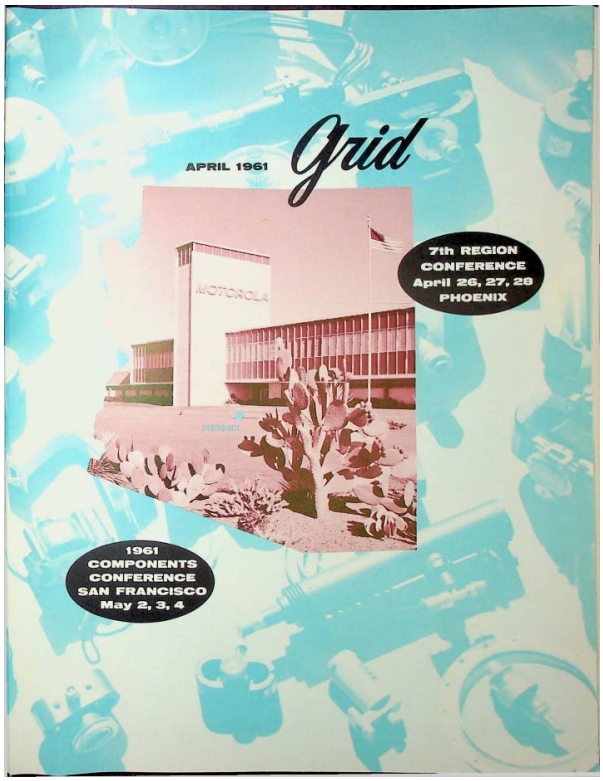
EDITOR'S PROFILE of this issue

from a historical perspective …

with Paul Wesling, SF Bay Area Council GRID editor (2004-2014)

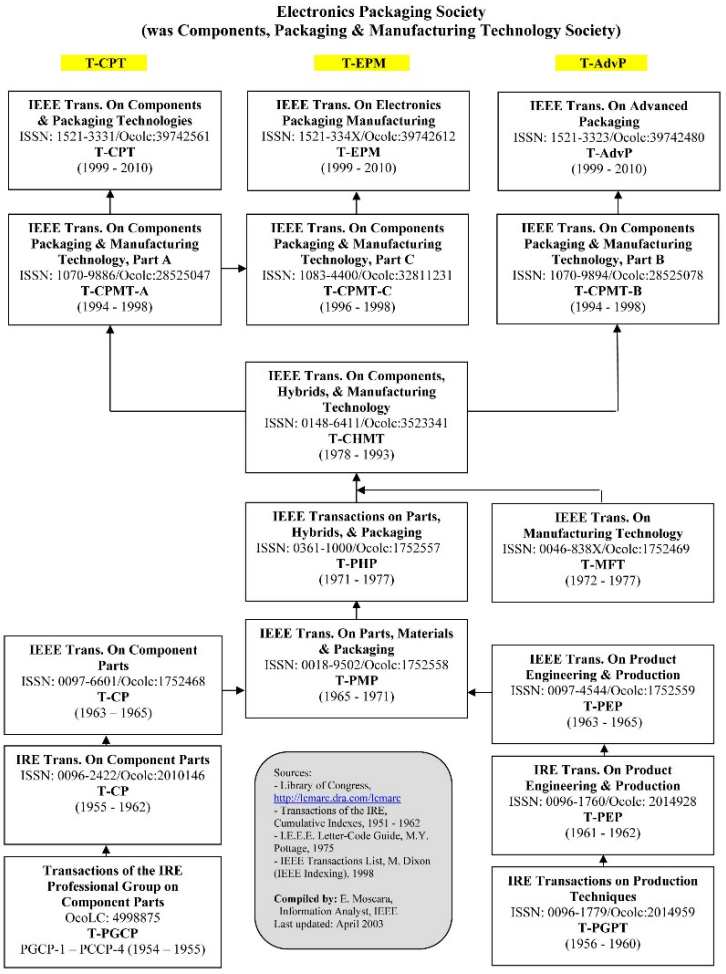


APRIL, 1961:

Cover: Several conferences are arriving on the West Coast, as noted on the cover. One of them (lower-left) is the Electronic Components Conference –being held in San Francisco. Sponsors include the AIEE and the IRE. This year's program starts on page 12. William (Bill) Shockley, Nobel laureate for his Bell Labs invention of the transistor, is a keynote speaker. Full registration is $23. This conference started in 1950; the IRE's **Transactions on Component Parts** grew out of this conference, starting in 1954. This became the journal of the Electronics Packaging Society (of which I was vice president for 22 years), as shown in the diagram below.

p. 14: We're used to seeing "The Dish" on the hills behind the Stanford campus, next to 280 – but at one time it was new. The IRE Group on Military Electronics set up an after-work drive up to the Stanford Research Institute (SRI) radar dish, to inspect the site and installation. It was used as a space research tool, especially for the nature of our sun, and also to communicate with deep-space probes.

p. 18: The IRE Group on Engineering Management heard more about the founders of Melcor, an early self-funded startup (1956). Two founders are of special note. C. Lester Hogan, at Bell Labs under Shockley, invented the microwave gyrator, and later become president of Fairchild Semiconductor. Jack Melchor went on to become a venture capitalist (ROLM, 3-Com) and chair of the SF Section of IEEE. At this meeting, entitled "The Technical Entrepreneur", Jack discusses how startups are formed, what is the best timing, and how to attract key technologists.



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APRIL 1961

Grid

7th REGION CONFERENCE
April 26, 27, 28
PHOENIX

1961 COMPONENTS CONFERENCE
SAN FRANCISCO
May 2, 3, 4

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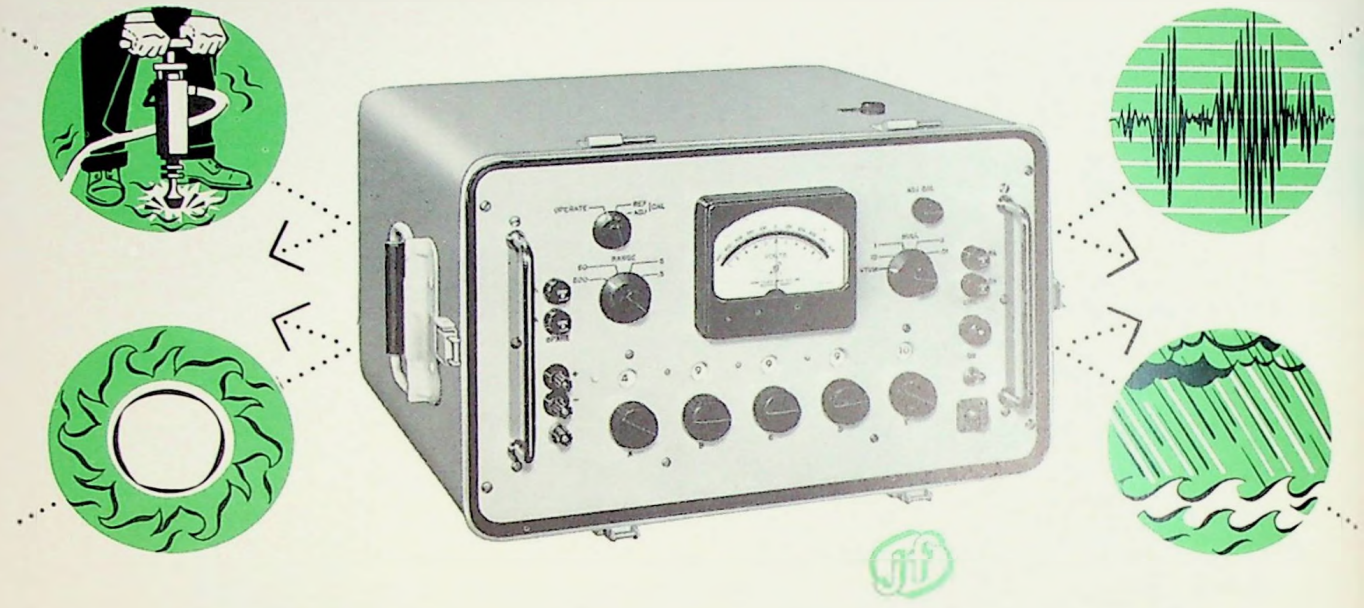

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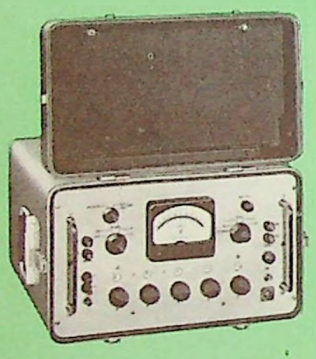

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volume 7
number 8

Grid

April 1961

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cover

Two events of technical interest concern us in the period immediately ahead: first in terms of time, the Seventh Region Technical Conference and Electronic Exhibits in Phoenix, Arizona, April 26, 27, and 28; second, the 1961 Electronic Components Conference at the Jack Tar Hotel in San Francisco, May 2, 3, and 4.

Local color for each appears on our cover, the background photo having been provided by courtesy of Litton Industries, electron tube division. Further details on the affairs including the complete program with abstracts of the latter will be found on succeeding pages.

remarks from the chairs

FOR WHOM THE R-F I'S

Peter F. Spencer

Radio interference problems are not new, indeed they have existed since the early days of radio when crystal sets were the latest thing. As receiver designs improved, we learned to employ such techniques as highly selective tuning, frequency conversion, squelch circuits and, in f-m limiter circuits, all of these developments helped to lessen the adverse effect of interference in communications equipment. As the population density of electronic equipment increased, the problems created by rfi grew right along with it. In fact, as the number of electronic equipments which are susceptible to rfi increased, radio interference became a misnomer. Radar systems, computers, autopilots, guidance systems, telemetry, and other electronic devices became prey to radio interference. The term was then changed to radio-frequency interference, which is a more apt term. As with many other technical problems of a specialized nature, a whole new field of endeavor has evolved to combat rfi.

This work has received much encouragement and impetus from the military services. Their interest was spurred on by many experiences during World War II that demonstrated all too dramatically the seriousness of the problem as a threat to successful military missions. Naval vessels forced to repair the damages of naval engagements were in danger of revealing their position to the enemy by the use of electric hand tools and electric welding equipment. Communications nets and radar systems were rendered ineffective by jamming techniques and, in some cases, by unintentional interference generated by such devices as d-c motors, universal series wound a-c motors, adding machines, calculators, radar sets, ignition systems on vehicles, and a host of others.

Thus, the nature of rfi problems had undergone a metamorphosis; no longer was this a casual nuisance to communications; it had become a serious threat to our electronic society. It was obvious that something must be done to correct the problem. The military services and FCC began to tighten the requirements on electronic equipments. A whole new series of rfi specifications were issued in order to standardize methods of measurement, instrumentation, and other factors influencing repeatability and accuracy of measurements.

In addition, the limits of rfi, both conducted and radiated, were reduced. The frequency range was extended, new requirements and measurement techniques were included. The new limits were so low that shielded rooms with high-performance line filters were needed to assure low ambient levels. The new requirements, coupled with the ever-increasing trend toward miniaturization of equipment, quickly illustrated the folly of pursuing circuit and packaging designs with no regard to interference requirements.

So important is the consideration of rfi in the initial stages of design, some late specifications require subcontractors to submit to the procuring agency a rfi control plan. This document is to outline proposed steps for overall control and reduction of rfi as equipments progress through design, prototype, and production stages.

In order to cope adequately with all these developments, engineers have had to re-educate themselves in this highly specialized field. Toward this end, we have, of late, seen many articles dealing with rfi problems in the trade journals. Professional societies and independent groups have formed committees to investigate rfi problems and to generate, accumulate, and disseminate information on this subject. PGRFI is one of these groups, but, of course, operates under the auspices of IRE. This position has obvious advantages. Through the Proceedings, we can reach most of the people interested in rfi. We can participate in the IRE Show and WESCON and regional conferences; in addition, we can conduct national symposia specifically dedicated to rfi problems. In this work we feel that PGRFI is making a profound contribution to the advancement of electronic science and toward that end, we pledge our greatest effort.

Peter F. Spencer

—PETER F. SPENCER, CHAIRMAN, PGRFI

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SPACE ELECTRONICS & TELEMETRY
Robert D. Baker, Granger Associates

INSTITUTIONS

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MEETING CALENDAR

SAN FRANCISCO SECTION

8:00 P.M. • Friday, April 21

(Joint meeting with Student Chapter)
"Computer Design from the User Standpoint"
Speaker: Dr. Walter F. Bauer, manager of information systems department, Ramo-Wooldridge, Los Angeles
Place: Officers' Club, Naval Postgraduate School, Monterey, Calif.
Dinner: 7:00 P.M. (Social Hour 6:00 P.M.), Officers' Club
Ladies welcome

EAST BAY SUBSECTION

• Monday, April 24

Talks and tour of Air Route Traffic Control Center, Fremont
Reservations: June Edwards, HI 7-1100, Ext. 84203

PROFESSIONAL GROUPS

Antennas & Propagation

8:00 P.M. • **Wednesday, May 10**

"Application of Log-Periodic Antennas to High-Frequency Communication"
Speaker: Dr. Ray Justice, Granger Associates
Place: The Red Shack, 4085 El Camino Way, Palo Alto
Dinner: 6:30 P.M. (Social Hour 6:00 P.M.), The Red Shack
Reservations: Odette Moore, DA 6-6200, Ext. 2414, by noon May 10

Antennas & Propagation

8:00 P.M. • **Wednesday, June 7**

"Interactions of a Plasma with Microwaves—Some Recent Experiments"
Speaker: Prof. R. S. Elliot, U.C.L.A.
Place: Room 101, Physics Lecture Hall, Stanford University
Dinner: 6:30 P.M. (Social Hour 6:00 P.M.), The Red Shack, 4085 El Camino Way, Palo Alto
Reservations: Odette Moore, DA 6-6200, Ext. 2414, by noon June 7

Bio-Medical Electronics

8:00 P.M. • **Wednesday, April 19**

"The Biological Effects of Air Ions"
Speakers: Paul Andriese and Sadao Kotaka, department of bacteriology, University of California
Place: Room M-112, Medical School Building, Palo Alto-Stanford University Medical Center. Room M-112 is located in the courtyard of the wing in the Center nearest Hoover Tower. Approach from Palm Drive on Stanford Campus, the extension of University Ave., Palo Alto
Dinner: 6:00 P.M., Red Cottage Restaurant, 1706 El Camino Real, Menlo Park
Reservations: Ken Gardiner, DA 6-6200, Ext. 2659

Circuit Theory

8:00 P.M. • **Wednesday, May 3**

"Synthesis of Passive Networks for Networks Active at P_0"
Speaker: R. W. Newcomb, Stanford University
Place: Lockheed Auditorium, 3251 Hanover Street, Palo Alto

RFI takes on impressive characteristics at the GE power tube department, Palo Alto. King-sized filter, possibly world's largest, will absorb harmonic and spurious signals in high-power microwave radar application. More familiar proportions are displayed by GE secretary, Judy Lamb, top

WESCON at work. John Granger, Granger Associates, convention director, addresses a working meeting of WESCON committee chairmen. Others, recognizable, Secretary Jeanne Howard and, foreground, with water glasses, Glenn A. Walters, vice chairman, cocktail party committee

MEETING CALENDAR

Electronic Computers 8:00 P.M. • Tuesday, April 25
"Philosophy and Practice of Display Systems, both Military and Commercial"
Speaker: Robert C. Schneider, advanced systems division, IBM
Place: Lockheed Auditorium, 3251 Hanover Street, Palo Alto
Dinner: 6:00 P.M., The Red Shack, 4085 El Camino Way, Palo Alto
Reservations: None required

Instrumentation 8:00 P.M. • Thursday, May 18
Annual meeting and field trip
"Innovations in Test Instrumentation"
"Speaker: Clay Rasmussen, manager, instrumentation section, Lenkurt
Place: Lenkurt Electric Co., 1105 Old County Road, San Carlos
Dinner: 6:30 P.M., The Gold Platter, 1000 El Camino Real, San Carlos
Reservations: DA 1-7751

Military Electronics 8:30 P.M. • Wednesday, May 3
Plant tour: 6:00 P.M. (Meet at the intersection of Junipero Serra Blvd. and Frenchman's Road. Frenchman's Road is approximately ¾ mile northwest of Page Mill Road. Auto caravan will leave from this point)
"Stanford Research Institute's Radar as a Space Research Tool"
Speaker: George Parks, Stanford Research Institute
Dinner: Immediately following tour and inspection of Stanford Research Institute's giant radar facilities, The Red Shack, 4083 El Camino Way, Palo Alto
Reservations: DA 6-7053 by 5:00 P.M., May 1

Product Engineering & Production 8:00 P.M. • Wednesday, April 19
(Joint meeting with PGRQC)
"Semiconductor Reliability, Project Virtue"
Speaker: W. P. Cole, Lansdale Tube Division, Philco Corp.
Place: Room 101, Physics Lecture Hall, Stanford University
Dinner: 6:00 P.M., Woodlands Restaurant, Stanford Shopping Center
Reservations: M. Muca, YO 8-6211, Ext. 2282, by noon, April 18

Reliability & Quality Control 8:00 P.M. • Wednesday, April 19
(Joint meeting with PGPEP, see above)

CHRONOLOGICAL RECAP

April 19—Bio-Medical Electronics, Product Engineering & Production/Reliability & Quality Control
April 21—San Francisco Section/Student Chapter
April 24—East Bay Subsection
April 25—Electronic Computers
May 3—Circuit Theory, Military Electronics
May 10—Antennas & Propagation
May 18—Instrumentation
June 7—Antennas & Propagation

New word in space electronics is "unfurlability." This refers to erection of items like this 8-ft log-periodic antenna held by Emmanuel Blasi from tiny package shown by technician Lenny Gutierrez, both of Lockheed missiles and space division. Pressuring function is derived from familiar New Year's Eve party favor known to the trade as a "blowout"

professional groups

NUCLEAR SCIENCE

According to an item gleaned from the Newsletter for the Professional Group on Nuclear Science, the San Francisco area is now being polled to determine the extent of interest toward a chapter of PGNS. If you are interested and have not been contacted, it might be well to get word to the Section Office in Palo Alto.

wescon news

INDUSTRIAL DESIGN COMPETITION

Deadlines have been established for the Third Annual Industrial Design Award Competition to be held in connection with the 1961 Western Electronic Show and Convention at San Francisco's Cow Palace next August 22 to 25.

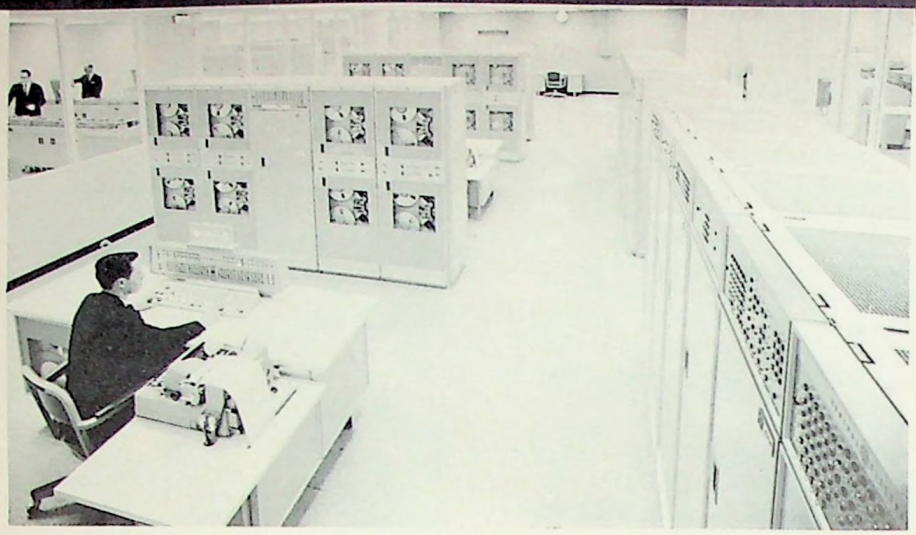
Carl J. Clement, Jr., of Hewlett-Packard Co., chairman of the Industrial Design activity, has announced a closing time of midnight on Friday, May 12, for posting entries to be judged for inclusion in the show.

Clement and his committee have asked for photographs of components, instruments, systems, and other electronic products which show evidence of original industrial design effort.

Submissions must be products of WESCON exhibitors, members of the Western Electronic Manufacturers Association, or companies exhibiting in booths of authorized representatives.

Still other conditions of acceptance are: products in the competition must

(Continued on page 10)



ERMA's new home is General Electric Phoenix facility, on the field-trip schedule at the Seventh Region Conference

Universial automatic pilot developed for the Army by Sperry Phoenix Co. gets prototype testing in typical Arizona scenery. Six-hundred-pound load swinging beneath Army H21 helicopter provides forces attempting to "upset" control equipment

George T. Royden

phoenix 1961

7TH REGION CONFERENCE

The annual Conference and Electronics Exhibit of the IRE 7th Region will be held in Phoenix, Arizona, April 26, 27, and 28. Conference and exhibit headquarters will be the Westward Ho Hotel, 618 North Central Avenue. George T. Royden, IRE Fellow, is Conference Chairman.

The technical program will concentrate on two major themes: "Problems Associated With Increased Use of the Electromagnetic Spectrum," and "Electronic Process Control and Instrumentation." Program chairman is Dr. H. William Welch, Jr., director of research and development for the Motorola military electronics division. Eleven separate technical sessions will be devoted to the presentation of selected papers on these two subjects.

Topics to be covered under the first category include spectrum management, new problems in frequency interference, interference analysis techniques, and conservation and interferece elimination. In the field of process controls, control theory, magnetic logic, computer controls, process control instrumentation, and other topics will be covered. A total of nearly 40 technical papers will be presented.

Among the San Francisco Section members appearing on the program are C. Wesley Carnahan, Varian Associates, Seventh Region Director, who will present the introduction to the Conference at Session I; R. C. Dorf, M. C. Farren, and C. A. Phillips of the U. S. Naval Postgraduate School, Monterey; Dr. Edwin K. Van de Riet, Stanford Research Institute; Harold R. Jones, Eitel-McCullough, Inc.; William J. Fleig, Microwave Electronics Corp.; and Roy M. Tidwell, Sandia Corporation, Livermore; all of whom appear on the program as authors.

Over 300 electronic exhibits will present an outstanding display of commercial equipment, providing a unique opportunity for IRE members and guests to view latest advancements in this field. Both the exhibits and conference sessions will take place in the Westward Ho Hotel.

The Honorable Paul Fannin, governor of Arizona, will deliver the welcoming address at a luncheon planned for the opening day. Feature speaker for this

(Continued on page 12)

MORE WESCON

have been marketed prior to this May 12 and must not have received WESCON Industrial Design awards previously.

Clement explained that submitted photographs will be judged by a professional panel for inclusion in the show, whereupon production samples will be invited for display. Products not suited to space restrictions or transportation may be represented photographically.

A jury of judges, practicing industrial designers independent of the WESCON committee, will make selections on three criteria—visual clarity of function, ease and safety of operation, and appropriateness of appearance.

Awards of excellence will be made at the time of WESCON's opening, Clement said.

Clement has been joined by Jack Stringer of International Business Machines Corp., San Jose, vice chairman, and a group of other prominent industrial designers in the San Francisco Bay Area to plan and execute the Industrial Design show for WESCON.

Entry forms are available from the WESCON Business Office at 1435 South La Cienega Blvd., Los Angeles 35.

wescon news

DISTRIBUTOR-REP-MANUFACTURERS CONFERENCE

Enlarged space and increased activity figures in planning for the Distributor-Representative-Manufacturers Conference in association with the 1961 Western Electronic Show and Convention in San Francisco this August.

Elvin Feige, chairman, has announced location of the conference at the Jack Tar Hotel for Monday, August 21, and an all-day program starting with breakfast and concluding with a dinner.

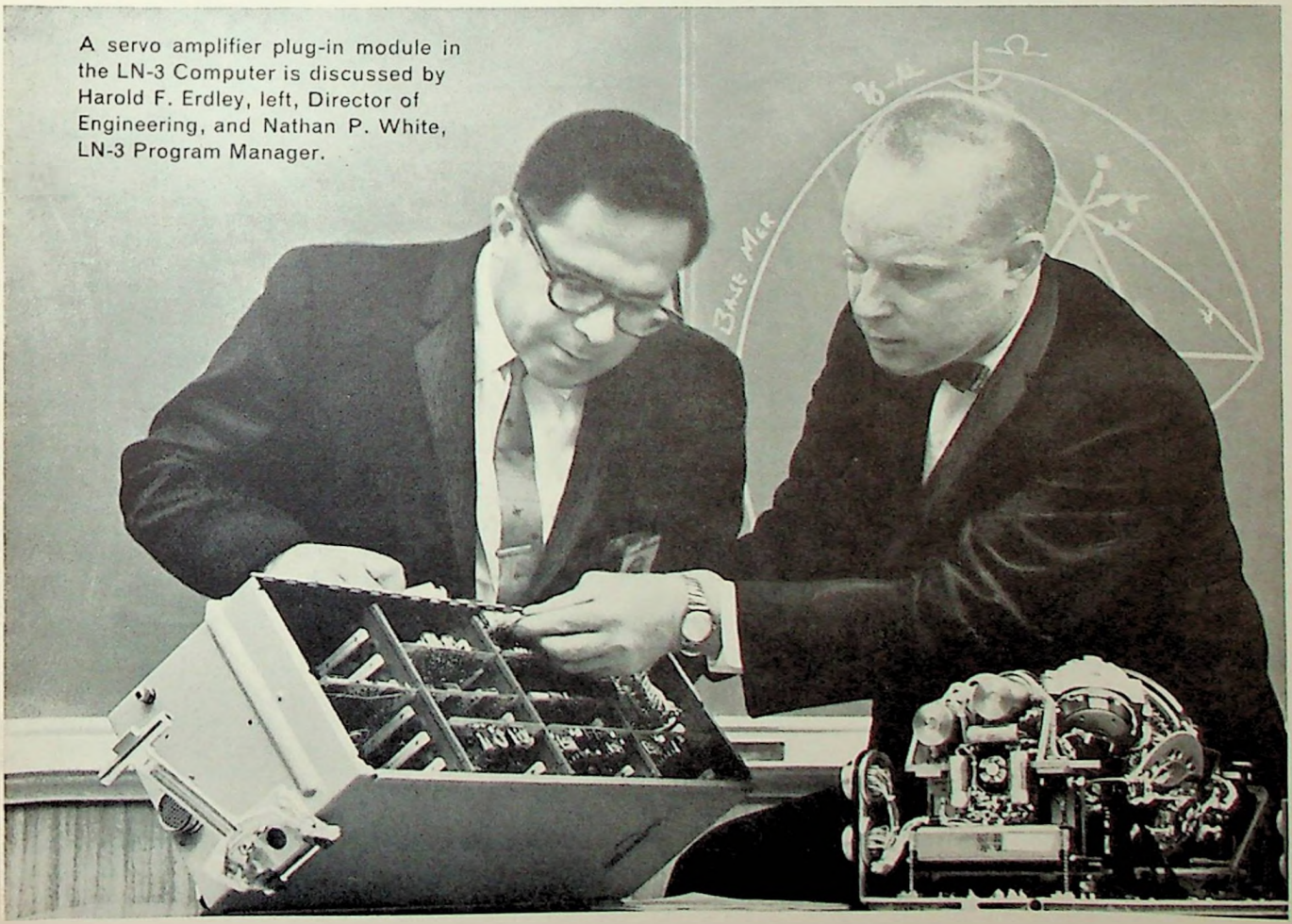
Morning and afternoon sessions will provide twenty 15-minute periods of table conferences for distributors to meet with manufacturers and their purchasing and sales agents.

INERTIAL ENGINEERING INGENUITY

The Litton LN-3 Inertial Navigation System is a system in being. Production orders for this system to be used in the F-104 are, to the best of our knowledge, larger in number than those for any other inertial guidance system. The LN-3, consisting of a two-gyro, four-gimbal platform, computer, adapter, and controls, weighs less than 80 pounds installed. Even smaller systems, designed for orbital and sub-orbital guidance, are in development. These will weigh less than half as much as systems now in production.

Do you have experience applicable to the integration of developmental inertial guidance and computer sub-systems into functioning prototype systems? Can you evaluate performance in such systems with a view toward increasing system capabilities even further? If so, contact Mr. Donald A. Krause of our Research and Engineering Staff regarding your interests. You can share in generous employee benefits, including stock purchase and tuition-paid education plans. Relocation assistance is provided.

LITTON SYSTEMS, INC.
GUIDANCE & CONTROL SYSTEMS DIVISION
Beverly Hills, California



A servo amplifier plug-in module in the LN-3 Computer is discussed by Harold F. Erdley, left, Director of Engineering, and Nathan P. White, LN-3 Program Manager.

Hugh C. Ross, Jennings Radio Mfg. Corp., general chairman, 1961 Electronic Components Conference

William F. Main, Lockheed missiles and space division, technical program chairman, 1961 Electronic Components Conference

electronic components conference 1961

BITS AND PIECES

Three themes and four sponsors stand behind the 1961 Electronic Components Conference running for the three days of May 2, 3, and 4 at the Jack Tar Hotel, San Francisco.

The three themes are: new components and their impact on engineering progress, new products and new requirements to meet the demands of our new engineering age, and new techniques which make new components possible. Sponsors are AIEE, EIA, WEMA, and IRE.

Heading the conference committee is General Chairman Hugh C. Ross, Jennings Radio Mfg. Corp., San Jose. He is assisted by William F. Main, Lockheed missiles and space division, technical program chairman; Carlton J. Daiss, Anaconda Wire and Cable Co., arrangements chairman; Berkley Baker, Litton Industries, publicity chairman; Roderick W. Neibaur, Jennings, finance chairman; and Don F. Hamm, Jennings, publications chairman.

Special events will include two featured luncheons with speakers Dr. William Shockley, Shockley Transistor Unit of Clevite Transistor Corp., speaking on "Basic and Applied Research in Component Development"; and C. W. Harris, Lockheed missiles and space division, speaking on, "Space Problems: Created or Solved by Components?"

Advance registration, the money-saving move, can be accomplished at the following rates: general registration, $7.00; luncheon May 2, $4.50; luncheon May 4, $4.50; Proceedings, $7.00; total, $23.00. Regular registration fees will be, in the same order, $9.00; $5.50; $5.50; and $9.00; total, $29.00.

PROGRAM

OPENING SESSION

Tuesday, May 2
9:00 A.M.

NEW COMPONENTS AND THEIR IMPACT ON OUR FUTURE

Keynote speaker: James Bridges, Director, Office of Electronics, Director of Defense, Pentagon

SESSION I
TRANSISTOR AND SOLID STATE DEVICES

Tuesday, May 2

10:00-12:00 A.M.

FAST RECOVERY FOUR-LAYER DIODES

K. Hubner, G. Weckler, and R. L. Biesele, Shockley Transistor, Mt. View, California

A new fast-recovery four-layer silicon diode has been developed as a switching device for application in radar pulse-modulator circuits for generating closely spaced pulses. Reduction in minimum interpulse periods for 200-volt devices from a range of 2 to 8 microseconds to a range of 0.8 to 1.0 microseconds has been achieved with devices from pilot production. Turn-on speeds have been reduced from 30 to 20 nanoseconds in typical circuits. The increased speeds have been achieved at the expense of a minor increase in forward voltage drop when the devices are in the "on" state. The devices are being evaluated currently for a major radar system.

TRANSISTOR OSCILLATOR SUPER REGULATED HIGH-VOLTAGE POWER SUPPLY FOR ACCURATE VOLTAGE SOURCE FOR RADIATION DETECTORS

Walter Nickel, G.E. Atomic Energy Division, San Jose, California

The design of a stable high-voltage supply is usually complicated by the temperature drift of solid-state components. Various parameters of the transistor, for instance, have been found which change significantly with temperature. The collector-to-emitter current with base open and the collecto-to-base current with emitter open both increase with temperature. The change of base-to-emitter voltage with temperature is also significant.

The use of high-gain feedback amplifiers is usually used to improve the condition, but temperature effects may still exist due to insufficient gain or reference-voltage drift.

This paper describes a circuit which eases the gain requirement and reduces reference-supply drift. The low-voltage section uses a series transistor to maintain the output voltage. This transistor is controlled by a two-transistor amplifier. High voltage is obtained in a conventional manner by operating two transistors as a magnetically coupled astable multivibrator. The output is filtered for both 120 cycle and the 1-kc-oscillator frequency components.

LUNCHEON

Tuesday, May 2
12:15-1:45 A.M.

BASIC AND APPLIED RESEARCH AND COMPONENT DEVELOPMENT

Dr. William Shockley, Shockley Transistor Unit of Clevite Transistor Corp., Mountain View, California—Nobel Prize winner for transistors

(Continued on page 14)

MORE 7TH REGION

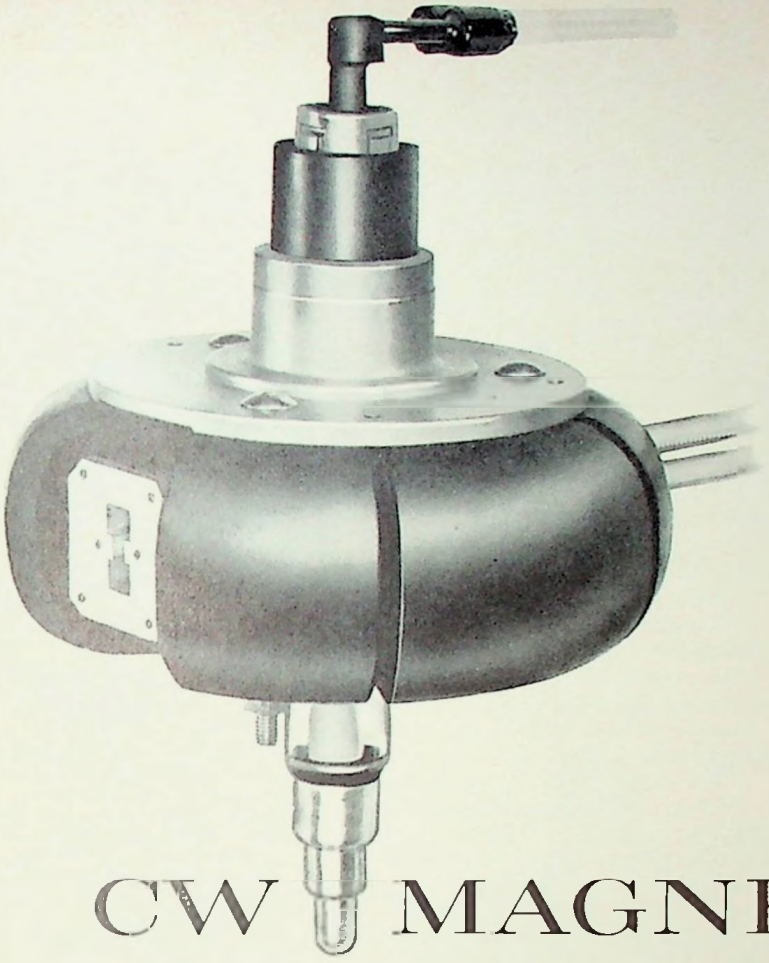
April 26 luncheon will be Dr. E. Finley Carter, president of the Stanford Research Institute. At the President's Luncheon, on April 27, Dr. Lloyd V. Berkner, IRE president, member of the space science board of the National Academy of Science and president of the Graduate Research Center, Inc., Dallas, Texas, will deliver the principal address. Berkner was for many years president of Asociated Universities Inc., directing the work of the Brookhaven National Laboratory.

A number of social activities are planned, including a western-style party and barbecue to be held Thursday evening, April 27. All IRE members and their ladies are invited to attend. Transportation will be available to and from the Westward Ho headquarters.

For the wives of attendees, a style show and luncheon at the famous Mountain Shadows resort in Scottsdale, a guided tour of Frank Lloyd Wright's Taliesin West, as well as a tour of nearby beautiful homes and other interest spots, is planned.

A field trip is planned for Friday afternoon, April 28, leaving the Westward Ho by bus for a tour through the Computer facility of the General Electric Company and the Deer Valley plant of Sperry-Phoenix.

Concurrent with the Conference and Exhibit, the board of directors of the IRE will convene in Phoenix on the 28th of April, the only board meeting scheduled to take place outside New York during 1961. Also scheduled for this period is a meeting of the national IRE executive committee, the WESCON board of directors, the 7th Region Committee, and the 7th Region education committee. For further information contact the Conference chairman at 912 West Linger Lane, Phoenix, Arizona.



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The dependability and versatility of Litton CW magnetrons has been time-proved by the many thousands in field service. There are undoubtedly long years of operation ahead in new military and commercial applications.

These Litton CW magnetrons are mechanically-tuned and liquid-cooled. We also manufacture CW magnetrons with versatile hydraulic tuning and, at lower powers, can supply them with forced air cooling.

Litton CW magnetrons are being applied in a pulse width modulated navigation system. Pulse rate, amplitude and frequency modulation techniques make possible other communication applications. This family also offers many advantages in such CW applications as RF drivers, industrial processing and component testing. They can be pulsed to approximately 2 KW peak power at a .25 duty cycle, a desirable attribute in component testing.

Investigation of these magnetrons and Litton pulse magnetrons, the international standards of excellence, may lead you to new applications. If we have stimulated your thinking a little, we *would* like to hear from you. Write to: 960 Industrial Road, San Carlos, California.

CW MAGNETRONS

Type Number	Frequency Range Megacycles	Minimum Power Watts
L-3456	350-590	500
L-3459	590-975	500
L-3465	975-1500	400
L-3464	1500-2350	400
L-3460	2350-3575	500
L-3461	3575-4975	400
L-3467	4975-6175	400
L-3468	6175-7275	300
L-3462	7275-8775	300
L-3463	8775-10,475	250

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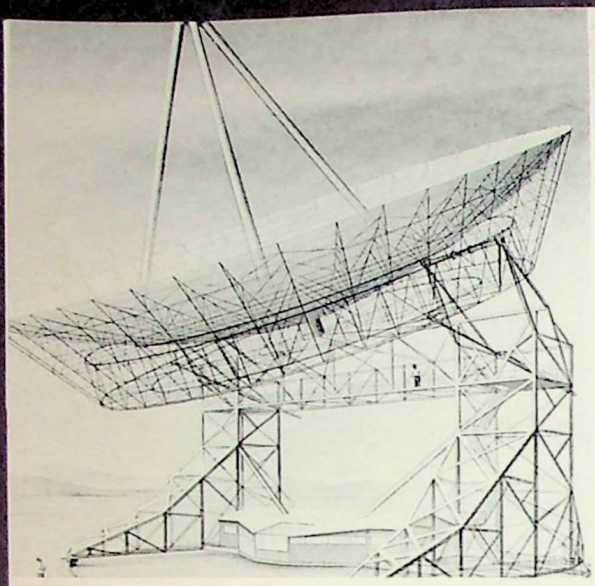

Big dish to be viewed by PGMIL tourists is a project sponsored by ARDC and DASA

meeting ahead

BE A DISH WATCHER

Early in May (see Calendar, page 9, for details), PGMIL will have a meeting with a somewhat unusual format. Members and guests will meet at 6:00 sharp at the intersection of Junipero Serra Blvd. and Frenchman's Road in Palo Alto. (Frenchman's Road is approximately ¾ mile northwest of Page Mill Road.) An auto caravan will leave this point on the first leg of a combination field trip and technical meeting covering the Stanford Research Institute radar as a space research tool.

This first leg will be an inspection of the installation site for the big dish on the hillside behind the Stanford campus.

Following this, the group will travel to the Red Shack Restaurant where the meeting and technical discussion will start at 8:30 p.m., following dinner.

meeting ahead

TIME FOR A SWITCH

Early in May (see the Calendar, page 8 for detail), the newly developed Professional Group Chapter on Circuit Theory will meet to consider, "The Synthesis of Passive Networks for Networks Active at P_0," a presentation by R. W. Newcomb of Stanford University.

R. W. Newcomb

In designing some kinds of switching circuits it is desirable to know the smallest transition time obtainable in going from one stable state of an active device to another such state. The determination of this switching time in terms of the concept "active at P_0" will be reviewed.

The synthesis of passive networks in which the active device must be embedded to obtain the desired switching time will be outlined. Several examples will be treated to illustrate the theory.

meeting ahead

VIRTUE: ITS OWN REWARD?

Mid-April will find PGRQC meeting at Stanford to hear W. P. Cole tell about Philco's Project Virtue—a transistor-reliability program. Cole is project manager in the Philco Lansdale tube division. Details of the meeting are in the Calendar, page 9.

The paper describes Philco's semiconductor reliability program which covers surveillance of semiconductor quality and reliability from the initial design stage to final release of the finished product. It includes liaison with the user for information on field performance, verification and analysis of failures occurring in the field or during in-plant life and environmental testing, and the initiation of corrective measures where indicated. Life-test procedures for characterization of new devices will be described. The facilities for in-process quality control and final evaluation will be reviewed.

An important part of Project Virtue is the use of reliable life-test equipment so that test results will not be obscured by either operator or circuit-induced failures. The Project Virtue life-test and parameter-test facilities will be described.

employment

WHO'S WANTED

Engineering management people are second in demand among all types of business executives, according to a survey made by Executive Manpower Corp. of New York. Questionnaires were received from 178 companies averaging sales of $11.5 million a year, but including only seven categorized as electronic. Of the companies, 32.7 per cent needed sales executives, 23.3 needed engineering executives, and 15.8 per cent needed manufacturing or production executives.

MORE ECC PROGRAM

SESSION II
PROGRESS IN COMPONENT RELIABILITY

Tuesday, May 2
2:00-5:00 P.M.

IMPACT OF THE DARNELL REPORT ON NEW SPECIFICATIONS FOR ELECTRONIC PARTS
Wm. H. von Alven, ARINC Research Corporation, Washington 6, D. C.

This paper reviews the impact of the Darnell Report on new specifications for electronic parts. Specifically, the accomplishments of the past year are reviewed, with particular emphasis on the emerging specification philosophies for guaranteeing high levels of reliability for several of the more prominent classes of electronic parts. Management techniques and contracting practices which are evolving to assure the procurement and use of high-quality parts in new system designs are also examined.

ON THE RELIABILITY OF SOLID TANTALUM CAPACITORS
G. H. Diginger, Jr., Technical Director, Kemet Co., Union Carbide Corp., Cleveland, Ohio

The solid electrolytic tantalum capacitor, properly made and applied, is a reliable electronic component. Long term tests made upon capacitors manufactured within the past three years (1957 to 1960) have shown mean times to catastrophic failure of more than five million hours when used as rated. This corresponds to a failure rate of a little below 0.02% per 1,000 hours, if exponentiality be assumed.

More recent tests, made under accelerated conditions of different harshness, have shown reasonable correlation with the long term data. In addition, an acceptable approximation to the ordered failure distribution has been found, graphically. It is, therefore, possible to obtain worthwhile information from properly run tests of small samples.

The way in which mean life varies with temperature and voltage has been charted. This permits the use of acceleration factors of 1,000 or more with reasonable confidence. It also allows the prediction of the improvement in reliability which will result from derating the capacitors.

NON-DESTRUCTIVE TESTING OF ELECTRONIC PARTS
G. G. Brown and K. Green, U.S. Testing Company, Hoboken, New Jersey.

If we are to achieve the levels of equipment reliability required for our missile and satellite programs, we must make more extensive utilization of 100 per cent non-destructive testing. This paper discusses design of screening methods from the standpoint of the ideal circumstances and situations where time and/or funds are limited.

AN APPROACH TO LIFE PREDICTION OF HIGH-VOLTAGE COMPONENTS
John P. Agrios, U.S. Army Signal Research & Development Laboratory, Ft. Monmouth, N. J.

Premature breakdown of insulations under high-voltage stress has been traced many times to ionization of voids within the component. To combat such failures, several methods have been used over the years to determine the safe limits and approve the installation of such components in electronic equipment. Dielectric strength and corona testing have been the most popular means for achieving these goals. However, it has been determined that these methods do not necessarily provide data for long and reliable life for such components. A study has recently been completed on the life characteristics of radio-frequency and pulse cable under high-voltage conditions at frequencies from 60 cps to 100 kc and at tem-

(Continued on page 16)

High selectivity, unique convenience, extreme accuracy

hp 302A Wave Analyzer

easily convertible to a sweep oscillator-tuned voltmeter with this hp AC-97C Sweep Drive!

No calibration or stabilization is required with the hp 302A Wave Analyzer, a completely transistorized instrument which represents significant improvement in design. Operating as a highly selective tuned voltmeter, the instrument provides a front panel control which selects the frequency to be measured. Voltage then is read directly on the front panel meter. Basically, Model 302A separates an input signal into individual components so that each—the fundamental, harmonics and any intermodulation products—may be evaluated separately.

With the AC-97C Sweep Drive, the hp 302A is converted to a sweep oscillator-tuned voltmeter for automatic frequency response measurements, even in noisy systems. The AC-97C motor accessory permits sweeping the entire frequency range of the 302A, 20 cps to 50 KC; provides fast sweep for covering the spectrum rapidly, slow sweep for high resolution plot. The Sweep Drive with an X-Y recorder permits automatic plots of harmonics or intermodulation products. Model AC-97C attaches to the 302A panel, or may be bench mounted on an adjustable stand.

SPECIFICATIONS

hp 302A Wave Analyzer

Frequency Range:	20 cps to 50 KC
Frequency Calibration:	Linear graduation 1 division/10 cps. Accuracy ± (1% + 5 cps)
Voltage Range:	30 μv to 300 v, full scale, 15 ranges
Warm-up Time:	None
Voltage Accuracy:	± 5% of full scale
Residual Modulation Products & Hum Voltage:	Greater than 75 db down
IF Rejection:	Intermediate frequency in input signal rejected by at least 75 db down
Selectivity:	± 3½ cycle b.w. — at least 3 db down ± 25 cycle b.w. — at least 50 db down ± 70 cycle b.w. — at least 80 db down Beyond ± 70 cycle b.w. — at least 80 db down
Input Impedance:	Determined by setting of input attenuator: 100,000 ohms on 4 most sensitive ranges, 1 megohm on other ranges.
Dimensions:	20¾" x 12½" x 14½" (cabinet), 19" x 10½" x 13½" (rack mount)
Weight:	43 lbs. (cabinet), 35 lbs. (rack mount)
Price:	hp 302A (cabinet), $1,800.00 hp 302AR (rack mount), $1,785.00

hp AC-97C Sweep Drive

Sweep Range:	50 revolutions
Sweep Limits:	Any interval from 50 revolutions to 5 degrees
Sweep Speed with hp 302A:	170 cps/sec and 17 cps/sec
Mount:	Front panel of hp 302A or bench stand, adjustable, 4" to 12"
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Dr. C. P. Yu, second from left, spoke before the PGI early in February on phase measurement. Paper was reviewed in the March issue —James Hussey photo

meeting review

AREA VS DENSITY VS STRIPE

Members and guests of the PGA and AES together attended a most interesting and informative evening meeting in February at the studios of W. A. Palmer Films, Inc., San Francisco. The host, W. A. Palmer, spoke on the subject, "Advancements in Optical Sound Recording."

Palmer introduced his listeners to the principles and techniques of the two basic optical sound-recording methods used in the film industry—the variable-area optical recording method in which a light beam of constant intensity is modulated in position, and the variable-density method in which a light beam of constant position is modulated in intensity. He then proceeded to discuss thoroughly the physical bases by which each system is limited in frequency response, distortion, signal-to-noise ratio, and signal overload.

In general, frequency response and distortion in both systems are limited in a matter of degree for a given film speed, to the size and resolution of the modulating light beam, the method of exposing the film to the light beam, the response or reaction of the film emulsion to the light (i.e.: contrast, size of grain etc.) and the exposure and developing techniques used in film reproduction.

Both methods of optical sound recording have, in the past, employed six, four, and two tracks. The trend in the film industry is now towards the use of dual bilateral variable-area sound tracks. Good sound reproduction for this method, employing a negative-positive film system includes, among other requirements, sharp contrast between light and dark portions of the exposed film. Therefore, careful film exposure is necessary.

Palmer's electroprinting process, successfully used for a number of years, involves the exposure of a positive film which can then be developed and used in the projector directly. In the exposure process, a specially constructed mask, inserted between the light source and modulating mirror, controls the rate of modulation of the light admitted to the film. The electroprinting process results both in improved signal-to-noise ratio and lowered distortion in sound reproduction.

A practical figure of signal-to-noise for the variable-area recording system is about 40 db as opposed to about 25-30 db for the variable-density system. However, the frequency bandwidth of the variable-density system is generally somewhat larger than that of the variable-area system. The upper frequency cutoff of optical sound recording for most 35-mm movie film is about 7500-8000 cps.

Palmer indicated that magnetic-stripe sound tracks on film have been used occasionally both for stereo and for single-channel movie recordings but that the cost of magnetic sound tracks as yet outweighs its technical superiority over optical sound recording. He also pointed out that while stereo sound reproduction was quite easily adaptable to present-day optical sound recording equipment, the motion picture industry has not been impressed by the results of attempts to impart stereophonic effects to large audiences.

Palmer concluded the evening by presenting a demonstration of an excellent optical sound recording excerpt from a film production and by conducting the audience on a tour of his varied and extensive audio facilities.

—S. OLESON

MORE ECC PROGRAM

peratures from –17C to 80C. A method has been developed to measure the number of discharges emanating from such cables and to establish the correlation between such discharges and the life of the cables. It is intended to present this work to serve as a basis for life prediction of other components under high-voltage stresses.

DEPARTMENT OF DEFENSE COMPONENT RESEARCH AND DEVELOPMENT PROGRAMS FOR LONG-LIFE PARTS, AND COMPARISON WITH RECENT EUROPEAN DEVELOPMENT

F. E. Wenger, Headquarters ARDC, Washington

(Abstract on page 35)

DERATING PHILOSOPHY OF MINUTEMAN TRANSISTORS

J. W. Tarzwell and G. K. Cullers, Autonetics, Downey, California.

Conventional systems requiring certain reliability levels normally approach the problem of component derating by specifying component type, failure rate, definition of failure, operating point, and verification tests to the component manufacturer. The manufacturer, therefore, is left with no degree of freedom to meet the requirements. Because of the extremely low failure rate requirements for transistors in the Minuteman system, the parts manufacturer was given more freedom at the beginning of the program.

Autonetics specified to the transistor manufacturer only the transistor prototype and the reliability goal. The manufacturer was then requested to recommend the approach to achieve the goal by specifying: 1) the operating point, 2) the parameter degradation to be expected at this operating point, and 3) a test program to verify these estimates. Autonetics prepared two types of specifications to implement the recommendations by the manufacturer. The first specification is the internal document intended for use by the design engineer. This document contains the recommended and absolute maximum operating points and the parameter degradation to be expected at these points. The document also contains failure rate curves, application information and failure mode information. The second type of specification is the procurement document which is used for the delivery of parts. This document contains tests to evaluate the ability of the parts to meet the parameter degradation specified by the manufacturer and the reliability goal specified by Autonetics.

SESSION III

HIGH VOLTAGE COMPONENTS

Wednesday, May 3

9:00 A.M.-12 Noon

MODERN MATERIALS IN HIGH-VOLTAGE PULSE TRANSFORMERS

C. Marshall Loring, Carad Corporation, Palo Alto, California

The requirements of various typical high-voltage pulse transformers are discussed with emphasis on the demands placed on transformer materials by each application. A brief review of transformer design principles is given in order to clarify the effect of material parameters on transformer performance. Examples of several transformer structures will be used.

Typical past practices utilizing such materials as kraft paper insulation and sicilon steel cores will be discussed and performance limitations imposed by available materials pointed out.

Modern dielectric materials permit improved electrical and mechanical performance as will be discussed. The use of cast, laminated, and film forms of various modern dielectrics will be illustrated.

Magnetic materials have been constantly improved both in their performance and their economy. The significance and relative costs of

(Continued on page 18)

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Robert D. Culbertson, speaker, and Dr. Joseph F. Hull, PGED chairman, as seen at the January PGED meeting

meeting review

MASSING UP THE VACUUM

A powerful tool for tube processing was the subject of Robert D. Culbertson's PGED talk on January 25 at Stanford. This tool, the mass spectrometer in a compact, convenient form, has been used by Culbertson and his associates at Eimac in the testing and processing of very-high-power klystrons. It permits the pressures of the gases within tubes to be measured to about 5×10^{-10} mm Hg, and identifies them by their mass number to within one mass unit.

Before describing in detail tests made on the Eimac BMEWS tube, Culbertson gave a brief discussion of the three major types of mass spectrometers used for similar purposes. These are the common crossed-field type, the cyclotron type, and the linear r-f type. The first or common crossed electric and magnetic field spectrograph was the type used at Eimac. This type was chosen because very simple auxiliary equipment is required. Two units made by Consolidated Electrodynamics were used in six basic functions. A relatively large console unit No. 21620 was used to inspect raw material and to monitor cleaning and processing of parts. A small portable unit (No. 21611, Diotron 5 in. by 1½ in.) mounted directly on the tube was used for determining vacuum-system efficiency, evaluating exhoust procedures and residual gas behavior on exhaust, and life behavior during operation and on the shelf.

The processing and operating history of an Eimac X-626 BMEWS tube was described. This is a large klystron giving 1¼ megawatts peak power at 75 kw average power. As processing begins, many gases are observed with peaks at hydrogen, water, and a number of organic gases. During cathode conversion, hydrogen remains relatively constant, CO_2 rises to a peak and diminishes rapidly after conversion. CO rises and remains relatively high. When the beam is about to be turned on, we have high concentrations of H_2 and CO with very little CO_2 or CH_4. The beam is found to be an effective pump when turned on. A titanium getter is now heated to 1600 C. and we find a sharp increase in hydrogen and a decrease in CO. With the getter off, the hydrogen is reabsorbed. The tube is now pinched.

Subsequent history was obtained from the small Diotron attached directly to the tube. Turning on the filament increases CO, water remains about constant and CH_4 and CO_2 are decreasing. The pressure is about 10^{-7} in the tube. The getter is heated and H_2 increases and CO disappears. The getter is flashed and the hydrogen drops sharply. Next the beam is turned on and an increase in CO is observed. It is believed this results from the beam striking the walls of the tube and releasing CO.

During the next 25 hours operation, all partial pressures were observed to decrease slightly as the beam voltage was raised to 110 kv.

Over the next 400 hours, the pressure decreased further. Most pumping was observed to occur during the first 50 hours of operation. After 500 hours, slight amounts of CO, H_2O and H_2 could be observed. Total pressure within the tube was 3×10^{-9} mm Hg.

During subsequent operation, Argon was observed to increase slowly and become the dominant gas after about 200 hours. It was concluded that the tube had a small leak and was gettering all the gases except the Argon. The total leak rate was determined to be 10^{-12} atmospheres cc per second. At this rate, the tube would require 100 years to get down to the 10^{-5} scale. The pumping rate of the tube was found to be 0.6 liter per sec in operation.

Use of the mass spectrometer in this fashion provides sufficient information to answer almost all questions concerning residual gases in tubes. In the measurement sense, then, we have reached an end with regard to this problem.

A lively discussion followed this most interesting talk.

—R. BORGHI

meeting review

THE TECHNICAL ENTREPRENEUR

At a March PGEM meeting at Rickey's, Dr. Jack Melchor discussed his experiences as an entrepreneur. Thirty members and guests were given a frank, interesting history of Melabs and a clear view of the problems which beset the technical entrepreneur of today.

Melabs was incorporated in 1956, using savings of founders Lloyd Addleman, Wesley Ayres, Perry Vartanian, C. L. Hogan, and Jack Melchor. Their

(Continued on page 22)

MORE ECC PROGRAM

various materials such as the silicon steels, the nickel alloys, and the ferrites in high-voltage pulse-transformer applications will be discussed.

Performance improvements made possible through the use of modern materials as filling media in place of oil will be mentioned.

TESTING THE INSULATION IN ELECTRONIC COMPONENTS WITH HIGH-VOLTAGE DIRECT CURRENT

G. Leslie Hill, Hill Research Company, Oakland, California

A brief review is given of the simplified high voltage d-c method of testing and electrical insulation in large electrical apparatus in the power generating and utilization field.

Power engineers have had a method of forecasting and dielectric level of a particular insulation for several years without destroying it. This method broadly comprises rectifying increasing increments of high-voltage alternating current to high-voltage direct current: the high-voltage direct current is then impressed on the insulation under test, and by means of a high-voltage voltmeter and a microammeter, the voltage applied and the current passing through the insulation are indicated for each increasing increment of impressed voltage. Then plotting the measured values of conduction current through the insulation, or the calculated values of megohms of resistance, versus the measured values of applied d-c voltage in a suitable system of coordinates to indicate graphically the dielectric strength of insulation before puncture of the insulation.

It is shown how this method of hvdc testing may be applied to lower voltage electronic components such as plate and filament transformers, cable, coils, etc. Due to the lower voltage and relatively small currents obtained, a more sensitive instrumentation is necessary. The use of the oscilloscope is described as a more sensitive microammeter to detect very low d-c currents and the start of ionization in voids in the insulation.

DIELECTRIC TESTING AND HIGH-VOLTAGE TRANSFORMER PROTECTION IN ELECTRONIC CIRCUITS

W. Wahlgren, Electro Engineering Works, San Leandro, California

This paper will seek to deal with high-voltage and high-power transformers other than power rectifier units. Of particular concern are high-power wideband transformers as well as other units which are powered from electronic generator sources.

Due to the wide range of frequencies and wave shapes involved and in voltages up to 30 kv and higher, and because of the unusual voltage distribution within these transformers, the conventional concepts of testing as accepted in fixed power frequency transformers are being questioned as to propriety.

The assignment by AIEE to the author to develop a proposed standard for wideband high-power transformers has given rise to much study of this problem and the realization of the shortcomings of our present concepts and methods. Various proposals to improve our testing and protection techniques will be presented and discussed.

USE OF CAST EPOXY ELEMENTS IN COMPONENTS DESIGN FOR ISOLATION OF ULTRA-HIGH VOLTAGE

Joe Bianco, Components for Research, Palo Alto, California

Concurrent with the development of radar and communication equipment into regions of ever

(Continued on page 21)

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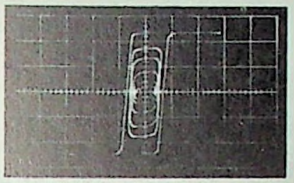
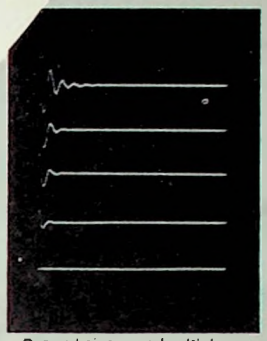
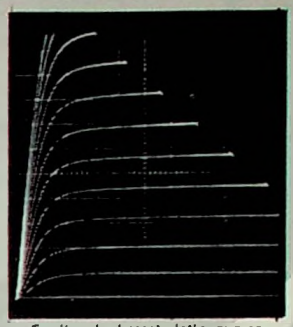


Typical hysteresis loops (multiple exposure of varying amplitudes).



Damped sine wave (multiple exposure using all 5 detent positions).



Family of characteristic curves (for NPN transistor).

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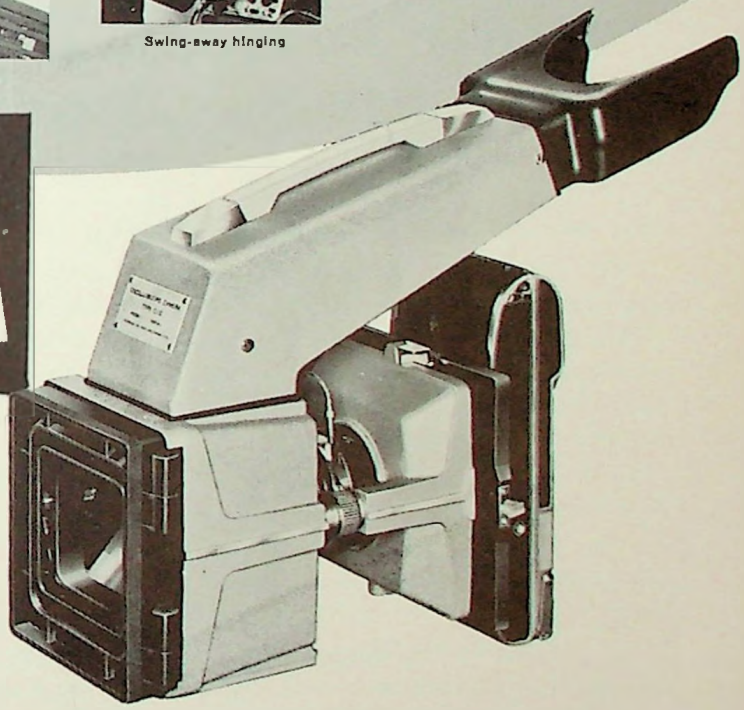

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increased powers, pressure is applied to the state of the art in the handling of voltages up into the 300 kv regious. Development of electron devices to power equipment of these kinds presents its own problems in ultra-high voltage management.

This paper discusses production and application experience encountered in the manufacture and application of cable terminations, feedthrough bushings, and standoff insulators for these services.

Comments are also included on the production of epoxy-encapsulated open-core transformers ranging from 15- to 6000-va with isolations up to 300 kv and a newly developed type of stand-off-encapsulated filament transformer which utilizes epoxy techniques to combine a high-voltage rectifier-filament transformer into a single package.

Extension of epoxy techniques into custom encapsulation and cross sectioning of electron tubes and similar delicate devices for design and production study will also be described.

ONE HUNDRED CYCLES PER SECOND HIGH-VOLTAGE VACUUM RELAY

Ron Tetz, Jennings Radio Manufacturing Corporation, San Jose, California

A spdt relay system was developed to fill the need for high-speed high-voltage switching in rapid data transmission. This high-speed system consists of a pulse power supply and a specially designed vacuum relay.

The vacuum relay adapts itself well for high-speed operation because of high dielectric strength and low mechanical travel. The short travel allows design of a mechanism that has low wear. The high dielectric strength lends itself to high voltage operation. Because of the vacuum, the contacts are free of contamination and maintain a maximum contact resistance of 5 to 10 milliohms. This assures high electrical reliability for the life of the relay. The relay was designed to give an operate time of less than 3 milliseconds and a release time of less than 5 milliseconds at voltages up to 10 kv and frequencies up to 300 mc.

In order to attain a speed of 3 milliseconds operate time, a pulse power supply was developed. The power supply consists of a capacitor discharged through the relay coil to get fast operation and a series dropping resistor to get low hold voltage. The relay is controlled by an electronic command pulse and silicon controlled rectifier or transistor cycling.

The low contact resistance, plus the short mechanical stroke, and high dielectric strength, give highly reliable high voltage relays from both the mechanical and electrical standpoint. This relay, with its electronic pulse power supply, gives a system capable of continuous operation at 100 cps. The lowest mechanical failure was at 12 million cycles with some relays operating as long as 200 million cycles.

This type of relay would probably have many applications beyond switching for high speed data transmission. Under consideration at present are teletype speed control and high-voltage rectification.

A FAST-ACTING FUSE FOR HIGH-VOLTAGE DIRECT CURRENT

L. H. Franklin, Franklin Engineering, Palo Alto, California

With the development of radar and similar devices it became apparent that a need existed for high-voltage d-c fuses to meet the short circuit protection requirements of electronic equipment in the multi-kilovolt range. Fuses to meet these requirements are now being produced.

To be effective, high-voltage d-c fuses must offer fast clearing under short-circuit conditions such as a flash-over, capacitor breakdown, insulation failure, or coble failure. Under these conditions the fuses must clear, disconnecting the faulted portion of the circuit from the rest of the circuitry. The energy to vaporize the fuse element must be low. In addition, the time required for the fuse to clear must be very small. Under high-overload conditions, this time can be as short as 1 microsecond.

If a high voltage d-c fuse (or any other fast positive-acting disconnect device) is used in a circuit containing a highly inductive element, such as a choke, such element and the circuit must be protected by a spark gap or other means of absorbing the energy stored in the inductive otherwse the stored energy will make itself apparent as a very-high-voltage inductive "kick."

It appears impossible to produce a fuse which is extremely fast and at the same time sensivtive to a small percentage of overload (say 100 to 500 per cent). Therefore, the fast d-c fuses will coordinate best for very-high overloads. However, under moderate overloads, it is possible, by use of auxiliary crowbar circuit between a fuse and its load, to introduce an extremely high surge current, overloading the fuses instantaneously, thereby disconnecting the faulted circuit from the power supply within a few microseconds.

The successful operation of these fuses depends upon several very important construction features and new concepts which are the subject of patent applications now in process.

SESSION IVa
MICROWAVE COMPONENTS

Wednesday, May 3

2:00-5:00 P.M.

A VACUUM COAXIAL RELAY FOR HIGH-SPEED, HIGH-POWER RF SWITCHING

T. N. Tilman and W. N. Lindsay, Jennings Radio Manufacturing Corporation, San Jose, California

Mechanical and electrical characteristics are given for a single-pole double-throw 3⅛-inch vacuum coaxial relay with a power-handling capacity of 20 kw c-w and 3-megawatt peak power at frequencies up to 600 mc. The voltage-standing-wave ratio is less than 1.08 over a frequency range of 200 to 600 mc. Insertion loss is 0.01 db maximum. Isolation of the open contact is better than 40 db down. The vacuum contacts, in the form of two shorting bars, are alternately closed and opened through bellows vacuum seals by pulse-actuated magnets. Bellows life is in excess of one million transfers. Relay transfer time is less than 10 milliseconds. The relay may be continuously transferred at repetition rates better than 30 transfers per second Reliable high-speed actuation is attained by resonating the moving masses with spring systems to provide internal energy storage. Actuator input power is only that required to overcome frictional losses and magnetically to hold the vacuum contacts in the open and closed positions. Auxiliary air-contacts provide two independent paths to indicate the attitude of the relay.

THE OUTPUT WINDOW—A CRITICAL ITEM IN HIGH-POWER MICROWAVE ELECTRON TUBES

Don Priest and Ruth Talcott, Eitel-McCullough, Inc., San Carlos, California

A survey of the various problems encountered with high-power windows is given, including on account of some new ones recently discovered. Techniques for dealing with them, including the choice of materials, are described. It is shown that with these techniques the r-f powers obtainable can be increased considerably beyond current practice.

(Continued on page 22)

Head table scene at the March PGEM meeting featuring Dr. J. L. Melchor, Melabs, right, speaker. Others are Dr. Bernard A. Wambsganss, Office of Naval Research; Mrs Wambsganns: and Thomas Morrin, SRI

MORE MELABS

first work was for Stanford, Sylvania, and Airtron and the first prime contract was obtained 11 months after incorporation. Since then, expansion has been steady and a product line developed. For the fiscal year ending in August 1960, sales were $2.9 million with earnings of $180,000 before taxes. Employees now total over 160.

What are the ingredients for success of a small technical business? Dr. Melchor presented the goals of the founders —to create, to generate economic security, to control one's destiny. All these coupled with a strong desire to succeed form the human side of the picture. Technically, the new business must fulfill a need; the staff must be competent and must know the methods of the industry.

For an enterprising group there is no wrong time to start a business. It's true that there have been optimum times for starting with certain specialties, but new companies grew in the 1930's (such as Eimac), in the 1950's, last year and there will be opportunities in the future.

In starting a small business, the technical area of coverage must be well-defined. Of course, it's better if you enter an area where business is expanding. Your product must be a better "mouse-trap" or you must be able to fill a need for services.

In government R&D work, the cost-plus-fixed-fee arrangement is more attractive than the fixed price contract. CPFF gives you a fee, enables you to support your R&D capability and provides special equipment necessary. When a new business fills a vacuum in the service field, its chances of success are great; however, service businesses have high failure rates during recessions. A third type of business is the one which develops new products and markets them. Outstanding examples of the latter are Hewlett-Packard and Varian.

Many unfamiliar problems are faced by a new technical entrepreneur, the most serious of these being caused by contracts. Government procurement regulations require extreme care in handling all matters regarding such contracts. Financial problems are continual, since banks and other members of the financial community must be depended upon for major support. Favorable employee relations are also important for a small company. Salaries must be good and fringe benefits must also be competitive with those of the industry. Each employee must be made aware of his potential. If he is a key man, he should be allowed to participate in the financial growth of the company.

In conclusion, Melchor emphasized that the business frontiers of today are similar to those of the forty-niners. Opportunities are still available for those who are willing to take the risk.

—LEONARD JEFFERS
AND PAUL JENSEN

meeting review

EXOSPHERIC SCATTER: NEW COMMUNICATIONS MODE?

Professor Von Eshleman of Stanford University presented the second lecture of the PGAP tutorial series on Plasma Physics on the topic of "Communication Potentiality of Exospheric Scatter," in mid-February.

Current interest in the scattering of radio waves from random distribution and fluctuation of electrons above the F-layer maximum stems from an original suggestion of W. E. Gordon of Cornell (1958) that such fluctuation might be detectable by a high power radar. Gordon predicted the total scattering cross section by adding the cross sections of individual electrons, and he estimated the spectral broadening of the incident signal by ascribing to the scattering elements the thermal velocity of individual electrons.

In the same year, Bowles of the

(Continued on page 26)

MORE ECC PROGRAM

SOLID-STATE MODULATORS AT MEGAWATT PULSE POWER LEVELS

Harry Heard, Radiation at Stanford, Palo Alto, California

PNPN two- and three-electrode solid-state thyratrons have been applied as switches in high-peak-power line-type modulators. Single three-electrode devices, having average current ratings of 50-200 amperes, have been found to yield highly satisfactory performance at megawatt pulse power levels with modulator efficiencies of 92-95 per cent.

Basic circuit design concepts that are peculiar to the application of solid-state thyratrons are presented. Included are factors such as repetition rate and pulse width and their relation to device holding current. Peak current, pulse width, and interpulse period are discussed in relation to junction fusion rating and device thermal fatigue. The importance of gate-electrode charge in relation to anode time delay and time jitter is also considered. Pulse fall time and device turn-off are discussed.

Alternate circuit arrangements for variable pulse width and high repetition rate are reviewed. The simplified design of a 250-kw peak, 5-kw average power pulser is presented.

MICROWAVE FILTERS USING GHOST-MODE RESONANCE

William A. Edson, Electromagnetic Technology Corporation, Stanford Industrial Park, Palo Alto, California

The term ghost-mode has been used by Jaynes, Forrer, and others to describe localized resonances associated with mechanical or dielectric discontinuities in an otherwise smooth waveguide. This effect, which is usually a nuisance, is here turned to advantage for designing compact and economical filters.

The basic resonance is localized at the gap between two posts extending through opposite walls of a cylindrical tube, which at the frequency of interest operates as a waveguide beyond cutoff. The fringing electric and magnetic fields decay rapidly and exponentially with distance, at a rate which is readily calculated.

A filter having characteristics similar to those of conventional coupled-cavity structures results when several adjacent ghost-mode resonances are coupled together by their fringing fields. A filter design method based on this approach is presented.

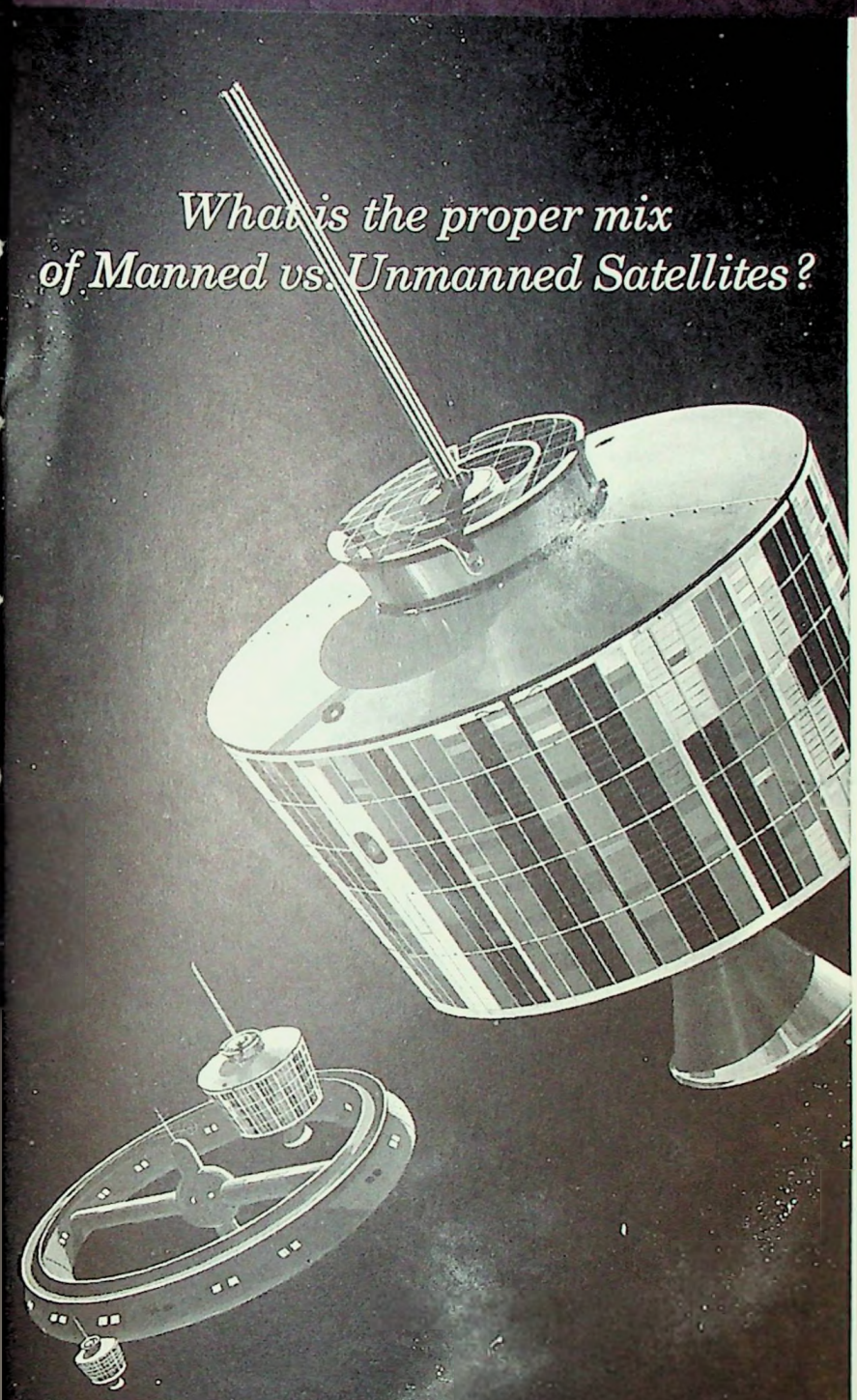
A MINIATURE-PACKAGE 2200-MC PARAMETRIC AMPLIFIER USING A VARACTOR-LOADED HELIX

C. Louis Cuccia, Radio Corporation of America, manager, West Coast Microwave Engineering Lab., Los Angeles, California

A miniature-package parametric amplifier of a new type, designed for operation in the 2200-mc frequency band, differs from conventional parametric amplifier circuits using resonant circuits and stubs and a single varactor, by its use of several varactors as periodic variable-capacitance loads of a helix. The input signal and pump signal are applied to the start of the helix. A pump signal having a frequency approximately 30 per cent higher than the input signal frequency is used, and harmonic generation of the pump signal is utilized within the parametric amplifier to provide for noise-figure reduction. The amplifier is operated as a four-terminal device with an insertion loss of approximately 30 db at input signal frequency provided between the input and output terminals when the pump is off. No circulator is required.

A parametric amplifier will be described which comprises a packaged structure included in a capsule one inch in diameter and five inches long, and weighing only five ounces. One form of this amplifier provides for a net input-terminal-to-output-terminal gain of 20 db with a noise figure of less than 5 db in the 2190-2210 mc

(Continued on page 26)



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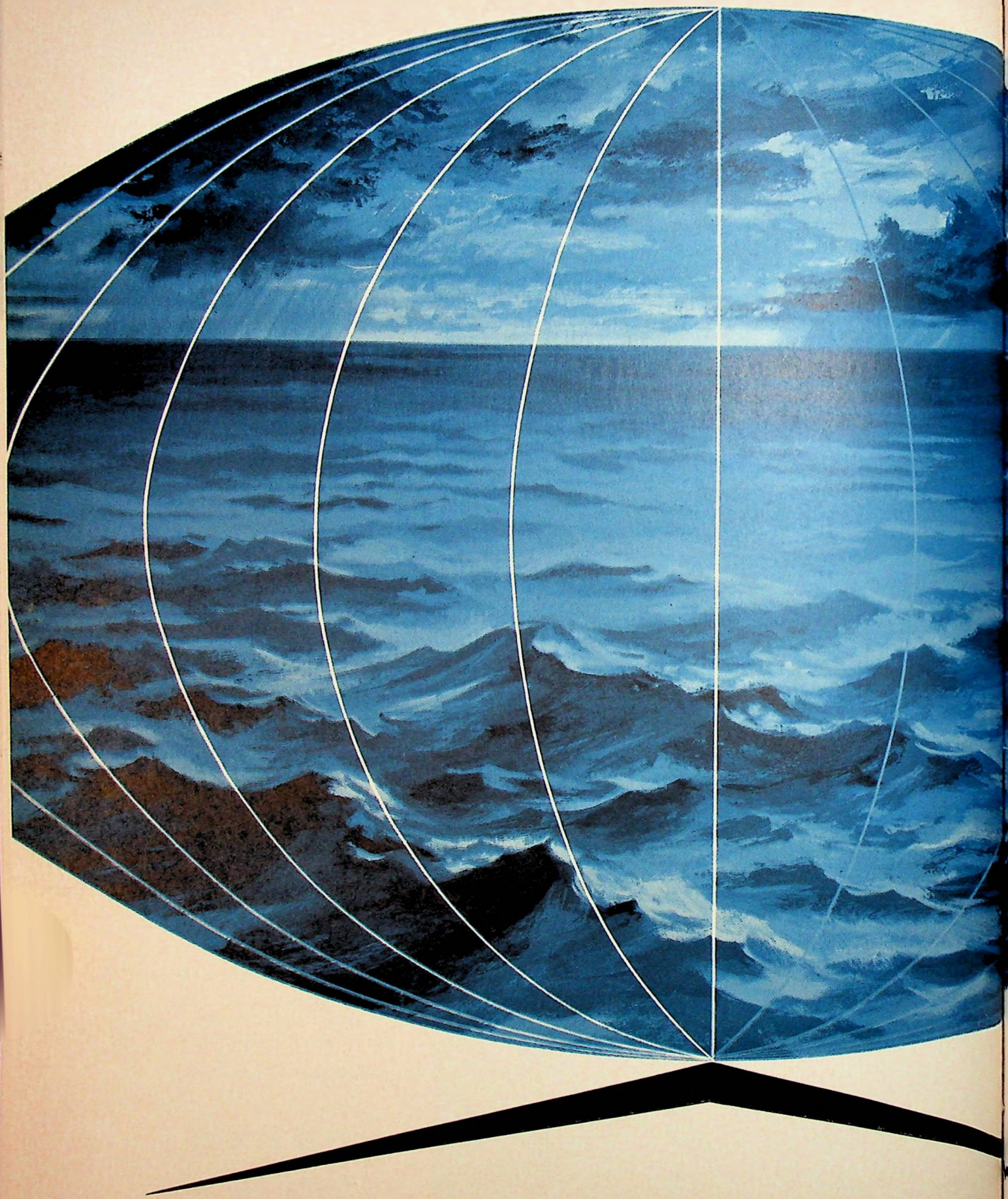

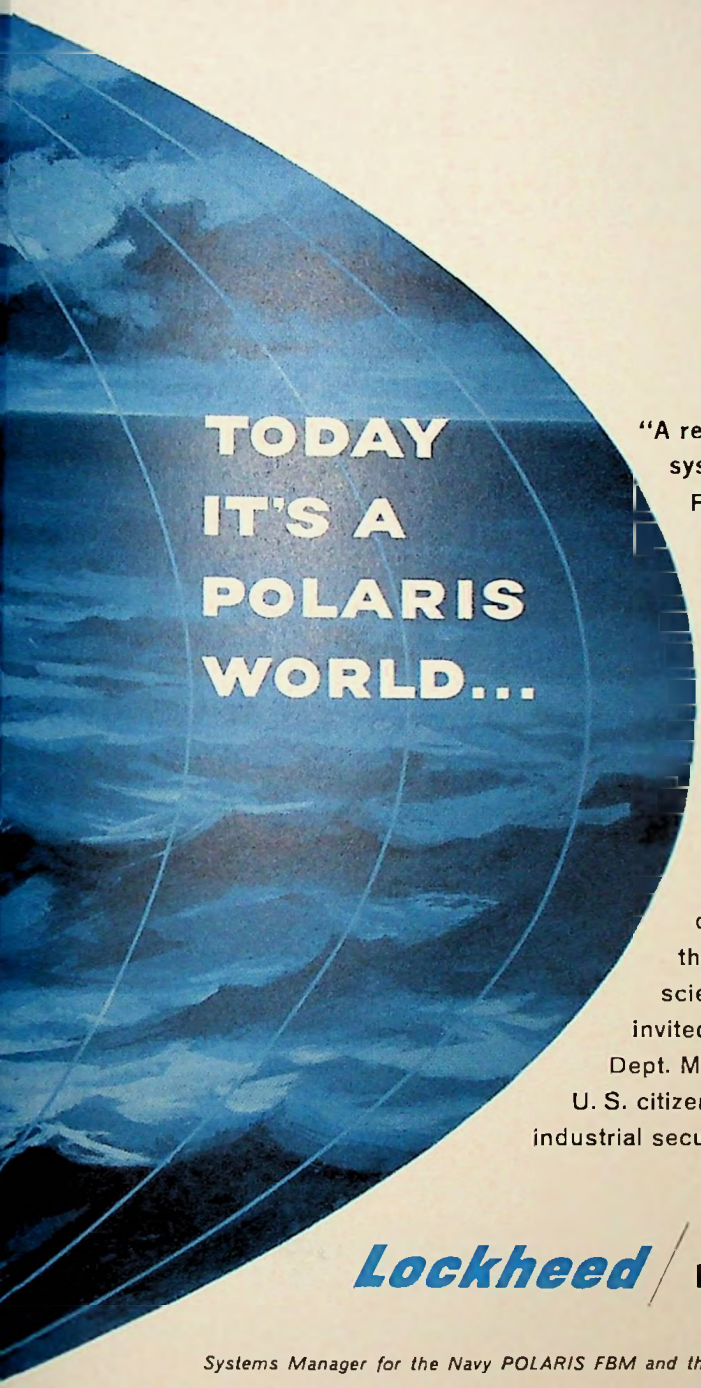

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Von R. Eshleman

MORE PLASMA

National Bureal of Standards observed this type of scattering using a one-megawatt 40-mc radar. While the total scattered power was the right order of magnitude, the spectral broadening was only of the order of 10 kc as compared with the predicted broadening of the order of 1 mc based on electron temperature of 2000 K in the F-layer. This narrow spectrum has been attributed to the interaction between the electrons and ions. Roughly stated, this interaction causes the spectral width to be that which would have resulted if the electrons had the mass of the ions and had been completely free to move.

A discussion of the analysis of T. Hagfros of Stanford for the spectral distribution based on a spatial Fourier analysis of electron density fluctuation for the plasma in thermal equilibrium was presented. The electromagnetic waves couple only to the Fourier component with the right direction and wavelength so that a selective scattering occurs.

In the presence of a magnetic field perpendicular to the direction of propagation, it appears that modulation of the spectrum due to ionic gyro-frequencies can be detected. From the frequency of the periodic components one may infer the mass of the gyrating ions, so that, in principle at least, a radar mass-spectrometer appears possible. To test this theory, Bowles is presently building, in Peru, a 50-mc, 6-megawatt radar with an antenna array of 2^{13} dipoles covering an area of 1000 x 1000 ft. Gordon is also building a 400-mc radar probe utilizing a 1000-ft dish in Puerto Rico.

The lecture was concluded with a consideration of the possible use of this scattering mode for communication. It appears that such scattering over oblique paths could be used as an important new mode for long-distance

(Continued on page 28)

MORE ECC PROGRAM

frequency band. Operating data demonstrating instantaneous bondwidth of up to 100 mc in this frequency range will also be discussed.

SESSION IVb
COMPONENTS, RESISTORS, CAPACITORS

Wednesday, May 3
2:00-5:00 P.M.

ANALYSIS AND SYNTHESIS WITH THE "COMPLETE" EQUIVALENT CIRCUIT FOR THE WIDE BAND TRANSFORMER

Thomas R. O'Meara, Hughes Aircraft Co., Los Angeles, California

One of the oldest lumped-parameter models for the transformer has been analyzed from the viewpoint of modern network theory. If the turns ratio of a transformer does not depart too greatly from unity, it is shown that many of the standard networks and design relations are greatly in error.

Some type of transformer-coupling networks may be represented at high frequencies by network models with only one (primary-secondary) capacitance and one leakage inductance, but most require at least three capacitances and one leakage inductance. General design relations, valid for any turns ratio, have been developed for a transformer with only primary-secondary shunt capacitance. It is shown how these reduce to the usual expressions for a small turns ratio.

If there exists appreciable primary and secondary shunt capacitance in addition to interwinding (primary-secondary) capacitance, then a three-pole, two-zero transfer characteristic is required to describe the transformer, and the analysis becomes more difficult. However, one may sometimes reduce the degree of the transfer function by designing for zero-pole cancellation. In any event, if a desired rational function transfer characteristic is available, one may generally (subject to turns-ratio limitations) match the transformer to the characteristic by the use of standard synthesis procedures.

A limited number of experimental checks have obtained good agreement between the theory and the data.

PROBLEMS IN THE DEVELOPMENT OF A 300 C CAPACITOR

E. C. Henry and A. V. Illyn, Electronics Laboratory, General Electric Co., Syracuse, New York

Development of a high-temperature ceramic capacitor was undertaken with a view to using a material having a dielectric constant higher than that of alumina. The objective was, in part, to permit some reduction in size. Limits on permissible temperature coefficient of capacitance and resistivity were set in advance.

Fourteen binary and twelve tenary compositions were synthesized by high-temperature solid-phase reactions of simple oxides or carbonates. In general, refractory oxides were chosen in order to prepare material that would be chemically stable at high temperatures. Chemicals of high purity were employed, to minimize the effects of impurities. In most instances, electrical properties improved with increasing density of the fired ceramic compact.

The compositions tested had dielectric constant values ranging from 11 to 350, higher than that of alumina which is approximately 9. Some of them had sufficiently high electrical resistivity at 300, 400, or 500 C, along with good dielectric constant, that their r-c products (megohm-microfarad values) exceeded those of alumina at these temperatures.

Part of this investigation was carried out under Contract No. NObs-77070, Bureau of Ships, Department of the Navy.

LOW FREQUENCY GYRATORS

C. P. Germano, D. R. Curran, Electronic Research Division Clevite Corporation, Cleveland, Ohio

Piezoelectric and piezomagnetic effects can be combined to form a linear passive antireciprocal four pole, resulting in the aggregate characteristics of a simple electromechanical band-pass filter cascaded with an ideal gyrator.

Electromechanical gyrators have been designed utilizing several modes of vibration to cover frequencies from 0.3 to 1000 kc. Bandwidths ranging from 1 to 3 per cent of center frequency have been realized with power-insertion losses of less than 2 db over most of this range.

Equivalent circuit elements are evaluated and design procedures discussed. Performance data presented includes input, transfer, and insertion-loss characteristics for typical units.

Because of their antireciprocal characteristic, gyrators can be combined with reciprocal networks to form isolators. Problems included in the realization of isolators using electro-mechanical gyrators are discussed and a low-loss narrow-band isolator is presented.

Performed under Contract AF 30(602)-2202, Rome Air Development Command, Griffis A.F.B.

THE SELECTION AND APPLICATION OF ELECTROMAGNETIC RELAYS FOR USE IN ELECTRONIC EQUIPMENT

J. A. Csepely, Electronics Division, Westinghouse Electric Corporation, Baltimore, Maryland

This paper presents the results of an extensive survey of the literature published during the past 30 years dealing with those features of electromagnetic relays which were deemed to be of the greatest importance and utility to an engineer engaged in the design of electronic equipment.

VITREOUS ENAMEL CAPACITOR DEVELOPMENT FOR HIGH RELIABILITY AND MILITARY APPLICATIONS

A. S. Takacs, Vitramon Inc., Bridgeport, Connecticut

Reliability of electronic components is often degraded by the drift of component-part parameters as a direct result of exposure to life-test conditions. Vitramon, Inc., embarked upon a program to develop a vitreous enamel dielectric that is impervious to the conditions of accelerated life tests.

The improper selection of raw material was found to be the cause of parameter drift. By incorporating proper modifications a capacitor was developed whose K did not vary with lift tests. The dissipation factor, insulation resistance, and Q of test units were, in fact, improved from pre-lift test values after having aged for 2000 hours at 125 C and 90 volts per mil. These same parts have completed 8000 hours of testing with no significant parametric change.

A seventy-two-hour lift test was developed which is comparable to 2000-hour life conditions.

SOLID ALUMINUM ANODE CAPACITORS, A NEW DEVELOPMENT IN ELECTROLYTIC CAPACITORS

Wolfgang Post, Singen Aluminum Works, Germany

SESSION V
MICROMINIATURIZATION, SPACE COMPONENTS AND RELATED DEVICES

Thursday, May 5

9:00 A.M.-12:00 Noon

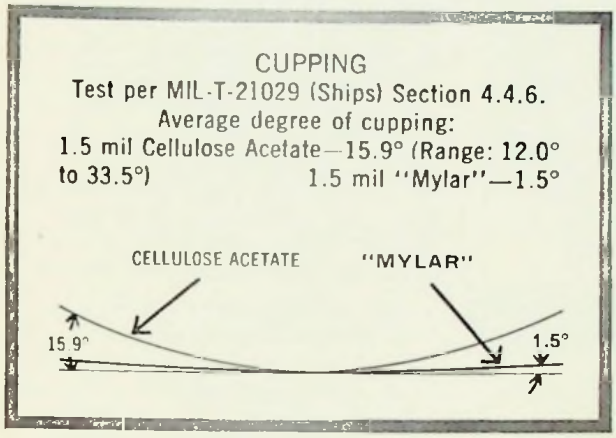
GAS MANIPULATION TECHNIQUES EMPLOYED IN MATERIALS AND COMPONENTS EVALUATION

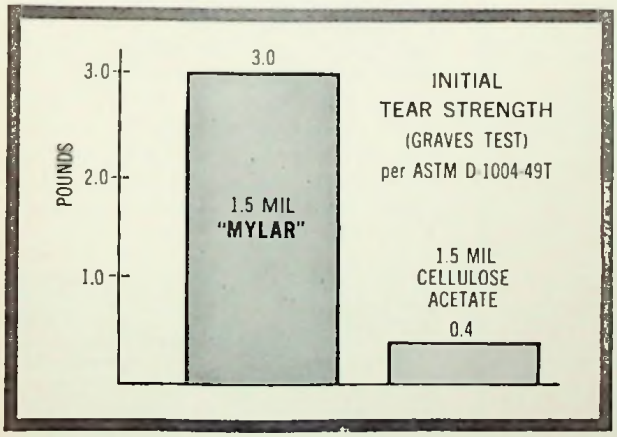
L. R. Yetter, I.B.M., Owego, New York

Ability to collect and analyze gases and vapors has proved to be useful in the investigation of

(Continued on page 29)

GUARD AGAINST SIGNAL DROPOUTS WITH RELIABLE TAPES OF MYLAR®





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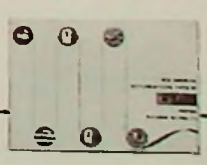

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communications in the vhf and uhf bands.

Dr. Eshleman was born in Darke County, Ohio, in 1924. He received his BEE degree from George Washington University and his MS and PhD degrees from Stanford University. In 1950-51 Eshleman was awarded an Atomic Energy Commission fellowship in the physical sciences. Since 1952 he has been with the electrical engineering department of Stanford University as a research associate, an assistant professor, and currently, as an associate professor. He has published about 30 technical papers in the fields of radio communication, upper atmospheric physics, and radar astronomy. Eshleman is a member of the IRE, URSI, Sigma Tau, Sigma Xi, the American Astronomical Society, the American Astronautical Society, the American Association for the Advancement of Science, and the American Geophysical Union. He is a Fellow of the Royal Astronomical Society.

—T. MORITA

meeting review

A DANGLING PARTICLE IN THE SKY

Don Williams of the Hughes Aircraft Company addressed a joint meeting of PGCS, PGMIL, and PGSET in February on a Synchronous Satellite Relay for Communications. The economy of launching and maintaining an orbiting communication system capable of relaying up to 600 two-wire telephone messages over transcontinental distances was capably discussed by Williams of the Airborne Systems Group.

The considerations necessary to establishing a synchronous orbit, with a period of 24 sidereal hours and the additional problems of establishing a sta-

(Continued on page 31)

Launching trajectories were discussed by Don Williams of Hughes at a February joint meeting of PGCS/PGMIL/PGSET

various electronic components and in the studies of materials being developed for future components. The evaluation of components requires that the component's atmosphere be sampled and analyzed during operational and environmental conditions to determine materials reaction products, particularly gaseous decomposition products. A number of gas extraction and transport systems also have been employed in materials-developmental programs.

To evaluate the components, gases are entrapped in controlled environment fixtures, both vacuum and inert atmospheres, in which the component can then be energized, heated, or ruptured for the purpose of investigation. The trapped gases are then analyzed for composition by mass spectrometric analysis.

Various vacuum extraction techniques have been employed to investigate residual gaseous contaminants in deposited metallic films. These techniques include static and dynamic degassing at temperatures up to 1000 C and vacuum fusion degassing at 2000 C, after which the quantities and composition of the gases are determined by mass spectrometer analyses. Results from the various degassing techniques may be interpreted to indicate modes by which the gases are occluded in the material, i.e., by physical sorption or by chemical reaction.

Gas analysis techniques also have been used in studying reaction processes, such as the formation of ferrites. Ferrite-forming processes have been investigated from rate-temperature studies of carbonate-oxide mixtures. Oxygen diffusion measurements have been made in studying the exchange mechanisms in ferrites, using enriched O^{18}.

THE SPACE ENVIRONMENT AND ITS EFFECTS ON MATERIALS AND COMPONENTS

S. N. Lehr and V. J. Tronolone, Space Technology Laboratories, Los Angeles, California

Space environments are considered in terms of temperature, high vacuum, micrometeorites, radiation, and other phenomena; with particular attention to the effects of such environments, insofar as they are known or conjectured, upon plastics, metals, both organic and inorganic materials, and upon electronic parts.

Information was compiled from a literature survey and from experience and is presented as an aid in the design and fabrication of electronic equipment for space vehicles. Data are presented concerning the behavior of materials in space, covering information not available in the usual engineering handbooks.

THE EFFECT OF STAGING ON THE PERFORMANCE OF THERMIONIC CONVERTERS

George N. Hatsopoulus, MIT, Cambridge, Mass.

Multistage thermionic converters are analyzed in detail. Both the case of infinite stages and that of finite stages is considered. It is found that staging of thermionic converters results in a considerable improvement of the overall efficiency of the system. In the case where large numbers of stages are used, an optimum work function exists for the electrodes. The optimum work function is strongly dependent on temperature. In the low temperature range, the optimum work function is far lower than the work functions of the presently available materials and therefore is not of practical significance. Comparison of a one-stage versus a two-stage converter, each operating between the same temperatures, indicates a 22-per-cent improvement of efficiency of the latter as compared to the former.

(Continued on page 30)

MORE ECC PROGRAM

PROGRAMMING USING DIGITAL TECHNIQUES, SOLID-STATE DEVICES, AND RESISTANCE WELDED CONNECTIONS

W. F. Shoop and A. J. Kaplan, Space Technology Laboratories, Los Angeles, California

Advanced solid-state digital circuitry applied to programming of missile and space-vehicle controls in a subminiaturized package using all resistance-welded connections is described.

One of the unique features of the circuit design is the unit's ability to retain the stored-count information during input voltage dropout periods up to 50 seconds in duration without affecting the predetermined sequencing profile. Radio-frequency interference is essentially eliminated due to the method employed in shielding the box and input leads. The unit has been designed to conform to typical environmental requirements for deep space probes.

Full advantage has been taken of the maximum density approach to packaging permitted by the low-heat resistance welding of interconnections. Ruggedness and protection of circuitry against space environments has been attained by careful choice of encapsulation for welded modules and interwiring matrices.

The paper is illustrated with results of tests conducted to establish the choice of circuitry, materials, and weld-process techniques. Examples of construction and final equipment are pictorially presented.

TANTALUM FILM CIRCUITS—PART I

C. J. Spector and W. H. Jackson, Bell Telephone Laboratories, Murray Hill, New Jersey

TANTALUM FILM CIRCUITS—PART II

W. H. Jackson and C. J. Spector, Bell Telephone Laboratories, Murray Hill, New Jersey

Integrated circuits utilizing tantalum thin films have been described previously. This system minimizes the number of critical material interfaces because both resistors and capacitors are produced from the same film. Also, a single process of anodizing is used to adjust resistors and to form the capacitor dielectric. An rcl film circuit has been constructed, by etching the tantalum film to define the circuit pattern, and its performance is the same as that of the circuit constructed with conventional components.

The stability of thin-tantalum-film capacitors and resistors makes it possible to realize precision circuitry. The development of this precision circuitry has imposed special problems of precision photography, masking, etching, and adjusting in order to take full advantage of the tantalum film system. The development of these techniques will be discussed.

LUNCHEON

Thursday, May 5
12:15-1:45 P.M.

SPACE PROBLEMS: CREATED OR SOLVED BY COMPONENTS?

C. W. Harris, Director of Quality Assurance & Test Services, Lockheed Missiles & Space Division, Lockheed Aircraft Corp.

SESSION VI
MICROMINIATURIZATION, SPACE COMPONENTS, MATERIAL AND RELATED DEVICES

Thursday, May 5
2:00-5:00 P.M.

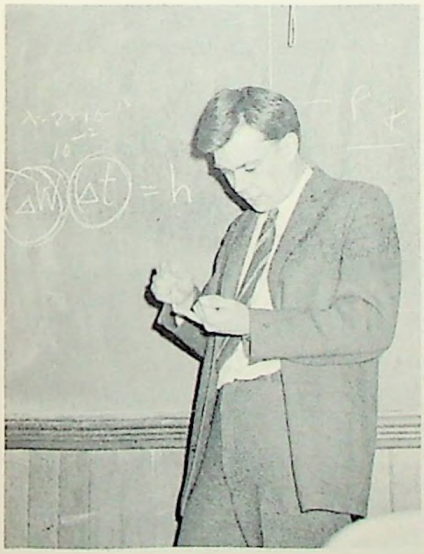
(Continued on page 32)

tionary orbit on the equatorial plane were capably discussed by the speaker. The altitude, some 22,000 nautical miles above the earth, establishes criteria for the transmitter power and the repeater sensitivity as well as the radiant power back to earth. Williams pointed out that with a stationary orbit, one could use large fixed antennas at the ground stations, such as dishes figuratively dug into the earth.

In addition to the desirability of using very high gain, massive ground antennas to cover the great ranges involved, one might consider that the satellite should use a pencil beam antenna oriented by an attitude-stabilized payload. This in turn would mean more weight to the satellite, dictating a larger and more expensive booster. The attendant costs of the project then becomes prohibitively expensive. The Hughes design employs a co-linear slot array antenna whose pattern is a figure of revolution about the spin axis. This design permits spin stabilization of the satellite. A maximum antenna gain of 8 db is realized in the circular plane normal to the spin axis and in the direction of the earth when the satellite is oriented.

The satellite consists of two concentric cylinders, the outer one 28 in. in diameter and 13 in. in length. The outside surface of the larger cylinder is coated by 2,700 glass-covered silicon solar cells capable of providing 18 watts of electrical power. Around the inner surface of the outside cylinder are toroidal compressed-nitrogen gas tanks which provide fuel for the pay-

(Continued on page 33)



—James Hussey photo

Dr. Kenneth Mallory, Stanford University, speaker at the February 15 joint PGED/PGMTT meeting on Project M. Paper was reviewed in March

MORE ECC PROGRAM

INTEGRATION OF MICROMINIATURIZATION INTO MICRO ASSEMBLIES

R. A. Gerhold, U.S. Army Signal Research and Development Laboratory, Ft. Monmouth, New Jersey

A unified approach will be presented for the integration of advanced micro-circuitry technologies into functioning circuits and their subsequent interconnection to form micro-assemblies. Maximum realization of advantages of microminiaturization will be achieved in equipment design only as advances in film techniques, semi-conductor packaging, and solid circuit processing are able to be efficiently integrated into micro-assemblies. Such micro-assemblies are conceived as comprising wafer-type functional circuits which are then stacked one over the other to be integrated by electron-beam welding techniques into micro-assemblies. Current developments will be described which illustrate the feasibility of electron-beam techniques for achieving interconnection termination densities approaching 1600 per square inch (the intersections of a 0.025-inch grid.)

ENHANCING THE BRIGHTNESS OF ELECTRO-LUMINESCENCE CELLS

William Brooks, Microsystems Electronics Department, Lockheed Missiles & Space Division, Sunnyvale, California

Due to intrinsic properties of electroluminescent phosphors, there is an optimum particle size for maximum brightness at a given applied voltage. There is also an optimum applied frequency and waveform to achieve maximum brightness.

The electroluminescent phosphor brightness is very voltage dependent. The binder material in which the phosphor is dispersed plays an important role in placing a large portion of the applied voltage across each phosphor particle. The effect of various binder materials and methods of loading the binder with high K materials to increase the effective binder dielectric constant is discussed. Curves are shown of experimental cells which have increased brightness due to loading of the binder.

A new technique of chemically coating each phosphor particle with a high-dielectric-constant transparent coating is described. The greatly increased brightness due to this treatment has been measured experimentally. A new brightness-vs-applied-voltage characteristic is obtained which is different from previously reported cells.

THE USE OF RHENIUM IN THIN FILM RESISTORS

H. E. Culver and Charles Feldman, Physical Science Laboratory, Melpar, Inc., Falls Curch, Virginia

Rhenium films have been vacuum deposited using an electron-beam technique. The electrical resistance of these films is stable at temperatures up to 500 C. Controlled and repeatable electrical characteristics are obtained. A discussion of formation techniques and curves of electrical characteristics will be presented.

IMPROVED ELECTRICAL ALLOYS—A KEY TO IMPROVED ELECTRONIC COMPONENTS

C. M. Jackson, J. G. Dunleavy, and A. M. Hall, Battelle Memorial Institute, Columbus, Ohio

Advances in the field of electronic components frequently depend on the metallurgist's ability to develop new alloys possessing specified combinations of electrical properties. The lack of a suitable alloy may delay or prevent development of a particular component.

To compound a specific alloy for a particular electronic component, the requirements of the

(Continued on page 35)

MORE RELAY SATELLITE

load's orbital orientation and velocity control jets as well as supporting the solar cell structure. The integrated avionic package is in the inner cylinder or central cannister.

Communications signals are broadcast from the ground via uhf, are received and mixed with a master oscillator signal, and the resulting intermediate frequency signal is phase-modulated for power economy, then multiplied up to the S-band and amplified in a twt for transmission back to earth. The communications are sent on one sideband of the uhf carrier and the signals for control of attitude of the satellite are sent on the other sideband.

The payload is capable of relaying up to 600 two-wire or 300 four-wire messages or one television channel. It will accept input from any number of ground stations on a frequency-division basis. Base bandwidth is 4.5 mc wide.

Williams gave a very convincing argument for launching from an isolated island near the equator and the Hughes scientists have even settled on Jarvis Island which is two square miles of U.S. Department of Interior property situated about 1300 miles south of Honolulu. Oddly enough, the costs, even including the terrific logistics necessary for maintaining a site on an isolated island, still compare favorably with costs of using one of the Cape Canaveral pads.

Since this in-house project at Hughes is designed for a commercial communications project, economics is of a paramount importance if the system is to pay off. For example, the choice of an isolated island near the equator also permits a direct ascent into the desired orbit with the least size and cost requirement for the primary stages of the vehicle. Another consideration is the trade-off of only one or two stationary orbit vehicles versus some thirty-odd low altitude satellites to cover intercontinental distances at all times.

Finally, to show that there's something for everyone, it was pointed out that the Hughes project would supplement and not compete with the projected ARPA - Signal Corps Project Advent since much of the military communications is unclassified but consists of very heavy traffic. —KEN PATTERSON

student activities

HEALD COLLEGE

The IRE Student Associate Branch at Heald College, San Francisco, has elected the following officers: chairman, Roy Hurd; vice chairman, Jim Brush; secretary, William Monks, Jr.; treasurer, Gene Bluder; program chairman, German Gonzales; and membership chairman, Cal Wong.

PGEP at work and play. Thomas Scatchard directs the work-simplification game in which the audience at the February meeting searched for hidden gold

meeting review

GOLD DIGGING

"Hidden Gold Through Work Simplification" was the subject for the PGPEP meeting held in the Berkeley division of Beckman Instruments at the end of February.

The speaker of the evening was Thomas E. Scatchard, director of manufacturing. Scatchard said that work simplification is a philosophy of management, rather than just a methods improvement program.

Allan Mogenson started the program at Lake Placid, New York. As a traveling consultant, he borrowed ideas from people in several fields to make up his project. The speaker reviewed the history of work simplification in the Beckman organization and showed logical step-by-step patterns for improving methods. This is the basic ingredient for method improvements. The major contributing factor in work simplification is human relations.

Experience indicates that most improvement programs fail to maximize value due to inadequate attention to human relations. Scatchard said that the people closest to a job are in the best position to make improvements. One of the best ways to overcome resistance to changes is not to tell or sell, but to consult. Work simplification emphasizes the green light and the open mind, looking for a better method rather than searching for ways that won't work. "Work smarter, not harder" is the motto of work simplification.

The Beckman program started in 1956 and has now saved the company well over a million dollars. Regular project teams and follow-up training programs have received national publication in trade magazines. Beckman Division is now in its fourth year of work simplification and the division has realized more than $300,000 in savings over a three year period. These savings are computed on the basis of 25 per cent overhead.

After Scatchard had outlined the work simplification organization at the Berkeley division, some members of the audience were given the opportunity to try their skill on a peg board. This is part of the work simplification training program and many humorous situations came up during this test, particularly when an incentive was introduced in the form of a gift wrapped I. W. Harper. The winner sure enjoyed that one.

After the audience had become familiar with the work simplification program, its techniques and mechanics, Scatchard displayed a flow chart showing all the trouble a man gets into when he wants a beer out of the refrigerator. One of the employees at Beckman had worked on this project and he was able to simplify the beer getting to require 1/3 as much effort doing it the new way compared to the old.

One of the work simplification teams at Beckman made a presentation on one of its projects and the savings achieved. Along with the demonstration, a number of work simplification projects were displayed.

After a plant tour, followed refreshments and the crowd visiting the plant was most enthusiastic over the program. Beckman/Berkeley should be congratulated on having such fine employee-management relations.

—OLOF LANDECK

NEW ELECTRONICS MITE

Precious things come in small packages. In the world of electronics, in fact, the smaller the package that will do the job the better and more precious.

So Fairchild Semiconductor Corporation yesterday announced a new development that it expects will lead to a "90 per cent reduction in the size and a 70 per cent itcderoiunn olor per cent reduction the cost of the logic section of a computer."

—From the *San Francisco Chronicle*, March 17, 1961

Well, logic is logic.

MORE ECC PROGRAM

electronic component must be translated into requirements for the alloy. The principal considerations usually comprise the necessary electrical properties, the required degree of reliability, and the capability of the material to be fabricated into the desired forms. The electrical properties of most frequent interest are electrical resistivity and temperature coefficient of electrical resistance. The reliability of the alloy encompasses the factors of stability and reproducibility. Stability refers to the ability of the material to maintain its properties at desired levels under the operating conditions of the component for a satisfactory period of time. The stability of an alloy is determined by its ability to resist microstructural and submicrostructural changes under the particular environmental conditions. Reproducibility refers to the degree to which properties are duplicated from heat to heat, or lot to lot, of the metal. This factor is sensitive to composition and processing variables. Fabricability may include ability to be drawn to fine wire, to be rolled to ribbon or foil, or to be precision cast or machined.

CIRCUIT CONSIDERATIONS IN MICROMINIATURIZATION

J. J. Suran, G.E., Syracuse, New York

(Paper 5, Section II—See page 16)

The paper will highlight such items as:

(1) Department of Defense and the Armed Services Research and Development Program on Electronic Component Parts, this includes physics of failure and longevity.

(2) Implementation of DOD Report "Parts Specification Management for Reliability."

(3) Air Force management and technical compliance specifications for weapon systems.

(4) Apportionment of quantitative reliability levels to subsystems, components and parts.

(5) Methods of quality auditing reliability programs.

— END —

the section

MICROMINUTES

On February 6, the Executive Committee of the Section met with Dr. L. V. Berkner, new president of the Institute.

Awards. Six members, all Fellows as is conventional, were appointed and confirmed to the Awards Committee as follows: Karl R. Spangenberg, Thomas H. Morrin, Edward W. Herold, O. G. Villard, Jr., John R. Whinnery, and Leonard J. Black.

Nominations. Junior Past Chairman Dr. Victor B. Corey was announced as chairman of the nominating committee responsible for Section and National officer nominations.

Future Engineers. Thomas Morrin was announced as coordinator of the activities for judging the exhibits at the Bay Area Science Fair and to represent the Section in arrangements for the WESCON Future Engineers Show.

Finances. Audits as of June 30, 1960 have been reported and a financial statement transmitted to Headquarters.

Communications. Chapter chairmen were reminded and asked to remind reporters that duplicate copies of meeting notification to the **Grid** editorial offices should be sent simultaneously to the Section Office in Palo Alto.

Publications. Grid and **Grid-Bulletin** budget matters were discussed. **Grid** costs have increased over budget estimates due to the expanded requirements for service to the growing Section, to the assumption of clerical services formerly supplied by the Section Office, and to a lack of growth of advertising revenues. Efforts were recommended in the direction of solving these problems without reduction in services, and promotional efforts toward increased advertising sales were described by the Publications Board.

National Activities. Dr. Berkner led a discussion in which the following points were made: IRE tries to keep about one year's budget operations ahead for protection; international membership as of January 1 was 88,500; about $51 per year is spent on each member; arrangements have been made for reciprocal membership transfers between AIEE and IRE for all grades except Fellow and Life Member; ultimate possible consolidation of AIEE and IRE is an open question; "Proceedings" print order is expected to go over 100,000 in the coming year; IRE wishes to work with the universities in enhancing the attraction of engineering specialization; and IRE members are already operating on the electronics committee of ECPD against the time when ECPD separates from EJC and IRE formally joins the former.

NEWS FLASH!

Under the chairmanship of Junior Past Section Chairman Dr. Victor B. Corey, the nominating committee has presented a slate of candidates as follows:

S. F. Kaisel, chairman
P. D. Lacy, vice chairman
Charles Süsskind, secretary

Jerre D. Noe, SRI, and
Alan T. Waterman, Stanford, treasurer

Meyer J. Leifer, Ampex, Section-Wescon director.

In accordance with the by-laws, further nominations are now open.

Striker *Dalton*

MacDonald *Rayment*

Jacobus *Ballou*

grid swings

IT IS REPORTED

John E. Striker Co. and **C. R. Dalton & Associates,** manufacturers representatives, both of San Carlos, California, have merged to form **Stridal Corp.** Main offices of the new organization will be at 1037 Laurel Street, San Carlos; with a branch at 720 Mission, South Pasadena, California. Product lines are in the areas of mechanical and electrical hardware, switches, power supplies, and magnetic components.

Ampex Corporation will relocate the tape unit division of its newly formed **Ampex Computer Products Co.** in the Culver City, Calif. headquarters of Computer Products Co. Culver City operations are devoted to the production and marketing of ferrite-core products and core-memory storage systems for the electronic data processing industry. The tape unit division designs, manufactures, and markets magnetic-tape memory systems.

Dr. **Alexander D. MacDonald** has joined the microwave physics laboratory of **General Telephone & Electronics Laboratories, Inc.,** as a senior engineering specialist. MacDonald will direct a program to study microwave breakdown phenomena in ionized gases. A series of experiments will be conducted to measure the basic plasma parameters of air in order to understand fully the microwave breakdown properties therein.

Prior to joining the GT&E laboratories, Dr. MacDonald was professor of physics at Dalhousie University, Halifax, Canada. He had been associated with the University since 1949. In addition, he served as a research scientist with the Defense Research Board in Canada, and spent a one-year sabbatical leave at the microwave physics laboratory working on gaseous electronics problems. In 1945 Dr. MacDonald received the BS degree in mathematics and in 1947 the MS degree in physics from Dalhousie University. Two years later he was awarded the PhD degree in physics from Massachusetts Institute of Technology.

Will Rayment has resigned as president of Sargent-Rayment to join **Fisher Berkeley Corp.** Rayment joined Sargent Rayment in 1947 and has been chief engineer and general sales manager since 1950. He joins Fisher Berkeley as executive vice president.

Negotiations have been concluded for the formation of a British company in the microwave-tube field by **Litton Industries, Inc.,** and Elliott-Automation of London, England. The new firm will handle production, distribution, and sales of electron tubes developed by Litton's electron tube division of San Carlos, Calif., and microwave tube operations of Elliott Brothers (London) Ltd., a member of the Elliott-Automation Group.

Lenkurt Electric has promoted **Edward G. Hall** to the newly created post of general commercial sales manager and has expanded its direct marketing organization to carry out its increased distribution activities. Hall formerly was western district sales manager. He is succeeded by **Robert E. Graham,** formerly manager of sales to the Bell System and other direct accounts.

International Telephone & Telegraph Corp. is acquiring **Jennings Radio Manufacturing Corp.** of San Jose in an exchange of ITT stock for Jennings assets. Jennings will continue its own operations as an autonomous group.

H. Raymond Jacobus joins **Eitel-McCullough, Inc.,** as manager of the negative grid tube division. He will direct the research, development and manufacturing activities for the production of Eimac power tubes in the negative grid tube field. This is the company's largest product line. Its operations are located in San Carlos, California, and Salt Lake City, Utah.

Jacobus brings to Eimac more than 28 years of experience in the electron-tube industry. For the past five years, he has been manager of the Washington division of Tung Sol Electric, Inc., at Washington, New Jersey. Prior to this, he served for many years with the Radio Corporation of America in engineering and production management of electron tubes.

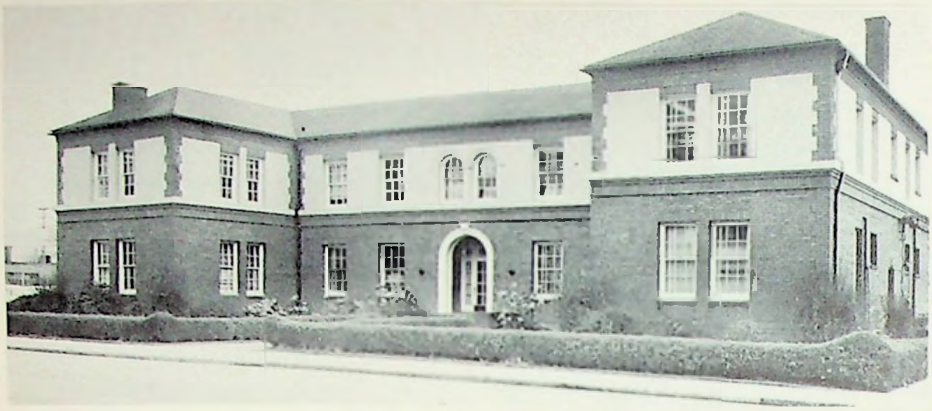
Appointment of **Byron O. Ballou** to head of the applications department at the microwave device operations of **Sylvania Electric Products Inc.,** has been announced. With Sylvania since 1956, Ballou has had over 15 years experience in field applications and instrumentation work. For 13 years prior to joining the microwave device operations he was associated with Eitel McCullough, Inc., engaged in application-engineering activities.

Dr. **S. C. Chao** has been named senior project engineer for new-product development, a new post, by **Vega Electronics Corporation.** A native of China, Chao completed his undergraduate studies at National Central University in Chungking and his advanced studies at Stanford University. Since that time, and before joining Vega, he was employed at IBM Research Laboratory, General Electric Computer Department, and Link Division of General Precision, Inc.

A new systems science program has been established in the San Jose research laboratory of **International Business Machines Corporation.** Dr. **Harwood G. Kolsky** is manager of the new program. His initial projects are to study the organization of business systems, the searching of large collections of documents and numerical analysis. Kolsky comes to the San Jose laboratory from earlier assignments in Poughkeepsie, N.Y., Omaha, Nebr., and Rockville, Maryland.

Chao *Kolsky*

(Continued on page 38)



Fisher Berkeley Corporation has moved to the old Marchant Calculator building in Emeryville. The 16,500 sq ft of production area will triple former facilities

Peter Georgiev has joined **Lenkurt Electric Co.,** as a senior electrical engineer in the advanced development group, where he has been assigned to studies of new microwave applications in telecommunications. He previously was with General Electric Co. at Lynchburg, Va., as a microwave development engineer. Georgiev is a native of Bulgaria. He received his degree in electrical engineering from the University of Sofia, and was a development engineer for Elprom, Inc., there until 1957.

George M. MacLeod of Los Altos, Calif., has joined **Monsanto Chemical Company's** inorganic chemicals division as a senior sales specialist for the company's single-crystal and polycrystalline silicon products. MacLeod was formerly vice president, sales, for Knapic Electro-Physics, Inc., at Palo Alto, Calif. He holds AB (1943) and MS (1946) degrees in geology from Stanford University and was employed by the Fisher Research Laboratory, Inc., at Palo Alto, before joining Knapic Electro-Physics.

Rudolph Lorenz, Jr., has been promoted to the manager's staff of the general products division development laboratory at **International Business Machines Corporation's** San Jose engineering center. He will serve as special assistant for technology. In this new capacity, Lorenz will assist **W. D. Bolton,** laboratory manager, in evaluating the technological positions of current laboratory programs. Lorenz' position as manager of technical services in the development laboratory will be assumed by **Warren H. Klippel,** a development engineer.

Appointment of **Arthur G. Cole** as manager of systems administration for the western development laboratories of **Philco Corporation** has been announced. Before joining Philco, Cole was vice president and treasurer of Aircraft Engineering and Maintenance Co., Oakland, and has more recently been associated with International Aircraft Services of Oakland.

Palo Alto Engineering Company, a wholly owned subsidiary of the Hewlett-Packard Company, has a new president: **John C. Beckett,** also general manager. New vice president is **Roy A. Melin** who will continue as production

manager. The new secretary-treasurer is **Nick J. Mardesich,** formerly chief accountant and assistant secretary. Replacing Mardesich as assistant secretary of the firm is **Rodger Earley,** purchasing agent.

A new division for engineering and manufacturing oscilloscopes has been formed by the **Hewlett-Packard Company** and **Cortlandt Van Rensselaer** has been named general manager. Van Rensselaer has been with Hewlett-Packard for 13 years, and was formerly general manager of Dymec, the systems division of Hewlett-Packard.

Robert A. Grimm, formerly manufacturing manager for Dymec, will succeed Van Rensselaer as general manager of that division. Three other appointments in the new oscilloscope organization include those of: **Norman P. Schrock** who will be engineering manager for product development; **Harold L. Wild** who has been named plant manager for the new division; and **Betrand W. Squier, Jr.,** who will become manager of cathode-ray-tube manufacturing and development.

The new division will be located in the Palo Alto facilities of the Hewlett-Packard Company.

Morse *Lien*

Herbert R. Morse, formerly vice president and treasurer of **Radiation at Stanford, Inc.,** Palo Alto, has joined **Electronics Capital Corporation** as senior financial officer. Prior to his association with Radiation, Morse was San Francisco manager of Arthur Young & Company, an international CPA firm.

Jesse R. Lien has been appointed general manager of the Mountain View operations of **Sylvania Electronic Systems.** The Mountain View operations include the company's electronic defense laboratories and reconnaissance systems laboratory.

The formation of **Diotran Pacific,** a new company serving the semiconductor industry, has been announced by **Rolf Grebmeier,** president. Located at 1015 Alma Street, Palo Alto, it will concentrate on the design, development, and manufacture of a broad cross-section of production and test equipment for semiconductor manufacturing. In addition to Grebmeier, company officers include **Norman Foster,** treasurer and production manager, **W. Glenn Johnson,** secretary and chief engineer, and **William McRedmond,** vice president and sales manager.

Herbert A. Finke has been named to the new position of vice president and general manager of **Bomac Laboratories Inc.** Finke will assume his new duties immediately, leaving his position as director of long-range planning for Varian Associates, Palo Alto.

Weatherbie Industrial Electronics, Inc., 333 Prevost Street, San Jose, is a new electronic distributor specializing in industrial service. **James A. Weatherbie** is president.

Precision Instrument Company, San Carlos, has created the new post of export marketing manager. It will be filled by **James A. Koch,** previously a senior applications engineer for the firm.

(Continued on page 40)

Rogers

Merriam

MORE SWINGS

Eugene L. Rogers is director of marketing for **Microwave Electronics Corp.** Since 1956 Rogers has been prominently identified with the San Francisco Peninsula electronics scene, as director of marketing for the instrumentation division of Ampex Data Products Co. and for the electron tube division of Litton Industries.

In the **Raytheon Company's** distributor products division, **Allen W. Merriam, Jr.,** California district manager, has been appointed Western Zone manager and will operate from the company's office in San Francisco. Merriam, a graduate of Colgate University, served with General Electric Credit Corporation, New York City, and A. Wayne Merriam, Inc., wholesalers for GE in Schenectady.

Servo Corporation of America has established a San Francisco district office at 430 Cambridge, Suite 114, Palo Alto. Manager is **William G. Theisner,** former manufacturers' representative and former **Grid** Associate Editor.

Arie Slikkerveer has joined the marketing division of **Lynch Communication Systems Inc.,** reporting to **Harrison Johnston,** marketing manager. Before joining Lynch's engineering staff in 1949, Slikkerveer was a carrier telephone engineer for the Netherlands Telephone and Telegraph Administration, Holland.

A native of The Hague, Slikkerveer received his MSc from the Technical University at Delft, Holland. He spent seven years in the Royal Netherlands Navy, serving as lieutenant s.g. in both European and Pacific Theatres of War. He is a member of the Institution of Electrical Engineers (England) and the Royal Institute of Engineers (Holland) as well as the Holland-America Society.

Dr. **Arthur G. Anderson** has been promoted to the position of manager of the **International Business Machines Corp.** research laboratory at San Jose. He succeeds Dr. **G. L. Tucker,** who has been named director of development engineering of the IBM World Trade Corp. in New York City.

Slikkerveer

Anderson

Anderson, who had been manager of the Research Laboratory's physics department, joined IBM in 1951 as a physicist in the Poughkeepsie, N.Y., laboratory. Subsequently he was assigned to the Watson Scientific Computing Laboratory staff at Columbia University where he specialized in research on magnetic resonance in metals.

Thomas R. Bristol has been promoted to assistant manager, linear beam department, of **Litton Industries'** electron tube division. Bristol formerly was sales manager of the linear beam department. He has been involved in the sales and applications engineering of Litton Industries' high-power klystrons and other linear beam devices since 1959.

A 1947 electrical engineering graduate of Notre Dame University, Bristol has a background in the power-tube field, including design, development and applications engineering. He was employed by the General Electric Company, Schenectady, N. Y., from 1947 until he joined the Litton tube division in 1959.

Two engineers at Lenkurt Electric Co., Inc., San Carlos, have won the best paper award as co-authors of a technical paper presented at the IRE-PGMIL Winter Convention in Los Angeles. The pair are **Thomas F. Mayne** who presented the paper and **Thomas J. Worlman,** co-author.

American Microwave and Television Corp. is a new concern formed in San Carlos with **F. Dan Meadows** as president. The company results from the combination of the American Microwave Division of Missile Systems Corp. and the Vicon Division of Insul-8-Corp. Products will include completely integrated cctv and microwave data-transmission systems.

Beall Electronic Sales, Palo Alto, has been appointed representatives for **G-L Electronics Co.** of Westville, New Jersey, supplier of magnetic components.

events of interest

IRE MEETINGS SUMMARY

May 4-5—**Second National Symposium on Human Factors in Electronics.** Marriott-Twin Bridges Motor Hotel, Arlington, Va. Ezra S. Krendel, Franklin Institute Laboratories, Philadelphia 3, Penna.

May 6—**Workshop in Graph Theory (PGCT).** University of Illinois, Urbana, Illinois. Prof. M. E. Van Valkenburg, Dept. of E.E., University of Illinois.

May 8-9—**5th Midwest Symposium on Circuit Theory.** Allerton Park and Urbana Campus, University of Illinois. Prof. M. E. Van Valkenburg, Dept. of E.E., University of Illinois, Urbana, Illinois.

May 8-10—**National Aerospace Electronics Conference (NAECON).** Miami and Dayton Biltmore Hotels, Dayton, Ohio. Ronald G. Stimmel, 809 Larriwood Avenue, Dayton 29, Ohio.

May 9-11—**Western Joint Computer Conference.** Ambassador Hotel, Los Angeles, California. Prof. Cornelius Leondes, Dept. of E.E., UCLA, 405 Hilgard Avenue, Los Angeles 24, California.

May 15-17 — **Microwave Theory & Techniques National Symposium.** Sheraton Park Hotel, Washington, D. C. Gustave Shapiro, National Bureau of Standards, Washington, D. C.

May 18-19 — **Electro-Optical Radiation Devices Symposium.** Dabney Hall Lounge, California Institute of Technology, Pasadena, California. Charles F. Spitzer, General Electric Co., 951 Commercial Street, Palo Alto, California.

May 22-24—**1961 National Telemetering Conference.** Sheraton-Chicago Hotel, Chicago, Illinois. Jack Becker, AC Spark Plug Div., General Motors, Milwaukee, Wisconsin.

NON-IRE LOCAL EVENTS

A new radio program, featuring scientific and engineering developments in the aerospace industry—**Lockheed Engineering News**—is now being heard from 5:25 to 5:30, Monday through Friday, on KGO, San Francisco. The Lockheed-sponsored program is written and reported by Henry Schacht.

April 18-21—**Bureau of Naval Weapons Missiles and Rockets Symposium.** U. S. Naval Ammunition Depot, Concord, Calif. R. B. Heilig, Captain, U.S. Navy, Commanding Officer, U. S. Naval Ammunition Depot, Concord.

April 25—Instrumentation & Controls Division, San Francisco Section, **American Institute of Electrical Engineers:** "Industrial Telemetering Systems" by William U. Dent, regional electronics engineer, Westinghouse Electric Corp. 7:30 P.M., Room 4, Crown Zellerbach Bldg., 1 Bush Street, San Francisco, California.

May 8—Santa Clara Valley Section, **Instrument Society of America:** Tour of environmental test laboratory, Lockheed missiles and space division, Sunnyvale. Dinner at Lockheed cafeteria 7:00 P.M. Tour starts from lobby of Building 102 at 7:30 P.M. Guests (U.S. citizens) welcome, but tour reservations are mandatory and must be received by April 24. Contact Russ Palmer, Consolidated Electrodynamics Corp., Los Altos, WH 8-8294.

IRE PAPERS CALLS

May 1—100-word abstracts and four-page summaries in reproducible form for the 16th Annual Association for Computing Machinery Convention (Los Angeles, California; September 5-8, 1961). Send to: Werner L. Frank, Ramo-Wooldridge, 8433 Fallbrook Avenue, Canoga Park, California.

May 1—12 copies of 150-word abstracts, and two copies of either the completed papers or 500-700-word summaries, for the 17th Annual National Electronics Conference (Chicago, Illinois; October 9-11, 1961). Send to: W. L. Firestone, Motorola, Inc., 4501 W. Augusta Blvd., Chicago 51, Illinois.

May 15—500- to 1,000-word summaries for the IRE Canadian Electronics Conference (Toronto, Canada; October 2-4, 1961). Send to: A. R. Low, 1819 Yonge Street, Toronto 7, Canada.

May 15—Abstracts of not more than 800 words with titles of not more than 50 letters and spaces, and brief biographical sketch of author (10 copies of each) for the 8th National Symposium on Reliability & Quality Control (Washington, D. C., January 9-11, 1962) Send to: E. F. Jahr, IBM Corp., Dept. 351, Owego, N.Y.

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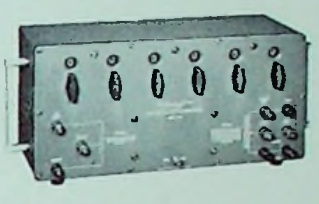

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