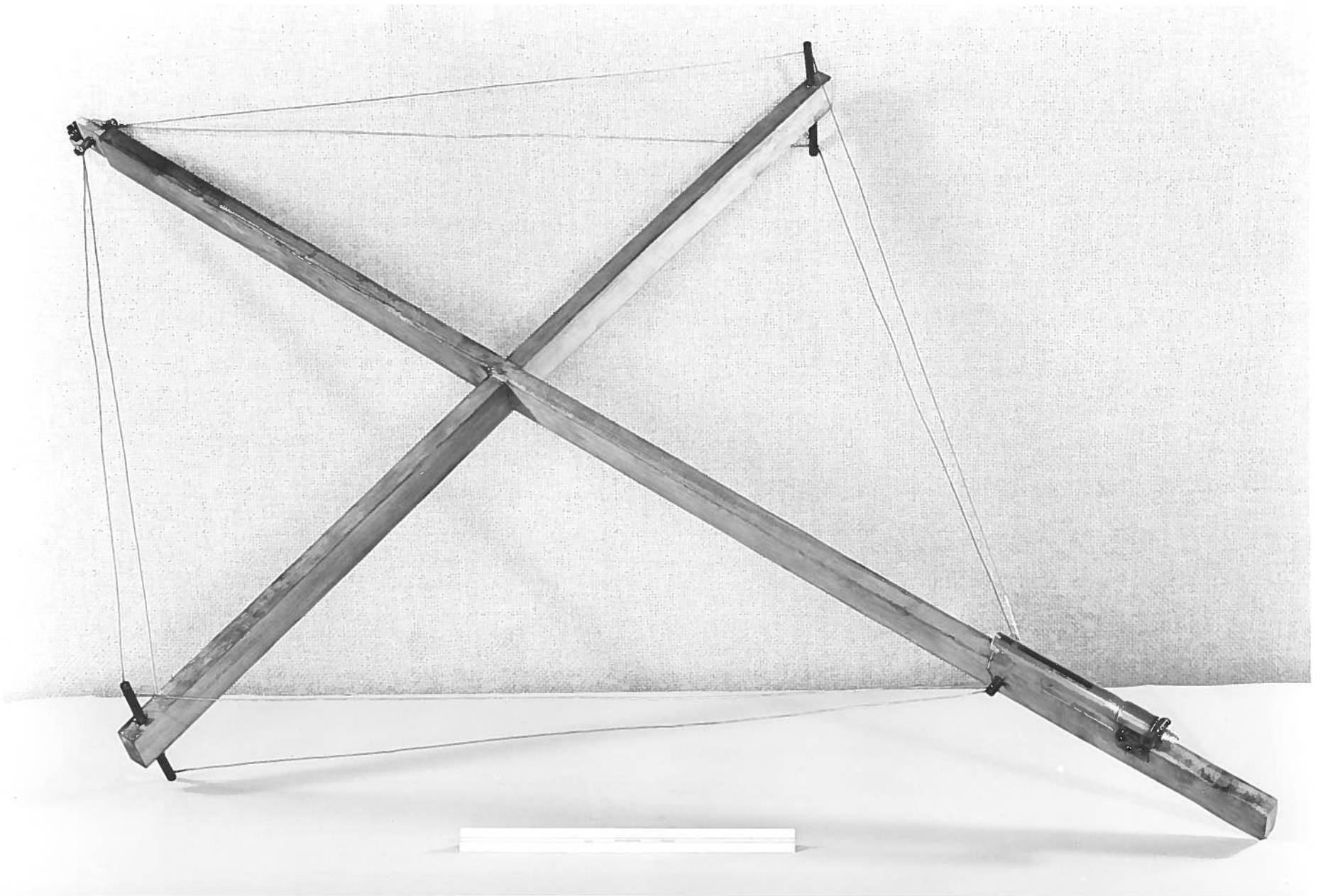
RHOMBIC ANTENNA FOR UHF TELEVISION

It was felt that a need existed for a broad-band, directive, UHF television antenna, having no critical dimensions, which could be built cheaply and quickly even in a home workshop. A rhombic antenna satisfying these requirements has been designed and tested. In addition to the UHF television application, this is useful for UHF communication, and as a transmitting antenna for radiation pattern measurements.

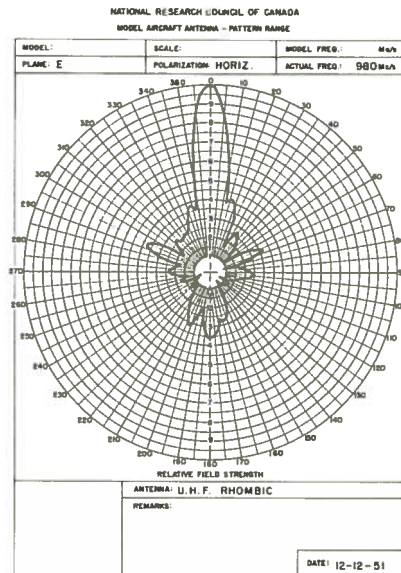
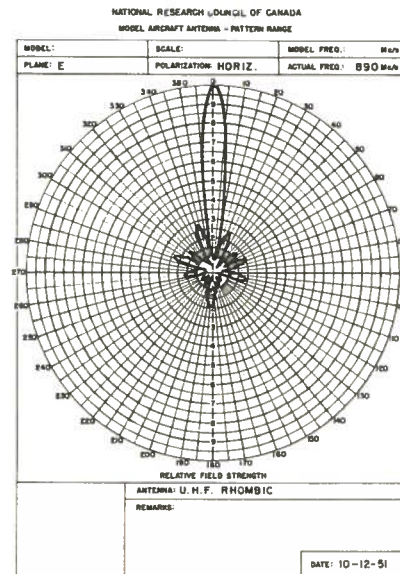
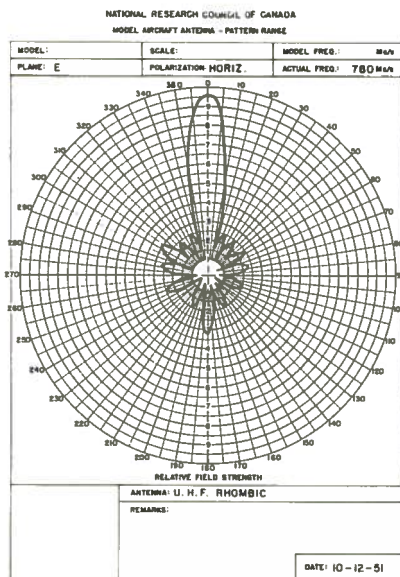
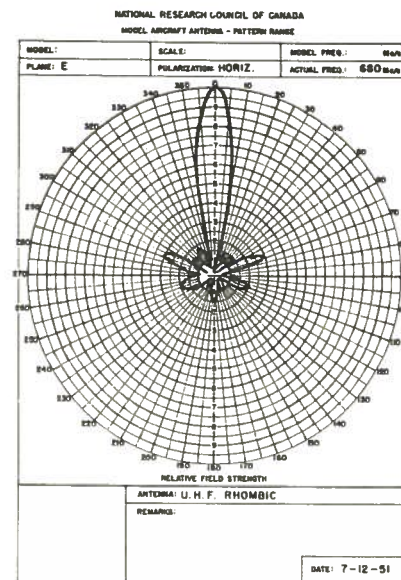
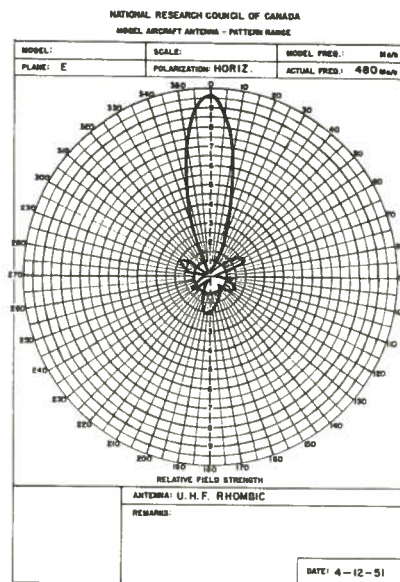
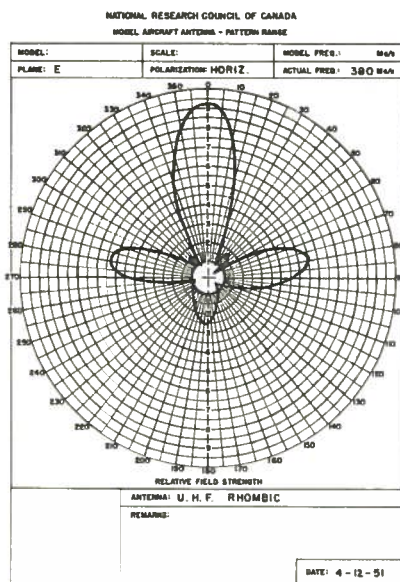
An experimental model of the antenna appears in the accompanying photograph. This model was designed specifically for the UHF television band of 470-890 megacycles, and hence is centered on a frequency of 680 megacycles. The length of each leg of the rhombus is  $34\frac{1}{2}$  inches, or  $2\lambda$  at the design frequency, while the total included angles at the terminated and driven ends are  $80^\circ$ . Thus the radiating portion of the antenna is 53 inches long and 44 inches wide, a reasonable size for mounting on a mast. Structurally, the antenna consists of a cross of varnished hardwood, through which are driven four Bakelite dowels which support the radiating elements (No. 14 gauge wire). The two wires making up each half of the antenna are soldered together at the terminated and driven ends, and are separated 6 inches at the center in an attempt to obtain a more uniform characteristic impedance along the length of the antenna. The antenna is terminated in approximately 720 ohms, and can be driven directly from the 300-ohm twin line commonly used in television installations. The antenna shown has a balance-unbalance transformer attached to it, so that it can be used with 50-ohm co-axial line.

The impedance characteristics are excellent over a band even wider than the UHF television band. Measurements showed the voltage standing-wave ratio on 300-ohm line to be less than 1.4 from 380 to 980 megacycles.

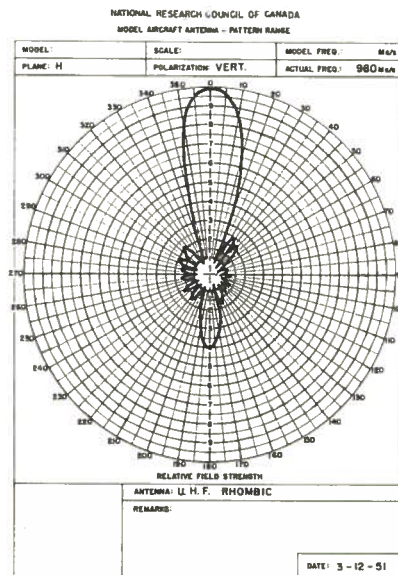
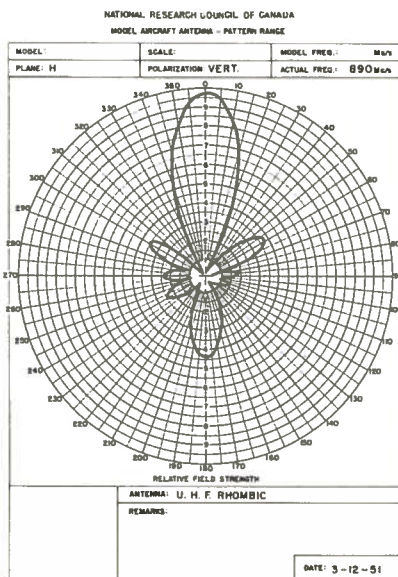
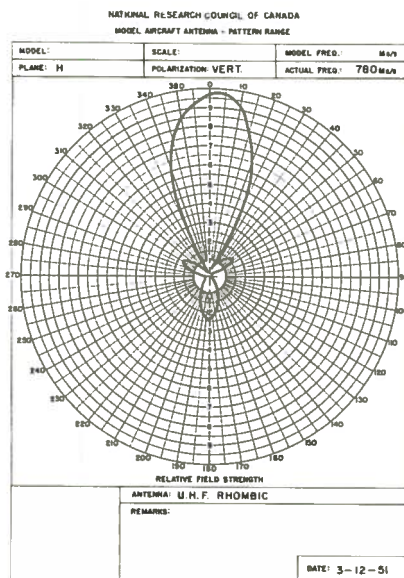
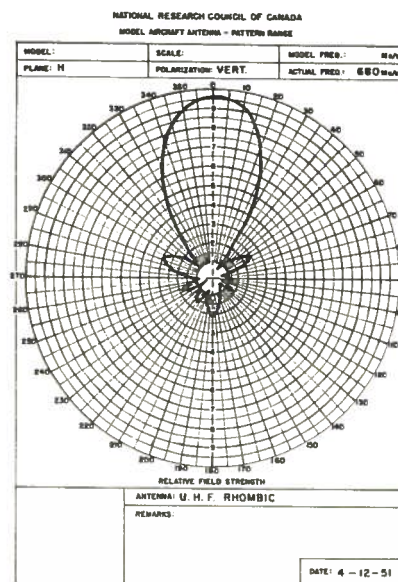
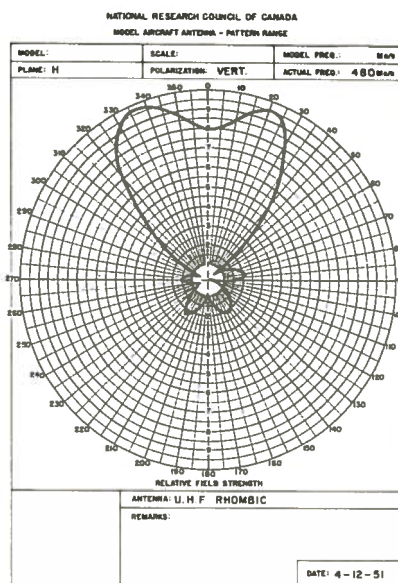
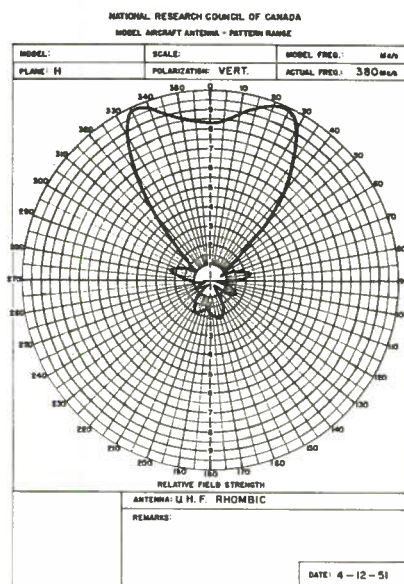
Radiation patterns over this band are shown in the accompanying figures for each of the two principal planes. The patterns show that the antenna is quite directive, and thus very suitable for point to point communication. The actual power gain of the antenna at various points over the UHF television band is being measured.



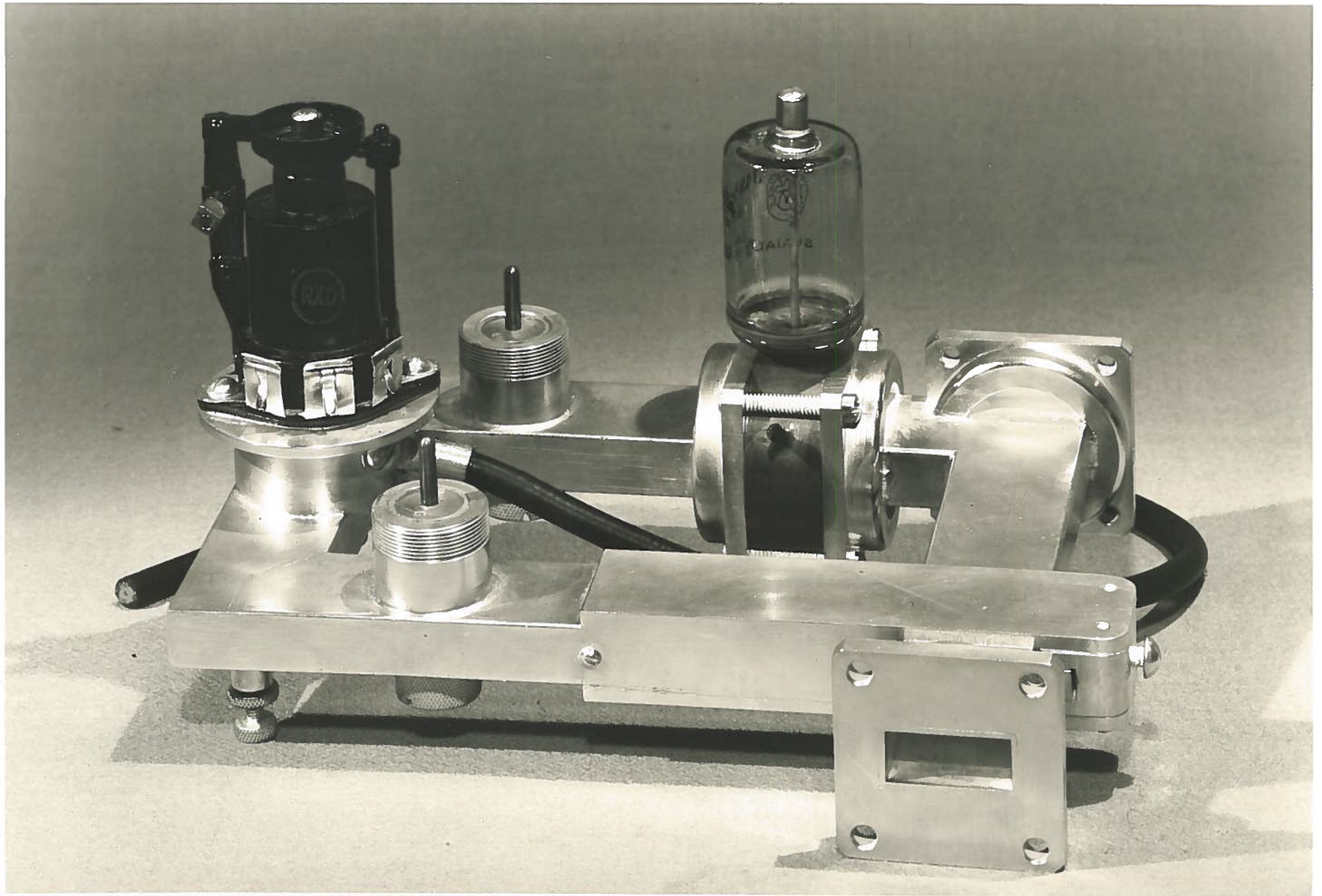
RHOMBIC ANTENNA FOR UHF TELEVISION



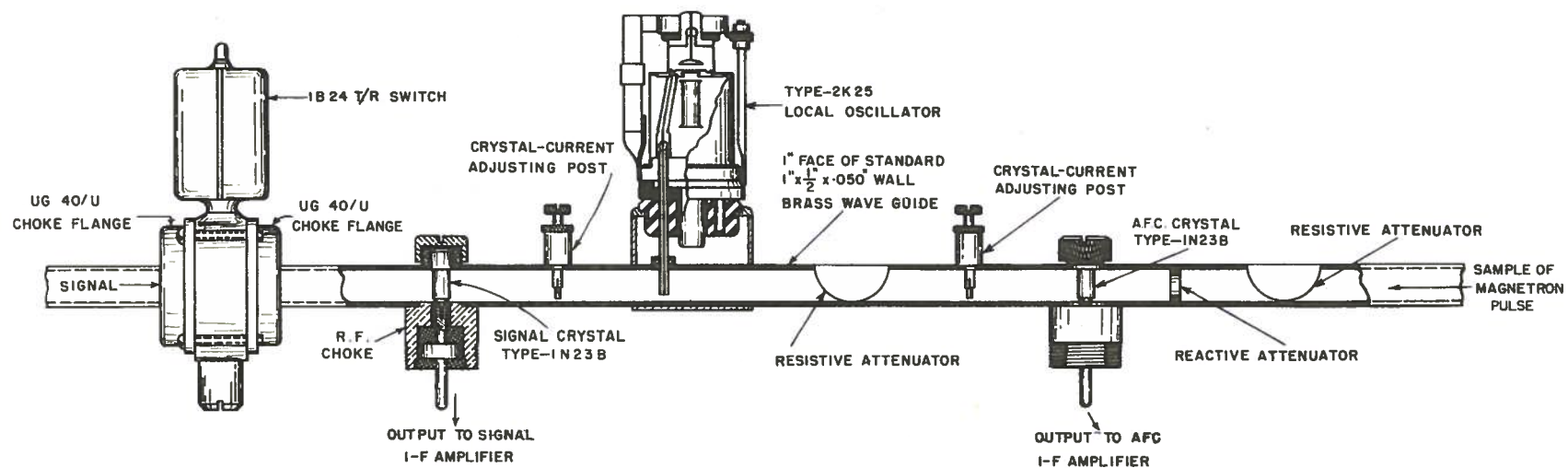
RHOMBIC ANTENNA FOR UHF TELEVISION  
E-PLANE PATTERNS



RHOMBIC ANTENNA FOR UHF TELEVISION  
H-PLANE PATTERNS



SINGLE WAVEGUIDE MIXER FOR X-BAND RADAR



COMPLETE BASIC MIXER

In view of its excellent electrical performance and mechanical simplicity, it is felt that this design will be useful to anyone requiring a cheap, directive antenna for use in the UHF or upper VHF band.

#### SIMPLIFIED RADAR MIXER

The duplexer-mixer shown in the accompanying photograph has been designed for use in the radar band centered on 9375 megacycles. The basic arrangement of the mixer is shown in the accompanying diagram. It is believed that reliable operation will result from the arrangement of the local oscillator in a mount electrically equivalent to the standard test mount for this tube. Manufacturing simplicity has been achieved by the use of a simple type of crystal-current adjusting post, and by arranging that the right-angle bends in the waveguide are located at these adjusting posts, so that the electrical susceptance introduced by the corners need not be considered. Interaction between the two crystal-current controls has been held to a low value. The mixer has been installed in a complete radar with satisfactory results. The mixer is fully described in Report ERA-207.

### VII

#### ELECTRICAL ENGINEERING

##### ELECTRONIC DETECTION OF FLAWS IN PAPER

A small laboratory-type sorter with manual feed has been constructed to test the dynamic behaviour of the flaw detector. This operates to reject sheets of paper which have marks detectable by the electronic circuit. However, the sensitivity is somewhat less than is desired because of the inherent noise of the first stage. The electronic circuit is being redesigned to discriminate against the spurious signals due to the noise, and thus improve the sensitivity.

##### 1200-KV IMPULSE GENERATOR

A few modifications were made to the impulse oscilloscope during the period under review. These consisted of the installation of a line-voltage filter inside the oscilloscope, the design and installation of a power supply of the voltage-multiplier type for the accelerating potential of the cathode-ray tubes, and changes in layout inside the oscilloscope

necessitated by the two units above.

Impulse tests have been made on a number of distribution transformers, bushings, and pothead insulators for Canadian manufacturers of electrical equipment. The reports on these tests have been completed.

#### A-C LINE VOLTAGE STABILIZER

As mentioned in the previous issue of this report, there was some difficulty in obtaining steel of the desired magnetic characteristics for the driving unit. The process suggested by the manufacturer to overcome this difficulty was not successful, so further investigation is necessary.

Operation of the stabilizer, using ordinary cold-rolled steel, is quite satisfactory, and the stability and speed of response are as expected; however, the smaller driving unit used in the laboratory model gives lower static accuracy when used with the larger Variacs.

The voltage-sensitive bridge, intended for measurement of the accuracy of the voltage stabilizer, is still under development. The ripple suppression circuit for rejection of the 120-cycle component in the output has been analyzed and improved to give a quicker response.

### VIII

#### STANDARD FREQUENCY SERVICES

The 150-megacycle standard frequency transmitter was installed in December. The output of the transmitter is 50 watts. The carrier frequency and 1000-cycle modulating frequency are derived from the primary frequency standard and have the same accuracy as the standard. Except for minor breakdowns due to tube failures, the transmitter has been in continuous operation since the first of the year. The defective tubes were of the 6AQ5 type and were used in the quintupler stages of the transmitter. These have been replaced with Type 5673 tubes and no further difficulty has been experienced. Improved operation of the final amplifier stage was obtained when the Type 829B final amplifier tube was replaced by a Type AX9903 tube with built-in cross neutralization.

A voltage regulating transformer has been installed in the 110-volt line supplying the primary frequency standard. This has taken care of the difficulties encountered because of poor line voltage regulation.

## IX

### ASSISTANCE TO OUTSIDE ORGANIZATIONS

At the request of the Department of Mines and Technical Surveys assistance was given to the Topographical and Geodetic Survey Branches in connection with radio communication facilities for their field parties. Frequency predictions for the coming summer were obtained, and operating procedures recommended to improve the performance of their radio equipment. A portable radio transmitter-receiver was modified and lent to the Surveys Branch for use during the coming summer. This work has now been completed.

Advice on microwave measurements has been given to several Dominion Government laboratories. Some minor assistance was rendered to Computing Devices of Canada, Ltd., and a power calibration was made on six microwave signal generators manufactured in Canada by the Beaconing, Optical and Precision Materials Company, Ltd.

## X

### PAPERS AND PUBLICATIONS

"Operational Trials of Electronic Equipment on the M.V. 'Radel II'", presented by H.R. Smyth at a meeting of the Kingston Branch of the Engineering Institute of Canada held on January 8, 1952.

"Recent Electronic Aids to Navigation", presented by H.R. Smyth at a meeting of the Ottawa Branch of the Engineering Institute of Canada held on February 7, 1952.

"Solar and Galactic Noise", presented by A.E. Covington at a meeting of the Ottawa Section of the Institute of Radio Engineers held on February 14, 1952.

"Optimum Patterns for Arrays of Non-isotropic Sources" by G. Sinclair\* and F.V. Cairns, presented by Dr. Sinclair at the National IRE Convention held in New York City, March 3-6, 1952.

\*University of Toronto.

"A review of Infrared Developments and Applications", presented by W.C. Brown at a meeting of the London (Ontario) Section of the Institute of Radio Engineers held on March 24, 1952.

"The Electron Cyclotron", presented by R.S. Rettie at a meeting of the Ottawa Section of the Institute of Radio Engineers held on March 27, 1952.

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"A Linear Radio-Frequency Mass Spectrometer", P.A. Redhead, Can. J. Phys., vol. 30, pp. 1-13, 1952.

A radio-frequency mass spectrometer is described using a system of electrodes similar to a linear accelerator to obtain velocity selection of the ions. A beam of ions is directed through a series of axial radio-frequency fields with alternate polarity, and the ion with a velocity (proportional to  $M^{-\frac{1}{2}}$ ) such that it traverses the individual stages in approximately one-half period of the radio-frequency field, acquires maximum energy from this field. A retarding field region prevents all ions, except the ion with maximum energy, from reaching the collector. An ion beam of large cross section is used. With 20 radio-frequency stages a mass resolution of 1% is obtained.

"The Q of a Microwave Cavity by Comparison with a Calibrated High-Frequency Circuit", Hugh LeCaine, Proc. Inst. Radio Engrs., vol. 40, no. 2, pp. 155-157, 1952.

A comparison method has been developed for the direct measurement of cavity Q at microwave frequencies. It is particularly useful for high values of Q, such as 5,000 to 15,000. The over-all error in the measurement is estimated to be less than  $\pm 3$  per cent.

A two-channel superheterodyne technique is used, in which both channels are driven by the same frequency-swept oscillator, and both channels use the same local oscillator. The cavity is inserted in the radio-frequency stage of the first channel, and a comparison circuit is inserted in the intermediate-frequency stage of the parallel channel.

The two resonance curves are displayed on the same oscilloscope for alternate sweeps of the oscillator. When the resonance curves are made to coincide, the Q of the cavity is n times the Q of the comparison circuit, where n is the ratio of radio frequency to intermediate frequency.

Cavity shunt resistances can be measured on the same apparatus.

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The following publications have been issued by the Radio and Electrical Engineering Division:

"A Simplified Radar Mixer" (ERA-207), by A.C. Hudson and E.A. Conquest.

A radar mixer for operation in the three-centimeter band is described. A type-2K25 local oscillator mounted in a manner electrically equivalent to the standard JAN mount, provides two well decoupled outputs to feed the AFC and signal crystals. This mount minimizes mode discontinuities and other difficulties peculiar to this type of klystron. The principle is applicable to mixers using any klystrons in which the power output is obtained from an antenna projecting into a wave guide.

"Measurement of Converter Crystal Parameters and Over-all Noise Figures at 10.7 Centimeters" (ERA-208), by W.J. Medd.

Apparatus and experimental procedures are described for the determination at 10.7 centimeters of conversion loss, L, and noise temperature, t, of converter crystals, and of the noise figure of the intermediate frequency amplifier. An over-all noise figure is thus obtained from the formula  $F_r = L(F_{if} + t - 1)$ . This is compared with an independent determination of  $F_r$  using a fluorescent lamp mounted across the wave guide as a source of radio-frequency noise power.

"A 100-Watt Amplifier Using Receiving-Type Tubes Only" (ERA-200),  
by E.L.R. Webb.

A 100-watt amplifier, originally designed to supply standard 60-cps power to a small synchronous motor, is briefly described. Because it employs only receiving-type tubes and has inherently good voltage regulation, the unit may be of general interest; for example, it may be used for the distribution of standard frequency signals in a large laboratory where the load is random.

"A Regulated Power Supply for the Range 5 to 7 Kilovolts" (ERB-257),  
by R.S. Richards.

A power supply developing 5 to 7 kilovolts at loads up to 75 milliamperes is described. Regulation is to within 12 volts, from zero to full load. Ripple is less than 10 volts.

The power supply was built for a large stroboscope designed for research in photosynthesis. With the exception of the filament transformer for the type-8020 tubes, which was specially wound, all components used were readily available.

"Operating and Maintenance Instructions for the NRC 230-Volt Line Voltage Stabilizer" (ERB-277), by D.M. Murray.

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