Laboratories of the National Research Council of Canada, Electrical Engineering and Radio Branch visit to the National Electronics Conference and the Mid-West Convention of the A.I.E.E.: held at Chicago, November 1947

Creed, F.C.; Katchky, M.

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LABORATORIES

OF

THE NATIONAL RESEARCH COUNCIL OF CANADA

ELECTRICAL ENGINEERING AND RADIO BRANCH

VISIT TO THE NATIONAL ELECTRONICS CONFERENCE AND THE MID-WEST CONVENTION OF THE A.I.E.E., HELD AT CHICAGO, NOVEMBER, 1947

OTTAWA

DECEMBER, 1947

TO READERS OF THIS REPORT

This report has been indexed under the following subjects:

Thermistors
Oscillographs
Vacuum Tubes Cathode Ray
Vacuum Tubes - Thyratron
Lines
Microwaves
Antennas - General
Guided Missiles - Television

Have you any suggestions for additional subject cards?

Radio Form
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Report no. ERB - 180

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ELECTRICAL ENGINEERING AND RADIO BRANCH

visit to

THE NATIONAL ELECTRONICS CONFERENCE

and

THE MID-WEST CONVENTION OF THE A.I.E.E.

HELD AT CHICAGO, NOVEMBER 1947

by

F.C. Creed and M. Katchky

Submitted by N. L. Hunter

Head: Electrical Engineering Section

G. R. Miller

Head: Microwave Section

Approved by B.G. Ballard

Officer-in-Charge

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Ottawa, December 1947

NATIONAL ELECTRONICS CONFERENCE AND THE MID-WEST CONVENTION OF THE A.I.E.E. CHICAGO, NOVEMBER, 1947.

INTRODUCTION

The National Electronics Conference was held in Chicago at the Edgewater Beach Hotel, 3 to 5 November, 1947. The program of lectures was so extensive that the Coordinating and Management Committee sent two representatives, Mr. M. Katchky and Mr. F.C. Creed. This group left Ottawa on 1 November, 1947, and arrived in Chicago the following evening.

SOCIAL FUNCTIONS

Two luncheon meetings were held by the NEC Conference in the Marine Dining Room of the Edgewater Beach Hotel, on Monday and Tuesday, 3 and 4 November. Mr. Walter Evans, Vice-President of the Westinghouse Electric Corporation, gave a talk on research and development for government projects. In this talk, Mr. Evans stated that research for war purposes had not been carried out by industry during the years between the wars because of lack of government support, and that in future, if the armed forces are to be kept up to standard, it will be necessary for a fairly extensive research program for the armed forces to be maintained throughout the years of peace. He stressed the necessity of adopting a policy of this nature in order to insure that adequate trained personnel of a high calibre would be available for urgent development work in the event of future hostilities, and stated that it had been found through experience during the last war that each research engineer could keep twenty men occupied full time.

LECTURE PROGRAM

Lectures presented at the National Electronics Conference were subdivided into four main headings for each half day. These four groups were running concurrently and there were four or five papers presented in each group. Mr. Katchky and Mr. Creed divided up the groups to cover as many papers of major interest to the Council as possible. The lecture accommodations at the Edgewater Beach Hotel were, in most cases, very satisfactory. The hotel had speakers at approximately ten-foot intervals throughout all the main lecture halls, which allowed complete audience coverage without the necessity of high volume in any one section. This was far superior to the set-up at the Congress Hotel in Chicago, at which the A.I.E.E. Convention was held. The latter hotel had only one loudspeaker in each lecture room and it was very difficult to follow what was being said. The following lectures were attended by the writer:

Electronic Instrumentation

(1) Self-Balancing Thermistor Bridge.
(2) A Miniature Gastro-manometer for Physiological Use.
(3) Short-Time Oscillography.
(4) Luminescent Screens for Cathode-Ray Oscillography.

Joint Session of the A.I.E.E. & the N.E.C.

(1) Position Convectron.
(2) A New Line of Thyratrons.
(3) Glass-Enclosed Reed Relay.
(4) Capillary-Fed, Mercury Contact Relay.

Industrial Electronics

(1) New Cathode-Ray Oscillographs and Applications.
(2) High-Capacity Servo System for Control of a Mechanical Testing Machine.

Industrial Applications

(1) Fluorescent Lamp Operation Above 60 Cycles.
(2) Magnetostriction Torque Meter.

Electronic Instrumentation

(1) High Resolving Power Infra-red Recording Spectrometer.
(2) The Phase Meter.

These papers have already been published in the November, 1947 issue of "Electrical Engineering".

No attempt will be made in this report to summarize all of these papers, since they will all appear in the proceedings of the National Electronics Conference, copies of which have been ordered by the Council. A few of the papers of special interest will be reviewed briefly.

SUMMARY OF THE PAPERS

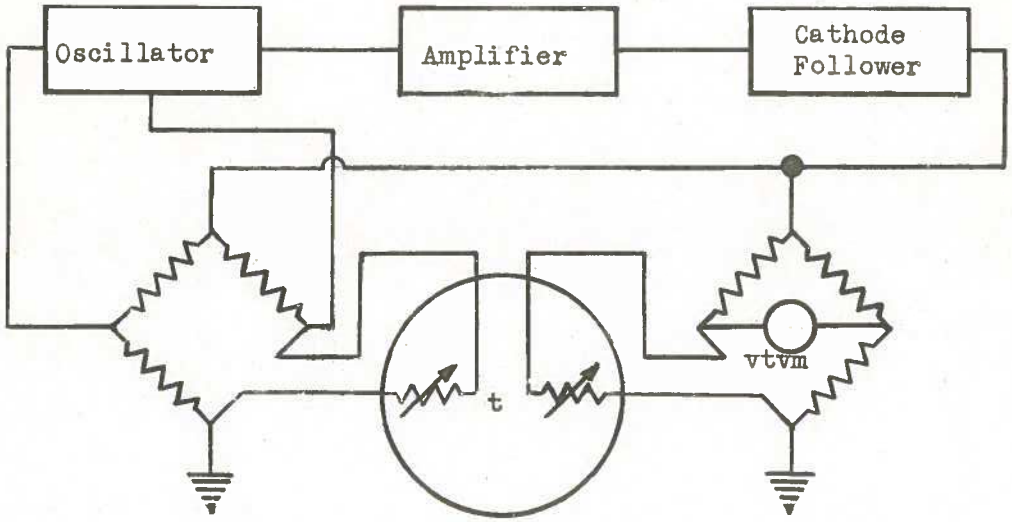
(1) Self-Balancing Thermistor Bridge:

This paper described a bridge for use with thermistors for the purpose of measuring r-f power. The features of specific interest were that the bridge was self-balancing and self-compensated for changes in ambient temperature. It is a direct-reading instrument with a scale which is linear with respect to power and has a maximum sensitivity of thirty-five micro-watts full scale, and a minimum sensitivity of one milliwatt full scale.

Two matched thermistors are used in the instrument, both being mounted in the same receptacle in order to subject both elements to the same

ambient temperature, and one being shielded from the r-f power.

The instrument uses two identical bridges, one for each thermistor. The bridge with the exposed thermistor is part of the feed-back loop of a 6 kc sine wave oscillator, which is used to excite both bridges. The second bridge, with the shielded thermistor, is connected in parallel with the first bridge and has a vacuum tube voltmeter connected across its terminals.

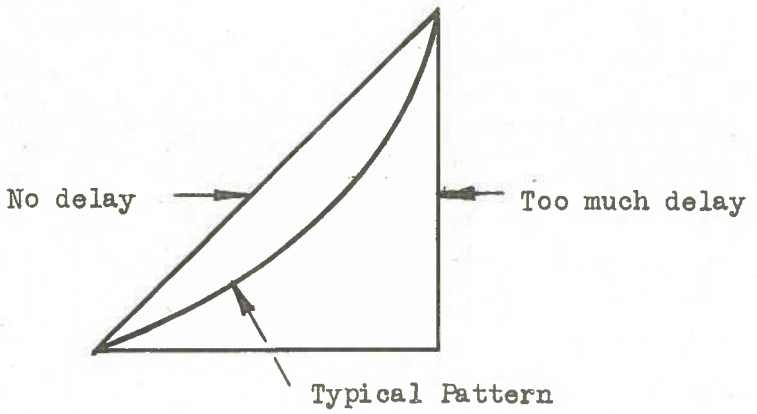


Exposure of the thermistor in bridge #1 to r-f power causes its temperature to rise, unbalancing the bridge. This unbalance, fed back into the oscillator, reduces the oscillator power fed into the bridge to bring the thermistor back to its original temperature and thus rebalance the bridge. This causes an unbalance in the second bridge which can be measured with the vacuum tube voltmeter, and is a direct measure of the reduction in oscillator power fed to the two bridges; this being equal to the r-f power absorbed by the first bridge.

(2) Short-Time Oscillography:

This paper deals with the measurement of time in the range of 10^{-9} seconds, and utilizes standard tubes of the type 5JP series, although the author of the paper mentioned that it had been necessary to drive the grid of the CR tube well into the positive region, in order to obtain sufficient intensity for measurement purposes. The instrument was developed at MIT for investigation into the time of build-up of current in pulsed magnetrons. The principle of operation was based upon the transit time of electrons between the deflection plates of the CR tube. The transient was put on both pairs of the deflection plates and a short, variable length of cable,

approximately one foot in length, was inserted between pairs of deflection plates. This length of cable gave sufficient delay for time measurement in the range desired, and this delay could be very accurately measured. The terminating resistors for the cable were inserted in series with the deflection plates, since for transients of the order measured, the capacity of the deflection plates was essentially a short-circuit. The delay introduced by the cable, together with the shape of the lissajou figure on the CRT face, enabled the time of build-up of the transient to be measured to an accuracy of 1×10^{-9} sec. The general shape of the pattern on the CR tube face is shown below.



(3) Luminescent Screens for Cathode-Ray Oscillography:

Criteria governing the choice of a luminescent screen for cathode-ray oscillography were discussed. The effects of factors, such as accelerating potential, beam current, spot size, screen efficiency, writing speed, repetition rate and decay time were evaluated. Factors subject to external control, such as ambient and incident light, selective colour filters and physiological considerations were given. The difference in requirements for general visual oscillography and the visual and photographic study of single transient phenomena were described. Problems encountered in high and low speed moving film recording were illustrated.

(4) A New Line of Thyratrons:

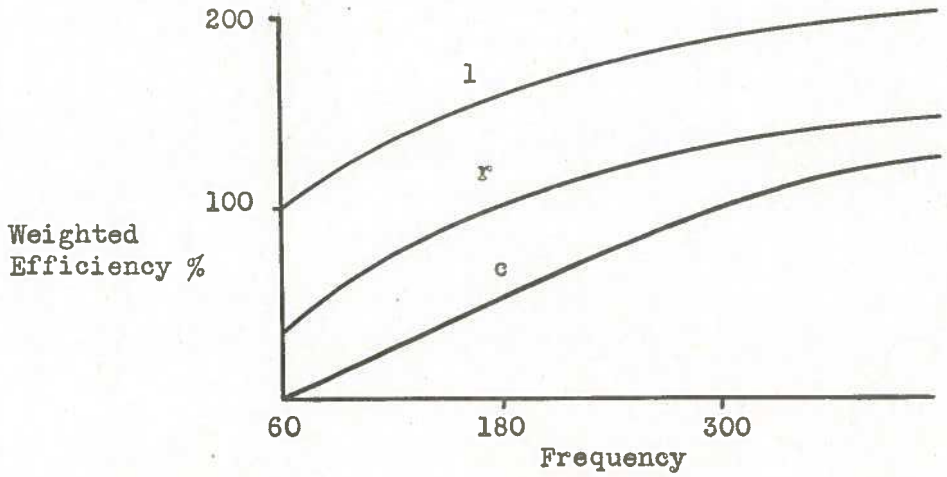
A new line of thyratrons, now being manufactured by the General Electric Company, was discussed. These thyratrons are of the GL5545 type, with a working voltage of 1500 volts.

Modern electronic motor control systems, in order to be competitive with other types of control, demand more tube for less dollars. New demands are for quick heating, high peak-to-average current ratio, wide ambient temperature range, high surge-current rating, dual-grid control, compactness, ruggedness and reliability. The novel method of tube construction used in this new line of thyratrons was discussed. The primary feature was a very close electrode spacing, with shields above and below the anode to prevent gas clean-up by the anode. This shielding has increased the life of tubes to the point where gas clean-up is now no longer the limiting factor. Ratings and characteristic curves were given for the 6.4 and 3.2 ampere, gas-filled tubes, and comparisons were made between these and mercury-filled tubes of similar ratings.

(5) Fluorescent Lamp Operation at Frequencies Above 60 Cycles:

This paper descussed the operation of fluorescent lamps over the frequency range of 60 cycles to 2500 cycles, and compared the effects on weight, efficiency and cost, of inductive, resistive and capacitive ballasts over this range. These three factors are grouped under the term "weighted efficiency" and, in this paper, efficiency is understood to mean "weighted efficiency".

The efficiency was found to increase with increase in frequency, being doubly efficient at 400 cycles for an inductive ballast, and tending to flatten off from this point onwards. From about 300 cycles up, the ballast could be so simplified that a condenser could be economically substituted for an inductance, from an efficiency viewpoint. The capacitive ballast at 300 cycles was equal to the inductive ballast at 60 cycles and a resistive ballast at 180 cycles, from an efficiency point of view. The following sketch gives the general shape of the efficiency versus frequency curves for the capacitive, inductive and resistive ballasts.



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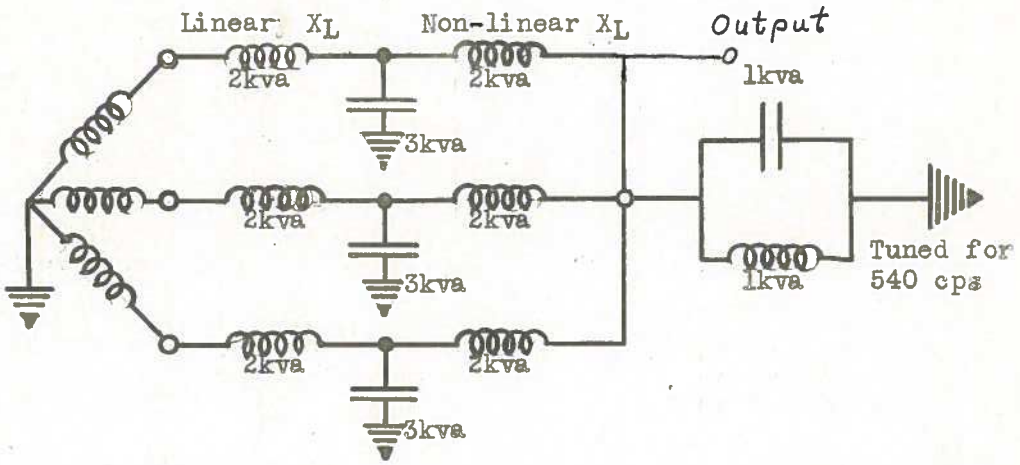
A method of frequency conversion from 3-phase, 60 cycles to single-phase 540 cycles was demonstrated. This unit, with the values indicated, operated at approximately 70% efficiency. Increasing the ratings of the components would increase the efficiency, since the rating goes up as the fourth power of the linear dimensions, while the losses go up only as the third power. A schematic diagram of the method of frequency conversion from 60 cycles, 3-phase to 540 cycles, single-phase is shown below:



It is felt that the major benefit of the conference was in the contacts made and the first-hand information received on new products demonstrated in the exhibits. Approximately fifty manufacturers had exhibits at the Conference and, although the exhibits were much smaller than those at the Radio Engineering Show, a great deal of valuable information was received by discussing with company representatives some of the specific problems which have been encountered in our work, and much useful literature was accumulated, which would normally have required innumerable letters and delays.

EXHIBITS

Exhibits of particular interest were the Dumont exhibit, which showed all of the latest Dumont equipment, including the Dumont Type K1017 cathode-ray tube. This tube operates with an over-all acceleration of 34,000 volts, spread over six intensifier bands, and has coaxial input to the deflection plates. Data sheets were acquired by the writer.

A new dictaphone was also demonstrated by the Brush Development Company which used a metalized plastic disc and magnetic recording. The pick-up arm was guided by an arm running on a separate grooved disc, and the instrument could use one disc almost indefinitely, depending on the number of times the disc was removed from the machine.

The General Radio Company had on display their new universal connectors which necessitated only one type of plug.

The Magnecord Company had on display a wire recorder with a frequency response flat within 2db from 40 to 12,000 cycles. One hour of playing was achieved with a spool of wire approximately 3" in diameter. Other displays of interest were:

(1) New 5674 Pl[illegible]iotron by General Electric.
(2) Pulse Generator with .04μsec. rise by Instrument Development Labs.
(3) Pressurgraph by Electro Products Incorporated.
(4) Watch Checker by Instrument Development Labs.
(5) Polar Coordinate Converter by Dumont Labs., Inc.

PERSONAL IMPRESSIONS OF THE CONFERENCE

The writer would suggest that in future representatives should be equipped with a small flashlight for taking notes during lectures. Most of the lectures were given in total darkness since a great many slides were shown, and without the assistance of a flashlight it is almost impossible to take adequate notes. A camera for photographing slides projected on the screen would also be a valuable accessory.

The Conference fulfilled a great need by enabling the writer to discuss with various manufacturers some of the problems which are encountered in research work and a great deal of assistance and many new ideas were received as a result of these contacts. It is probably in this field that the conference does the most good, since representatives from the major manufacturing industries of electronic componemts were on hand, and, in addition, many highly qualified personnel from other research organizations were able to throw light on problems which they themselves had encountered.

A.I.E.E. CONVENTION

Two sessions of the A.I.E.E. Convention were attended. One of these, a communications session, covered three papers which are filed in the Electrical Engineering Section. These papers with their numbers are as follows:

(1) General Mobile Telephone System - 47-256.
(2) The Application of Western Union Multiplex to Navy Radio -47-257.
(3) The Frequency Division Techniques for a Coaxial Cable Network - 47-258.

The other session was on electronic relay applications and was essentially a discussion group. A report from the Project Committee of the A.I.E.E. Relay Committee on Electronic Relay Applications was read, and also two papers on the advantages of practical aspects of electronic protective relaying. Copies of the above are filed in the Electrical Engineering Section.

In the discussion which followed the presentation of the papers, various engineers expounded on the type of relaying in use in their organizations, and the general idea seemed to be that electronic relaying filled a definite need and was not intended to circumvent other types of relaying systems, but rather to supplement them to handle jobs which could not be handled otherwise. Electronic relaying also provided a necessary stimulus to the relaying field, which already has brought about an improvement in the conventional style of relaying systems.

F. C. CREED

Mr. Katchky's notes on the lectures he attended appear on the following pages.

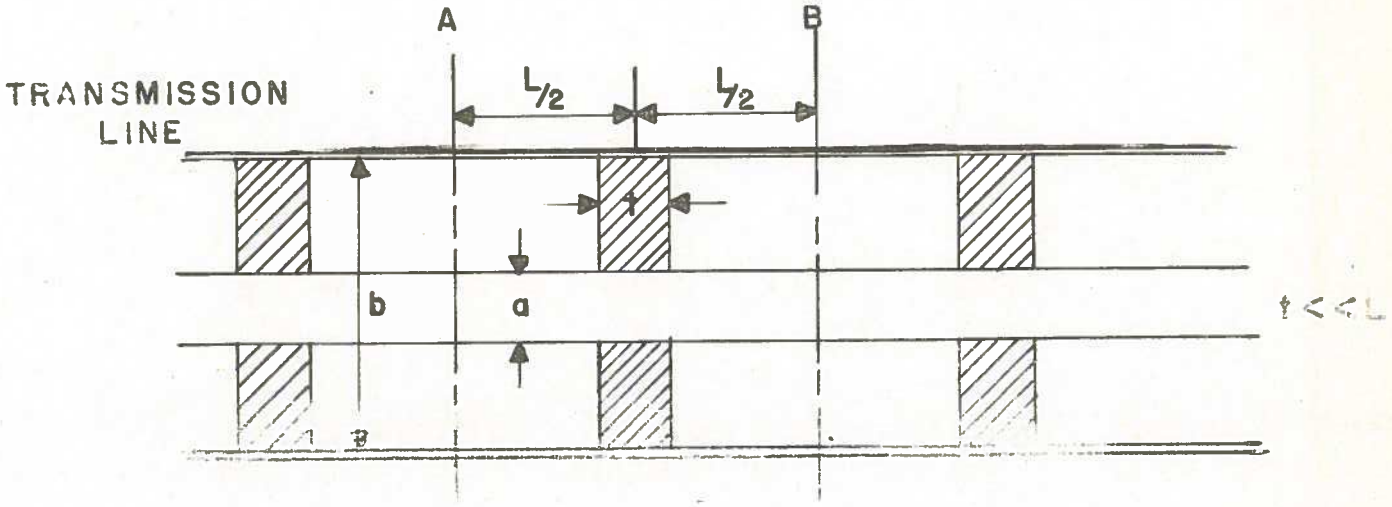
I COAXIAL ELEMENTS AND MICROWAVES

(a) Bead Supported Coaxial Attenuator for the Frequency Band 4,000-10,000 Mc/s - J.W.E. Griemsmann, Polytechnic Institute of Brooklyn.

The chief requirements were that the attenuator should have small attenuation spread and low input reflections over the entire band. This was achieved by making the centre conductor a very thin metallic film on a glass rod of about 6" in length. The metallic film must be very thin to insure uniform current distribution over a wide frequency band.

A complete analysis was presented on the design and operation of grooved bead supports and inserts for type "N" connectors to provide broad band characteristics. Performance curves were shown for units with 3, 6, 10, and 20 db. attenuation and these indicated a very good match over the whole band with only slight change in attenuation. No data was available on the power handling capacity of the attenuators nor on the materials used in the composition of the metallic film.

(b) Wave Propagation in Beaded Lines - R.E. Beam, Northwestern University.



The section A-B of the above transmission line is treated as a four-terminal network which can be represented by an equivalent T-section having the following expressions for characteristic admittance and propagation constant:-

$$Y_{OT} = \sqrt{\frac{1+Y_b/2Y_o \cdot \coth \gamma\ell/2}{1+Y_b/2Y_o \cdot \tanh \gamma\ell/2}}$$

γ - propagation constant

Y_o - admittance of line

$$\sinh \gamma s \cdot \sinh \gamma\ell \sqrt{(1+Y_b/2Y_o \cdot \tanh \gamma\ell/2)(1+Y_b/2Y_o \cdot \coth \gamma\ell/2)}$$

Y_b - admittance of bead

Curves of the above expressions plotted as functions of the electrical length between beads, indicate that the beaded cable has alternate pass and attenuation bands as the frequency is increased. The higher the order of the pass band, the smaller is its width. The speaker admitted that this theory was only good for frequencies below 1000 Mc/s, but should be useful for work in FM and Television for which purpose the investigation was initiated.

(c) Coaxial Elements and Connectors:- W.R. Thurston, General Radio Co.

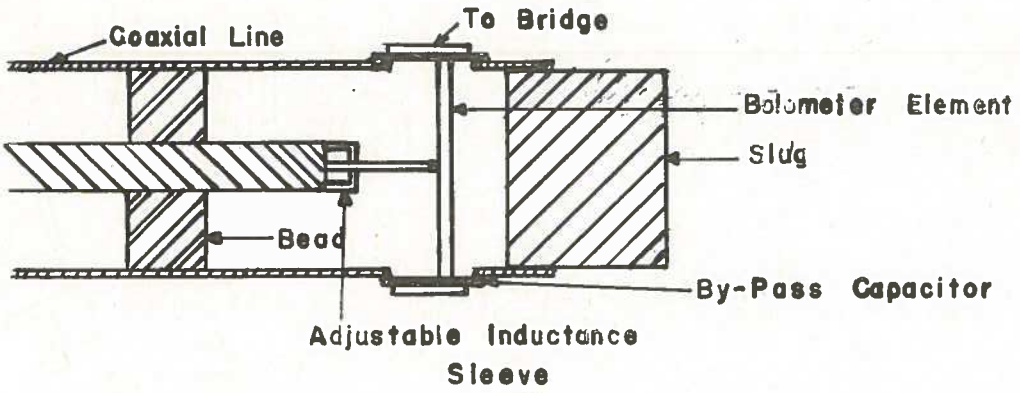
This paper summarized the development of a new line of coaxial elements and connectors for UHF measuring equipment. The connectors themselves are characterized by the identical form of the two mating parts, thereby eliminating the need for adapters. A VSWR of 1.02 to 1.04 over a frequency band of 300 to 3000 Mc/s was claimed for these connectors in an otherwise matched 50 - ohm line. Among the display of coaxial elements utilizing these connectors were slotted lines, tuning stubs, variable length short-circuited lines, right-angle bends, tee sections, rotary joints, bolometer and thermistor holders, and matching terminations. The design of these units are such that they permit flexibility of use, rapidity in setting up, and relative lowness of price.

(d) Theoretical Limitations on the Broadband Matching of Arbitrary Impedances - Dr. R.M. Fano, Massachusetts Institute of Technology.

The general problem of matching an arbitrary load impedance to a pure resistance by means of a reactive network was treated mathematically. The necessary conditions were derived for the physical realizability of a function of frequency representing the input reflection coefficient of a matching network terminated in a prescribed load impedance. These conditions were then transformed into a set of integral equations involving the

logarithm of the magnitude of the reflection coefficient. From these, a convenient method was derived for computing the elements of a matching network to give the optimum theoretical bandwidth for a given tolerance of match. An important conclusion was derived on the basis of the mathematical analysis which indicated that matching at one frequency, and subsequently using a reactive network for broadbanding, does not yield the maximum bandwidth.

(e) Broad Band Bolometer-Type UHF Power Meters - H.J. Carlin - Polytechnic Institute of Brooklyn.



In the above power meter, the bolometer element is either a Wollaston wire, or a metallized film which is mounted as the termination of the coaxial line in which the power is to be measured. The design of this unit involves a compromise between bandwidth and sensitivity. Calibration is performed at low frequencies, and the error at UHF, due to skin effect and mismatch, was minimized by appropriate design. Three separate meters were developed for the range 20-1000 Mc/s, 1000-4000 Mc/s, and 4000-10000 Mc/s. The power ranges are from 20 microwatts to 2 watts.

II MICROWAVES

(a) Higher Mode Techniques for Wave Guides - W.M. Goodhue, Polytechnic Research & Development Co.

Two methods for eliminating higher order modes are:-

1. Probes.
2. Mode Filters.
   (a) partition in centre of guide - variable length - did not work very well.

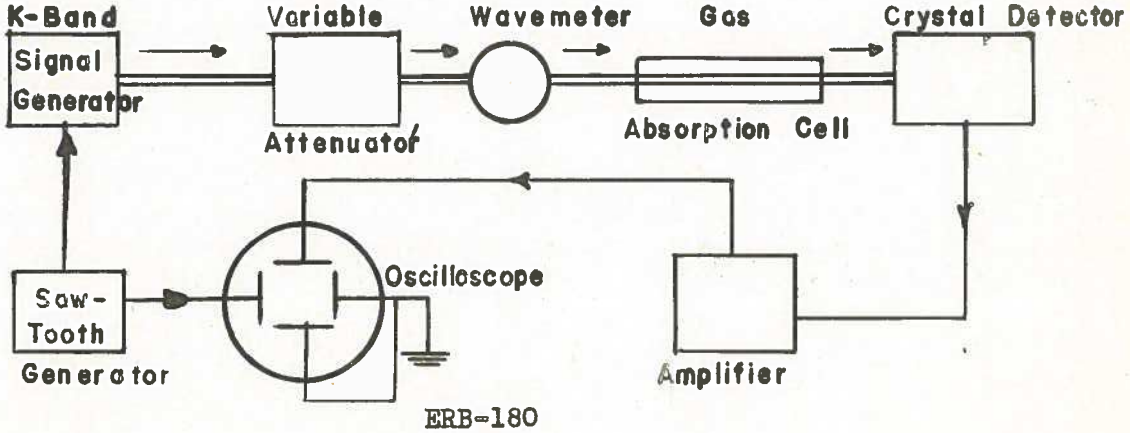
(b) transducer type - numerous rods.
(c) lossy type filter - similar to (a)
(d) two exciters placed back to back.

These devices can be used to produce a pure first mode, and alternatively can be arranged to allow transmission of a pure higher mode by rejection of all other modes. This makes it feasible tc transmit very high microwave frequencies in a guide-size that would normally be considered too large. An example described by the speaker was the transmission of X-Band in S-Band waveguide, using a tapered section between the two sizes of guide. When the higher order modes were eliminated, good transmission was achieved with only a slight increase in attenuation.

(b) Multiplex Transmission Through Wave Guides Using Higher Order Modes
W.A. Hughes, Northwestern University.

The possibility of transmitting two or more signals through a wave guide on the same carrier frequency, but using different modes to separate the signals, was investigated, both experimentally and theoretically. This method was found superior to the previous one of using slightly different carrier frequencies and separating the signals by means of the superheterodyne principle. Various means of launching and separating the different modes were described in detail. This was illustrated in an experimental set-up in which two 10 cm. signals were propagated in a large piece of waveguide, one in the $TE_{1,0}$ mode, the other in the $TE_{2,0}$ mode. The former was modulated at 900 cps., the latter at 1700 cps. The two signals were transmitted through gradual bends and tapered sections and then separated, detected, and amplified into a speaker, where they were identified by their pitch. A separation of 60 to 80 db. was claimed by the author.

(c) Microwave Spectroscopy - Dr. D.K. Coles, Westinghouse Research Laboratories.



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The above set-up was used to present part of the absorption spectrum of several compounds on the screen of an oscilloscope in order to examine the Stark and Zeeman effects.

The frequencies at which absorption takes place corresponds to the rotational frequencies of the molecule. Information regarding the spins of the atomic muclei within the molecule and the charge distribution within the nuclei can be obtained by studying the fine structure of rotational absorption lines. By studying the Stark and Zeeman effects, it is possible to determine the electric and magnetic dipoles associated with the molecule and the magnetic dipoles associated with the atomic nuclei.

(d) Some Fundamental Considerations Concerning Noise Reduction and Range in Radar Communication - Dr. S. Goldman, Massachusetts Institute of Technology.

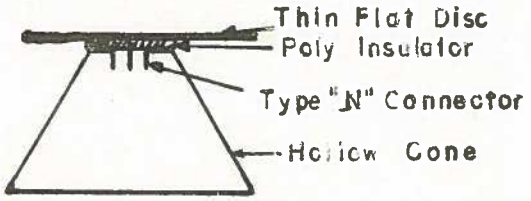
Using the probability theory and the information theory as a basis, two general theorems were derived concerning the noise properties of signals. These theorems allowed a fairly complete answer to be given to questions of range and noise reduction in radar, and the beginning of the answer in the case of communications systems. It was then shown that the maximum range in communication is essentially independent of the type of modulation used for a given total energy. Due to lack of time, the speaker was unable to present the mathematics involved in his theorems, but stated that these would appear in the Proceedings.

III ANTENNAS:

(a) High Gain with Discone Antennas - A.G. Kandoian, International Telephone and Telegraph Corp.

A paper on the theory of the discone type antenna was originally presented before the IRE in 1945, and since that time, discone type antennas have been developed for a large number of applications in the VHF and UHF ranges.

The discone antenna was found to be most effective for broad band performance, its operation being analogous to a high pass filter. The mechanical features are outlined in the accompanying sketch. The taper of the cone influences the impedance of the element, while the length of the slope determines the cut-off frequency, being slightly less then one-quarter the cut-off wavelength. The disc diameter is not very critical.



Applications

(i) High Gain Omni-directional Array

This is a 9-element array for the frequency band 960-1215 Mc/s. The elements are spaced 180 electrical degrees apart vertically, and fed in phase, to produce a circular pattern in the horizontal plane and a narrow beam in the vertical plane. To tilt the pattern upwards, the cable to the top element is made longer than the cable to the adjacent element, and so on down the array, the difference in length determining the amount of tilt. The limination on bandwidth is due to the quarter-wave transformer necessary to match the low impedence of 9 elements in parallel to 50 ohms.

(ii) Pencil Beam

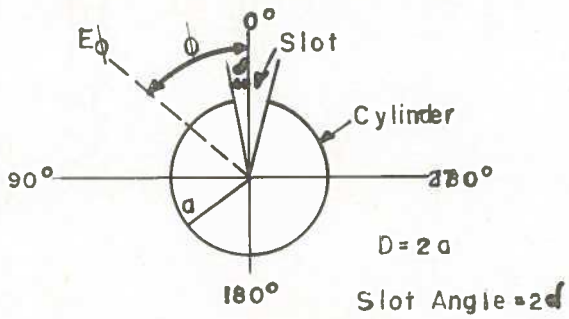
This was achieved by using a 72" paraboloid with a discone antenna as the feed, and the combination gave very good patterns over the remarkably wide band of 600-3200 Mc/s with beamwidths varying from 20° at 600 Mc/s to 4° at 3200 Mc/s. The power gain was down 4 db. from the theoretical value due to the omni-directional pattern of the feed. The match, however, was good over the whole band.

(b) Slot Antennas- Dr. Miller, Radio Corporation of America.

The development of slot antennas was described in a chronological manner with special emphasis placed on the types applicable to aircraft. Specific solutions to altimeter and marker beacon antennas were outlined. In the majority of cases, workable arrangements could be obtained only by means of actual experience since variations in the surroundings have first order effects on such characteristics as the radiation patterns, slot impedance, and bandwidth.

(c) The Patterns of Multiple Slot Cylinder Antennas - Dr. G. Sinclair, University of Toronto.

Polar Co-ordinate Notation



Assumptions

1. α is very small w.r.t. λ
2. Horizontal pattern is independent of vertical pattern (true for a symmetrical system)
3. Electric field is uniformly distributed along the slot.

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It can be shown by Fourier analysis that:

$$E\phi = A\left(a_0/2 + \sum_{n=1}^{\infty} a_n \cos n\phi\right)$$

$$a_n = \frac{(j)^n}{d/dx\,(H_n^2(x))}$$

where $x = ka/\lambda$

$d/dx\,(H_n^2(x)) = J_n(x) - jY_n(x)$

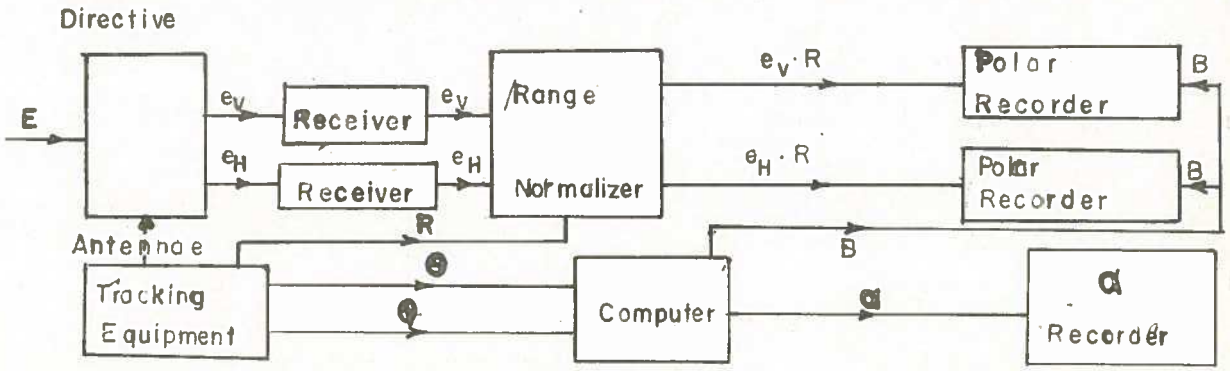
$J_n(x)$ = Bessel function

$Y_n(x)$ = Neumann function

Using the above equation, it is possible to calculate the horizontal patterns of vertical slotted-cylinder antennas. This was done for various values of the ratio D/λ. For small values of D/λ, the pattern is omni-directional, and as D increases, the pattern tends toward a cardioid. Actual measurements have borne out the theoretical conclusions. This formula can also be used to calculate the patterns of arrays of slots, provided the phase and amplitude characteristics are known. Patterns for two slots, located at opposite ends of a diameter, and fed equally and in phase, were also given for various values of D/λ. In general this combination gave a more nearly circular pattern than did the single slot radiator.

The equations evolved for the calculation of the horizontal pattern of vertical slotted-cylinder antennas provides a means of controlling these patterns theoretically, and is therefore useful in designing antennas for FM and Television.

(d) A System for Measurement of VHF Aircraft Antenna Patterns in Flight - J.S. Pritchard, Airborne Instruments Laboratory.



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The above is a block diagram of an air to ground system which is capable of automatically plotting the absolute pattern of both the horizontally and vertically polarized radiation from an aircraft in flight. An automatic tracking radar system is used to provide information and to orient the directive receiving antenna. During measurements, the aircraft describes level-flight straight-line paths, making possible the recording of the patterns in the plane described by the flight path and the ground receiving station. The range normalizer automatically corrects for changes in distance between the receiver and the aircraft during flight.

A complete description was given of all the component parts, and also a discussion on the limitations and errors of the system. The external errors are due chiefly to the difficulty in obtaining the exact bearing of the aircraft, propagation anomalies, and transmitter fluctuations. The main internal errors are due to the recorders, and the speaker admitted that the overall accuracy of the system is only about 25%, which corresponds to about 5% of full scale. This, coupled with the complexity of the recording system and the high cost of flying aircraft for pattern measurements, renders the value of the system rather doubtful.

(e) Factors Influencing Choice of Transmission Frequencies for Line of Sight Systems. - L.S. Schwartz, Naval Research Laboratory.

The main factors confronting one in the choice of a transmission frequency are:

1. Reliability
2. Coverage
3. Traffic Capacity
4. Range and Height
5. Interference

As an example, the speaker chose an interrogator beacon system for anaylis. A study was made of the electromagnetic spectrum properties to determine how these factors were influenced by frequency, and on the basis of this study it is possible to select the frequency band for which the characteristics of the propagation path, antenna pattern, and receiver sensitivity are such as to provide the optimum design of a good interrogator beacon.

IV MILITARY APPLICATIONS OF ELECTRONICS

(a) The Role of Electronics in Guided Missile Research - Walter N. Brown, Jr., Haller, Raymond, and Brown.

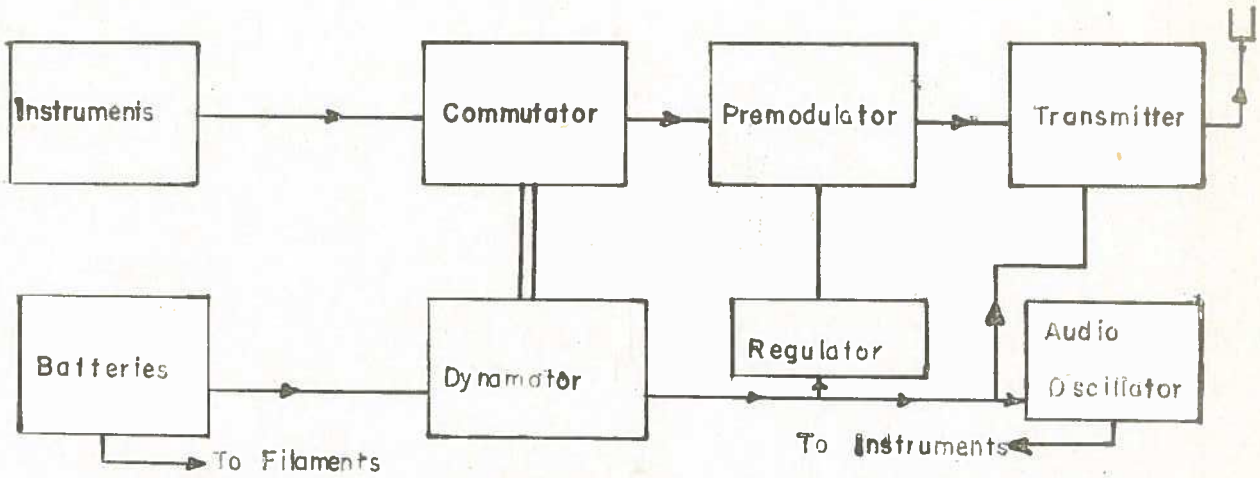
During World War II, many of the guided missiles were developed by

specialists in the design of aircraft or bombs, with the result that desirable electronic features were not sufficiently integrated with the design of the guidance system. Steering missiles while in flight involves aerodynamic problems which are not yet well known, and this sets a limit on the manoeuverability. For successful operation, the missile must be more manoeuverable than the target.

Three methods for guiding the missile to its target were outlined. The first was called a constant bearing angle course in which the trajectory is a straight line, the bearing of which is determined by the velocities of the target and missile and the original distance and bearing between the two. The second method is known as the Chaser or Pursuit course, and in this case the path of the missile continuously varies so that it always aims at the target until contact is made. A third system, known as the Proportional Navigation course, is a combination of the first and second methods. The chaser course gave the best results, but required the most manoeuverability.

The speaker also discussed the limitations on long range missiles, which are due mainly to the fact that sky reflected waves do not give accurate information as to distance and direction of transmission. Present day electronic techniques are still not capable of solving the problem of striking a small target several thousand miles away.

(b) A Telemetry System for Guided Missiles - Walter Hausz, General Electric Co.



Block Diagram

Essentially, the system is comprised of a mechanical commutator which samples each of 28 channels 35 times per second, and the information is transformed to pulse width modulation. This is transmitted to the ground

station where the display on a cathode ray tube permits photographic recording on 35 mm. film.

(c) German Microwave and Component Developments - B.L. Griffing, Air Material Command.

Among the microwave oscillators developed by the Germans were such items as magnetrons of the inter-digited type, tunable klystrons covering bands from 1 to 5 cms., and velocity-modulated tubes using one cavity only, the bunching taking place in the presence of the electro-magnetic field.

The metal ceramic tubes developed by Telefunken have become an important item of development in this country. Companies in this country are now rapidly adopting this technique, and soon these ceramic seals will be available for experimental laboratories.

Another notable achievement was the development of a focusing cathode by Dr. Heil. Some of his latest experiments in these cathodes gave a concentration of 200:1, when the area of the cathode is compared to the area of the beam.

The image storage tube is a unique German development, in which an image can be retained in the form of electric charges on a mosaic screen for as long as three weeks. At any time during this period the image can be viewed by illuminating the mosaic and focusing the photo electrons on a fluorescent screen.

V. TELEVISION

(a) The Chromoscope - A New Color - Television Viewing Tube - A.B. Brownwell, Northwestern University.

This tube contains a single electron gun and a composite image screen. The image screen contains three screens, each of which is coated with a different color phosphor, corresponding to the three primary colors. These screens are optically superimposed, but separated a short distance apart and electrically insulated from each other. By controlling the potentials on the screens, any one of the screens can be made to fluoresce. The screen potentials can be electronically commuted at so as to obtain any desired color sequence, and it is possible to change color at the end of every line instead of at the end of a frame, thereby eliminating color break-up in the received image.

(b) Color in Television Cathode Ray Tubes - Edith B. Fehr, General Electric Co.

This paper was mainly a discussion on the physical and psychological factors which should be considered in the selection of a desirable color. For black and white systems, a bluish-white color, corresponding to the color of a black body radiator at 6500° K, represents the best compromise.

(c) New Television Field Pick-up Equipment - John Roe, Radio Corporation of America.

A complete review was presented on the development of pick-up tubes with greater sensitivity, which culminated in the image orthicon. The first image othicons could operate in the field even on cloudy days, but they had a limited range of lighting over which the tubes would operate. A photographer's flash bulb going off would cause it to cease functioning until certain potentials were applied to the electrodes. New orthicons have a much wider range of lighting, but these tubes are very difficult to manufacture, the shrinkage figure being around 90%.

M. Katchky.